ARCHITECTURAL AND URBAN SIMULATION TECHNIQUES IN RESEARCH AND EDUCATION

DEVELOPMENTS OF ANALOGUE AND DIGITAL EYE LEVEL VISUALISATION

Third Conference of the European Architectural Endoscopy Association
August 27th - 29th 1997
Edited by Jan van der Does, Jack Breen and Martijn Stellingwerff

Faculty of Architecture Delft University of Technology
Delft University Press
The European Architectural Endoscopy Association was founded in 1993. The first conference was held in 1993 in Tampere, Finland at the Department of Architecture of the Tampere University of Technology. The second conference was held in Vienna, Austria at the Department for Spatial Simulation at the Technical University of Vienna 1995. The EAEA is a platform for the exchange of knowledge and experience in the field of simulation technology. Members of the association are European institutes of research and education, active in the professional implementation of Architectural and Urban Endoscopy techniques.

The third conference was held in 1997 at the Faculty of Architecture of the Technical University of Delft, in the Netherlands, organised by the Media sector and chaired by professor Jan van der Does. This book contains the Proceedings of the Conference by 22 professional contributors from international institutes under the following headings:

- *Current Developments and use of Endoscope- and Computer techniques*
- *Results of Research on Simulation and Architectural Representation*
- *Teaching, Planning and Adapting visual Media for Architectural Design*

Furthermore this publication offers an overview of results from the design visualisation workshop Imaging Imagination, which was part of the conference and to which a number of international institutes contributed.
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Michael Matalasov :
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Dmitry Berdinski :
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Purpose compliant visual simulation; towards effective and selective methods and techniques of visualisation and simulation

Frue Cheng :
Visual simulation techniques on environmental cognition systems

Arpad Pfellsticker :
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PRESENTATION OF THE NEW DELFT ENDSOCPE LABORATORY

Jan van der Does
Jack Breen and Martijn Stellingwerff: Development of the Imaging Imagination workshop

Tokyo Institute of Technology, Japan

Stuttgart University, Germany

Nagoya Institute of Technology, Japan

Technical University Dresden, Germany

Moscow Architectural Institute, Russia

Slovak Technical University of Bratislava, Slovakia

Rostov State Architectural Institute, Russia

Technical University Vienna, Austria

Technical University Vienna, Austria

Delft University of Technology, The Netherlands

Institute Sint-Lucas, Brussels, Belgium

Moscow Architectural Institute, Russia

Technical University of Bialystok, Poland

Yonsei University, Seoul, Korea

Delft University of Technology, The Netherlands

Some general remarks concerning the Workshop Questionnaire

Workshop Presentations and discussion

Conclusions
Ladies and Gentlemen,

On behalf of the Faculty of Architecture, I am delighted to welcome you to this endoscopy conference. An excellent command of the various transposition techniques currently available is an important part of being an architect these days. Visualisation of design ideas is not only essential for ensuring effective communication between designers and, for example, clients, it also constitutes an important analytical instrument within the design process itself. Nowadays there are many transposition techniques available, ranging from modern computer simulations to the traditional perspective drawing. However sophisticated these techniques may be, it is important to stress to you the power of the humble pencil. Often a simple sketch may be more powerful and more moving than the finest computer simulation. I therefore feel it is important to continue using all of these different techniques alongside one another. In principle, each new technique developed should add to, rather than replace, the tradition of the architectural drawing.

An illustrative and famous example of how far some architects are prepared to go in their efforts to visualise their design dates back to the beginning of this century. In 1912 the architect Mies van der Rohe had a 1:1 scale canvas model built on location of his design for the house of Mrs. Kröller-Muller. The design was rejected on the basis of this model, however. Nowadays it is a relatively simple matter to make visual representations using advanced computer technology. But alongside the development of digital design environments, analogous visualisations are still made using endoscopic equipment. Our Faculty also has an endoscope laboratory. Our endoscope was recently completely modernised. In conjunction with digital visualisation techniques, this equipment can contribute to research into the perception of the built environment. And the technology does not stand still. The purpose of this conference is therefore to give us the opportunity to share our experiences and compare research results. One aspect that will be looked at is the part that the various media techniques can play in the different stages of the design process. The possible combinations of different media will also be explored. In addition, we shall consider the question of whether these media are merely sophisticated transposition techniques, or whether they can serve as new design instruments.

These and other topics will be addressed during the conference. In short, this third EAEA conference will make an important contribution to the advancement of our profession. On behalf of the Faculty, I hope that this conference will be an innovative and inspiring experience for you all.
INTRODUCTION TO THE 3RD EAEA CONFERENCE

Jan van der Does
Chairman

"Endoscopy as a tool in architecture". We began with these words in Tampere in 1993, where the lectures were grouped under three headings: Review of Existing Laboratories; Theories, Methods and Applications and The Future of Endoscopy. We also enjoyed an interesting workshop. In Vienna in 1995 we focused on three different themes: The 'Re-Design of Spatial Experience'; 'The Choice of Appropriate Technology' and 'The Implementation of Applications in the next generation'. We worked on a second workshop, called "The (In-)visible City".

Now, August 1997 we meet again, for the third time in four years; to speak, to listen, and to discuss new goals for the conference. As Media group we identified three main topics to guide your choice of subject matter. On the basis of the abstracts you sent in, we have allocated each presentation to the following topic headings: 'Current Developments and use of Endoscope- and Computer techniques'; 'Results of Research on Simulation and Architectural Representation; and Teaching', 'Planning and Adapting Visual Media for Architectural Design'.

It is my pleasure to announce here to you our new EAEA member, professor George Yesaulov of the Laboratory for Visual Modeling at the Rostov State Architecture Institute in Russia.

It is a pleasure to meet you again and to welcome our new guests from Japan, Korea, Taiwan, Poland and Belgium who will show their interest in the EAEA with presentations of their research and laboratories.

Special thanks to our keynote speakers Patricia Alkhoven and Jaap Drupsteen who will give us new insights on the use of visualization and simulation techniques from two totally different points of view: historic analysis of cityscapes and innovative video editing for television production.

Jack Breen and Martijn Stellingwerff arranged a workshop called "Imaging Imagination". We were delighted by your enthusiastic response to our call for participants in the workshop and by the many interesting designs and imaginative images you brought from your institutes and laboratories to our Faculty of Architecture at the Delft University of Technology. The many images of the Imaging Imagination Workshop are presented in small size on a computer disk and can be
found in a bigger size on the website of our Media group.
An important part of the Proceedings will be the compilation videotape with inserts of the animated computer images and moving endoscopy videos presented at the conference. Regrettably, Professor Philip Thiel was unable to attend the conference for medical reasons. Our thanks to Professor Ryuzo Ohno, who will present a summary of Philip's lecture. In these proceedings we would like to focus your attention on Philip Thiel's new book called: "People, Paths, and Purposes, Notations for a Participatory Environment".
Among the conference papers, you found another new book called "Stadtbilder / Stattpläne" from the Argus team at the University of Essen. Professor Wolfgang Thomas is behind this surprise gift. On behalf of us all, Wolfgang, many thanks for this book.

_The fourth EAEA conference will be held in Dresden in August / September 1999._
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CURRENT DEVELOPMENTS
AND USE OF ENDOSCOPE- AND
COMPUTER TECHNIQUES
Philip Thiel believes that environmental design and research should be based on the eye-level experience of the users in the course of their movement through the environment. He also argues that design should be primarily concerned with the self-identified and clearly specified needs and preferences of the users. He presents here a progress report on his forty years of work on the development of new tools and procedures necessary for the implementation of this approach in environmental design and behavioral research.

Thiel describes a user-oriented participatory process of environmental planning, design, and management. Named “enviroitecture,” it identifies and profiles the prospective users and flow-charts their proposed activities on site, in the context of their day. It then employs a representative sample of these users as consultants for the formulation of “experiential performance specifications” as part of the project program. Design development then proceeds with reference to the responses of these user-consultants to alternative designs in the form of simulated environmental sequences.

After construction, users’ experiences are monitored as a function of facility management. Comparison of these realized experiences with the predesign experiential performance specifications then provides a valid measure of design and managerial competence. Envirotecture thus offers designers an opportunity to achieve greater social significance in their contributions to the public domain. It also provides a means for the long-overdue development of empirical theories of design, in conjunction with the work of researchers in environment and behavior studies.

This book brings together a social awareness, a knowledge of environmental perception and cognition, and an operational design method in an unprecedented synthesis. It focuses on the central and critical concerns of socially responsible designers, as well as on the interests of researchers in environmental psychology, sociology, and anthropology.
COMPUTER VISUALISATION AS A TOOL IN ARCHITECTURAL HISTORICAL RESEARCH: REPRESENTATION AND RESEARCH OF THE HISTORICAL URBAN ENVIRONMENT

Dr. Patricia Alkhoven
Koninklijke Bibliotheek / National Library of the Netherlands

ABSTRACT The historical city has been represented over time using various ways of drawing, modelling and simulation. Using different kinds of visual information as a basis, computer visualisation techniques are used in this presentation to reconstruct the urban development in the twentieth century of the town of Heusden and other towns. The resulting visualisation provides us with a tool for a better understanding of the dynamics of urban transformation processes, typologies and morphological changes. Though for most of these rather specific research questions the computer images proved adequate and useful, some morphological studies can well be carried out using more traditional techniques.

INTRODUCTION In what way can computer visualisation help us to study our historical urban environment? The image and structure of a town are constantly subject to a dynamic process of change and continuity. Repairs, replacement, rehabilitation, redevelopment, demolition, and urban renewal take place in every town, while some areas, however, are left untouched for periods of time. Visual material, such as photographs, historical maps, town plans, drawings and prints, show us the impact of these changes on the image of a town. The question is of how this process of change and continuity is visually detectable in a town or city. Computer visualisation techniques and animation can help us recreate the historical city and give us an idea of how it used to look. Although this presentation mostly deals with computer visualisation of the historical urban environment, before we get to that point I will tackle some aspects of architectural representation methods in general.

REPRESENTATION OF ARCHITECTURE The architectural drawing itself can be considered a means to communicate aspects of buildings in different architectural projections, for instance, plans, elevations, roof plans, sections, perspectives, axonometrics and isometrics. In architectural practice, an architectural object is mostly represented by orthogonal projections: a plan, elevations, and sections. Orthogonal projections represent objects without optical distortion. Agreements are made on the way walls, doors, windows, and other elements are represented in drawings. Because of these conventions, one usually has to learn how to read them. In the architectural analysis of buildings, other kinds of visual material are added, such as reconstruction drawings involving (all) phases of a building, photographs, paintings, and drawings of details. Whereas the more technical, orthogonal representations in architecture function to convey information as "facts", clients of architects usually base their decisions on the perspective projection. Contrary to orthogonal projections, which are more difficult to interpret because of their conventions, the perspective projection is closer to the human perception and there-
fore easier to understand and interpret. For instance, Gordon Cullen's *Townscape* contains nothing but perspectives as seen through the human eye (approximately 1.60 meters). He also presents *walks through* towns to grasp the fourth dimension (movement) by means of a series of different viewpoints, which he calls *serial vision.* In presentation drawings, buildings are also often represented in perspective in order to convey spatial information at a level understandable for many people.

**BENEFIT OF ABSTRACTION** In order to be able to graphically represent a building, a decom­position of the idea of a building into different parts needs to be made. An unavoidable consequence of this process of abstraction is the loss of information. Loss of information is, however, not always a negative consequence. Abstraction forces one to focus on the subject under study without being distracted by elements that are not relevant for a specific study. It allows one to ignore unnecessary details so that a selection of relevant elements, essential for carrying out a certain project, becomes apparent. If applied consistently, abstraction allows us to analyze different architectural objects in a uniform way, since all elements can be viewed at the same level of detail and at the same scale.

The fact that beautifully refurbished drawings had the effect of distracting the attention from the main structural appearance of a building was already recognised by Jean Nicolas Louis Durand in his *Recueil et parallèle des edifices* (1800). In this book he juxtaposed line-draw­ings of buildings of the same type. The drawings were mostly at the same scale, therefore they can be compared in form on the same level of detail, producing a catalogue of forms of each type. He wished to do away with all unnecessary extravagance and decoration in archi­tecture. In this way, he reduced architecture and its representation to its structural and for­mal geometry. As an engineer he was more in favour of technical, abstract line-drawings than the refurbished drawings which were acceptable at the time, such as watercolors from the Ecole des Beaux-Arts. Beaux-Arts representations mainly consisted of plans and eleva­tions which were later lavishly rendered with shadows, colours, and decorative elements. In Durand's view, these refurbished drawings concealed the *essential* geometry of forms and buildings would be represented more *objectively* by orthogonal line-drawings stripped from superfluous details.

At the end of the 19th century, the notion of *objective*, abstract line drawings, as opposed to *subjective* perspective projections, led to the reintroduction of the axonometric projection. The axonometric projection became popular after Auguste Choisy had illustrated his book *Histoire de l'Architecture* (1899) with axonometrics. The axonometrics provide infor­mation about both the three-dimensional structure, the plan, and the elevations of buildings. There are no optical distortions, parallel lines remain parallel until infinity. It was probably because of these qualities that The Style and the Modern Movement and more recently, Bruno Fortier, made extensive use of the axonometric, since it conveyed several kinds of information in a single image.

**SCALE MODELS AND COMPUTER MODELS** The difference between a scale model (made of cardboard, wood, stone, paper, etc.) and a computer model is that the physical model can be touched and made on a certain scale, while a computer model consists of virtual lines, surfaces or solids, which suggest spatiality. It can also be given any required scale and can
be viewed from any viewpoint. Three-dimensional computer models are made combining geometrical primitives forming virtual space. Given enough time, any detailed, coloured scale model could be created. In the same way, several ways of electronic elaboration of computer models are possible to enhance the idea of reality. The kind of elaboration needed depends on the purpose the model has to serve. The models can be rendered photo-realistically using texture maps and colour, shadow, and other special effects. CAD models can be merged with video images or images captured by scanning. In this way one can speak of synthetic images which can in fact be very close to the refurbished drawings of the Ecole des Beaux-Arts.

In the urban planning process of evaluating the aesthetic qualities of a new building in the townscape with respect to proportions and scale, these simple geometrical models appear very effective. Especially, the possibility to make animations of these urban models in which one can walk through the streets at eye-level and at walking speed, or fly over the town provides a way to survey the morphology of the urban environment. In fact, an animated walk through a town is nothing more than the computerised and intensified version of Cullen's serial vision.

RECONSTRUCTION OF THE PAST The existing or lost city increasingly attracts the attention of archaeologists, architects and architectural historians. In order to tackle the complexity of the townscape one needs to focus on the research of the transformation of the spatial structure of the townscape. This being the case, we need to know how the process of change and continuation of the townscape can be represented and made understandable by means of visualisation techniques. In connection with this, the question needs to be answered what kind of and how much visual information is necessary for the computer models of a town to provide a basis for interpreting the changes over time.

To study the transformation of the architecture of an existing city means to work with imperfect, heterogeneous and often incomplete sources. Hypermedia systems which are able to manage and integrate different kinds of visual sources (photographs, text, digitised maps, plans, elevations, and sections) as well as computer models, animations and video are becoming increasingly important in the research of the historical environment.

VISUALIZATION OF THE HISTORICAL TOWN OF HEUSDEN, THE NETHERLANDS To study the transformation of an existing city, research has been carried out to the town of Heusden in The Netherlands. Heusden, enclosed in its system of fortifications, is a well-defined coherent unity, small enough to be studied in its entirety. Different planning strategies have determined Heusden's image and form in the twentieth century. The focus will therefore be on the urban developments in the twentieth century, a period that is richly documented.

Heusden was founded near a castle probably in the 13th century. It was fortified at the end of the 16th and again at the beginning of the 17th centuries by a fortification system which was modern for its time. During the Dutch Golden Age (17th century) it was a famous garrison town. Heusden, which had been part of the province of Holland from 1357, became part of the much poorer province of Brabant in 1813. After the fortifications had been dismantled in 1816, prosperity declined due to economic factors and the definitive departure of the garrison in 1879. In 1904 the old Town Harbor was filled in and turned into public gardens.
Towards the end of World War II, part of the town was destroyed, including the Town Hall and part of the Church. During the reconstruction period after the war (1945-1965), a new town hall and a number of council houses were built. Modernist plans in the sixties to level the fortifications and to build multi-story apartment blocks on the outskirts of town were never realised. Instead, a radical restoration plan (Development Plan) was adopted in 1965, involving repair of the fortifications, reconstruction of the historical street structure and restoration and reconstruction of buildings. The Town Harbor was re-excavated. During this restoration and reconstruction, an old map by Joan Blaeu (1649) played an important role for the realisation of the reconstructed 17th-century image of Heusden. While the restoration had not yet been finished, Heusden was officially given the status of Protected Townscape in 1972. The restoration campaign was finished around 1990.

Three-dimensional computer models were made representing six significant periods in the 20th century: 1900, 1943, 1946, 1965, 1975, and 1990. From each of these reference dates the changes in the ground plan, the building masses and the façades were visualised. These computer images were needed to be able to analyse, among other things, the approaches to restoration. The volumes of the houses are modelled as simply as possible in order to be able to enhance recognition and reduce the computer storage space needed to a minimum. Dormers, chimneys, porches, and other three-dimensional objects are therefore absent in the computer models.

By simulating a walk through, urban spaces can, depending on the level of realism, almost be physically experienced. This was done with the 1943 model of Heusden in which a walk from the harbour, via the main street leads through a narrow alleyway to the marketplace. Another option is to make still images of each period from the same viewpoint which allows for a uniform analysis. It is also possible to study the extent of scaling-up or down, the difference of heights or proportions in the townscape. These images show the larger structural changes in the morphology of the town, the increasing density of the urban texture and the use of different area's.
SOME OTHER USES OF THE SAME COMPUTER MODEL

Once computer models are made they can be used for various kinds of research.

Since any viewpoint in a three-dimensional model shows only part of the façades, it is difficult to analyse the transformation of the façades. From the existing three-dimensional model, images of the façades were extracted, ordered per century and displaying the six reference dates. These were used to examine the changes in and the treatment of the façades in the 20th century or the work of a particular architect. In this way, the façades forming the street walls seen in elevation were formed. When the six street walls are displayed in a single image, the often subtle changes in the façades can be read from top to bottom. It should be noted, though, that these images still need to be interpreted and that the computer does not tell us what has been changed.
The images show us that only the houses around the harbour and Fishmarket were deplastered to a certain extent. Small changes, such as the use of mullioned windows can have an important impact on the appearance of the streets. It also appeared that houses were rebuilt in their old form.

In the 60's the fortifications were reconstructed 1.5 meters lower than they used to be, and the houses are nowadays higher than they were in the 17th century. As a consequence, comparison of the images shows that much more of the roofs can be seen from a distance than the map by Matham (1625), for example, shows us.

The changing area around the Town Hall can easily be followed in the various periods of the models. The gap left after its destruction in 1944 and the construction of the new Town Hall (1956) constituted an important structural change at the very heart of the town. The old Town Hall had literally been the centre of the town, and seen from the Veer Poort its tower used to be a focal point. The new Town Hall is much lower than its predecessor and of a more horizontal character. Only part of the building is visible from the same vantage point, providing a less interesting town view than before 1944. As a typical Town Hall of the reconstruction period, a corner square was created leading to a different use of space and opening up the town block.

Even in a town as small as Heusden one finds areas distinct in character. In order to make the computer images better understandable, these areas have been given different colours, thus linking up with thematic cartography. We can distinguish the following areas as shown in the theme map:

1. Botermarkt, Hoogstraat, Waterpoort, Engstraat and Vismarkt, are characterised by relatively high, narrow, deep plots. They form the main historic area.
2. Putterstraat is a typical back street with various kinds of buildings, mostly residential, which are usually lower in height than buildings in the main street
3. The area near the former castle, Burchtterrein, is marked by open rows of houses from the reconstruction period which have no relation to the former urban texture.
4. The complete fortifications and the waterfront in particular (Town Harbor, marina) is a recreation area.
5. The area south-east of the Demer Canal is characterised by urban renewal social housing in adapted style.

Figure 9
CONCLUSIONS  The question is whether to use still images or rather to show animations simulating for example a walk through a street. Since, in the Heusden project regular pc's were used, the calculation of an animation appeared to require far too much computer power. Therefore we refrained from finishing an animation. The still images I showed have proved to be equally effective for the analysis, since they allow the viewer to leisurely study each image or the model on the computer screen.

Since these computer models still rely very much on the traditional model maker's art, the still images of Heusden convey information in a comprehensible, clear way. Though movement definitely enhances the idea of realism it does not allow the user to view each individual building or the city as a whole. Even when an animation of a city exists, such as in the case of Edinburgh, the still images are impressive and functional in their own right.

For the same reason I have deliberately not shown the newest materials available in the field of computer visualisation and animation. Elaboration of computer images at an almost photo-realistic level such as was done with some Italian cities, is very useful and attractive for presentation purposes, but in the Heusden and Edinburgh research abstraction served a specific purpose for which refurbishment would turn out to be a burden.

Though more and more tools for interactive rendering and animation and virtual reality become available for pc's, we should resist the challenge to keep running away with the newest tools and developments and not giving enough thought about the scholarly deployment of the tools already developed. In connection with this, we should always keep in mind that approaching an object, according to our perception, more details will have to become visible, which is not possible with most scale models or computer models. Though the newest tools based on wavelet technology seem to have found a solution in providing the possibility for seamless zooming in on details based on the calculation of the distance or the zoom-level, all those details still need to be entered into the computer model, which requires a great deal of work and computer power and storage space.

In the Heusden research, the computer models were used to show the transformation over time and many other aspects of the city. Almost all the drawing or modelling work can, in principle, be done manually, but it would certainly take much more time. Although using computer visualisation techniques in research and analysis is time-consuming, it allows a more flexible way of studying the dynamics of the built environment. Visualisation can be a powerful tool in representing a townscape in three dimensions from different angles. It allows for a better understanding of the components of the city, their distribution, formal analysis, relation with the context, proportions and their process of change and continuity. In addition, it provides the possibility of exploring many alternatives.

However, photo realism in computer visualisation should not always be the default purpose for evaluation: although computer visualisation provides more possibilities and is more flexible for carrying out specific research tasks, using simple scale models may turn out to be quicker to realise and easier to create. If possible, using a combination of traditional and computer techniques appears to be the best approach. The purpose is, after all, to be able to communicate and evaluate spatial information. In order to achieve that goal, one should use the most appropriate medium available.
NOTES

ABSTRACT This paper presents a method of using computer animation techniques in order to solve problems of visual pollution of city environment. It is our observation that human-induced degradation of the city environment, results from well-intentioned but inappropriate preservation actions by uninformed designers and local administration. Very often, a local municipality administrations permits to build bad-fitting surroundings houses. It is usually connected with a lack of visual information about housing areas of a city, its features and characteristics. The CAMUS system (Computer Aided Management of Urban Structure) is being created at the Faculty of Architecture of Bialystok Technical University. One of its integral parts is VIA - Visual Impact of Architecture. The basic element of this system is a geometrical model of the housing areas of Bialystok. This model can be enhanced using rendering packages as they create the basis to check our perception of a given area.

An inspiration of this approach was the digital endoscopy presented by J. Breen and M. Stellingwerff at the 2nd EAEA Conferences in Vienna. We are presenting the possibilities of using simple computer programs for analysis of spatial models. This contribution presents those factors of computer presentation which can demonstrate that computers achieve such effects as endoscopes and often their use can be much more efficient and effective.

STATE OF OUR CITY Present-day parts of the city are criticised for the fact that they do not form the space, neither create the housing environment, nor adopt it to human needs and feelings. (see figure 1) These areas are not accepted by the dwellers. People do not experience the link with their place of habitation. The area outside their own flat, “the urban area” of the estate is treated as completely alien. Research made in Polish housing estates shows that only a few of the inhabitants have a good opinion about their surroundings. Centres of the cities are degraded both functionally and aesthetically. Many public buildings (hotels, banks, schools, shops) have been raised without any link with the surroundings, configuration of the surface and existing buildings. Simultaneously, the historical continuum has been broken. This resulted in a complete desemantisation of the downtown areas. (Asanowicz A., 1995)
REASON  In the past war years millions of people moved from villages and small towns to big agglomerations. There was a need to provide those people with housing. Hence to that the ideas of an international modernism: “... concepts of mass and affordable housing prefabricated on an industrial scale found a fruitful political & social climate. Wide spread implementation of those ideas took place in sixties, when by decision of the central government building industry a priority was given to manufacture prefabrication systems. The construction period of gigantic subdivisions of “military quarters” begun.” (Dabrowska G., 1994)

Not all of us realise the fact that the space order of our city, influences positively or negatively all our senses, creating our visions. The aesthetically perception of an architectural object is related to its spatial concept. Chaotic concentration of buildings does not provide an adequate quantity of information either to influence our memory. On the other hand, too much orderly spatial setting of objects is easily memorised, but ceases easily to attract our attention.

Spatial arrangements of prefabricated buildings situated according to a schematic order provide a minimum portion of information. That is caused by the fact that we've seen those buildings many times before. Monotony of living districts built of ferro-concrete prefabricated blocks (inadequately called modernistic) does not contribute to create a spatial order or to develop social contacts.

Self expressiveness of living districts is below normal level of perception, due also to its bad spatial arrangement and to face the outlook of various buildings. The same windows and balconies in the same spatial rhythm are repeated. A primitive sculpture and lack of facial expression causes that an observer receives a minimum quantity of visual information. Simultaneously repeating of the same buildings complicates spatial orientation. The phenomenon of visual pollution of city environment occurs.

POSSIBILITIES  If we want to improve the state of our living districts we ought to consider three problems related to their perception. The first is expressiveness of buildings form, the second natural and artificial illumination, and finally the third - dynamic perception.

EXPRESSIVENESS  Aesthetically, information of urban spaces is strictly connected to their spatial - massive composition, proportions, rhythm, symmetry or asymmetry. It contains such notions like: facture treatment, colour, detail.

Providing these elements we would like an architectural object to be distinguished by its expressiveness, it should contain a set of elements of which informational impulses possess various values, not overpassing though the power of the whole informational area of a building. Verifying the quality and quantity of information carried by the elements creating a form and defining the minimum information level causing that such object, is being percepted and memorised and could be carried out experimentally. In view of such a purpose drawings containing progressively more and more elements in a form should be prepared. The first drawing would be just a contour of a form. The following drawings present a form enriched by the next elements as: windows, balconies, terraces, bay windows, columns etc. After introduction of each group of elements a subjective evaluation of a form expression could be done.
Illuminating Urbanistic space on the level of visual reception is realised by light. Daylight renders accessible the architecture to a receiver always in the same way. The artificial light has become a new category - something that turns out to be a qualitatively different medium in the space. It has huge perspectives in creating space from the new beginning in a completely different reception of architecture. (see figure 2)

The light used in housing estates does not have to just assure the security or safety of the dwellers. Appearing among the small architecture, shrubs and trees, lights are to expose the beauty and climate of designed forms in the more suggestive way than daylight. In order to face the growing pain of housing estates the specific way of visual reception has to be created in every estate. It can be done by:

- varying the exertion of lights source, not to let the user feel confused in local informational structures of space.
- creating spaces by setting with light orientational points (characteristic buildings, dominants)
- variety of light colours in order to emphasise the importance of light-ed set pieces
- leading a passer-by with light
- careful organisation of dispersed light arrangement (from several delicate sources), not too excessive exposing the fragments of space with strongly accumulated light
- creating scenery and climate by architecture; exposing architecture in urbanistic meaning

According to the treatment of the architecture as a medium by which one can create a separate architecture of lights, it would be also possible to create specific characteristic climate and emphasise the architectural forms.

DYNAMIC PERCEPTION  The important aspect of perception is a fact that we constantly move, changing position and perception points of an object. According to the point of perception various buildings and their parts group together, move, hide, enlarge or shrink in perspective and finally totally disappear. The closer we get to the object, the more detailed the information we receive. Quantity and quality of information are not only influenced by the form of urbanistic spaces but also by such factors as: distance between the object and the observer, road and quickness of the observer. However, despite of so many factors influencing the perception, among these analysed by us in housing estates, we can determine two basic types of space and two types of perception connected with them.

1. Wide open spaces - perception is possible in any direction (360
degrees) which means that the reception of space is potentially more universal. Unfortunately it makes it impossible to determine the closed view frames and it is also one of the reasons why housing estates are estimate as chaotic and uncomposed.

2. Closed spaces - determining the direction of perception and precisely determining the view frames. The example of such spaces are: streets, squares and pedestrian ways.

METHODS The digital endoscopy as the inspiration of this approach were presented by J. Breen and M. Stellingwerff at the 2nd EAEA Conference in Vienna. (Breen J., 1995) We've been presenting the possibilities of using simple computer programs for analysing a spatial model. This contribution presents those factors of computer presentation which can demonstrate that computers achieve such effects as an endoscope and often their use is much more efficient and effective. The CAMUS system (Computer Aided Management of Urban Structure) is being created at the Faculty of Architecture of Bialystok Technical University. One of its integral parts is VIA - Visual Impact of Architecture. It shall help us to create the methodological basis enabling the analysis of the different relations and space conflicts and the answer at the question: "What should be done in order to make our surroundings look nice?" The basic element of this system is a geometrical town data base. It will integrate various data types, such as: cultural heritage, contemporary housing areas, suggested design directions according to plans of extension of a city, proposals, based on work of our Faculty, which could be a useful information base for the municipal administration.

From the beginning it seemed clear that two separate models, the 2D model of the plan and the 3D model had to be developed. The first step was to establish a 2D basemap of chosen housing areas. The level of detail and resolution of this map was still limited to an urban planning scale and depended on the level of detail of the source material. Based on the 2D-representation already built up in the computer, the 3D model was developed. Following experience in conventional model building, the computer model was subdivided into a number of "morphological units" (insert models). Again similar to the traditional building of a model, one also has to consider different levels of resolution in order to represent different levels of scale and information.

TOOLS Whereas the computer is used in the architectural office to design future objects, it can also be used as a drafting tool for drawing architectural objects which already exist. In the present work the computer is used as drafting tool and as a digital endoscope. Usefulness of an endoscope and graphical computer programs should be considered
within three already mentioned problems to be solved. Both tools are to enable the estimation of the reaction of designed spaces or changeable urbanistic assumptions.

**Problem number one - expressiveness**  The study of the reaction of spaces and the checking of the quantity and quality of information, using the endoscope and the computer, is similar. The first item to estimate is a strictly massive model. In order to further verify the quantity and quality of additional elements, we have to make a new element at the endoscope and put it in the model. In a computer we have to make a new spatial element and put this in the place of the old one. We use the AutoCAD program for building a spatial model. The limited massive forms are constructed from prepared elements of the program and they are connected by AME. All others additional elements are made as repeating block set put on existing blocks. Such a made spatial arrangement is imported to 3D Studio by DXF format. The difficulty is more or less at the same level. The first and the second method is only for building different massive elements and checking their mutual connections. In 3D studio, in order to present a created spatial assumption, we set a camera (our endoscope). The camera used in this program has a variable focus, from a fish eye to a wide angle. For our needs we choose a focus close to the possibilities of the human eye.

**Problem two - Illumination**  A computer is unreplaceable in studying lights, not sunlight, which can be simulated in an endoscope by a lamp, but an artificial and local one. We can test the lighting of urbanistic ways, particular buildings and also create the climates—a huge number of modifications and possibilities for testing many variants. In respect to the imperfection of a computer in using the light exertion (no possibility of expressing exertion in Lux) we are able to check the quality of lighting only on a small scale but we can perfectly check the way of lighting of spatial partitions. We are able to try to interpret the reception of space, created by the light, from the user's point of view. Artificial lighting is simulated by using the lights Omni and Spotlight*. One problem is pointing light without making the edge shadow. The second one is a directing light with the possibility of generating realistic shadows (Ray-tracing). With respect to the possibility of changing the volume of the light's source, the light's reach (attenuation) and degree of dispersion, they are used as reflectors lighting the concerned space. The climate of lighting can be obtained by using many-coloured lights within the scale of 256 colours.

**Problem number three - Dynamic perception**  Passing through the model is the only factor which makes the endoscope better than a computer, because of its real time and its choice of the optional way. Generating the set's way path is tedious and time consuming when using a computer. There are almost no possible modifications in already existing animation and there are no possibilities of instant changes. Every new way and each new element brought into a spatial assumption must be followed by creating a completely new animation. However, this statement does not discredit a computer in comparison with the endoscope, because problems discussed above concern only those programs and the equipment that we have used. This restriction does not concern super multiprocessoral computers which allow animation in real time and are not worse in comparison with the endoscope. A computer animation does not only concern passing through the conceived space. We can animate buildings (stretching and shortening), change materials, put on elevations (mapping). Additionally we can create an animation of light using different colours and with an exertion and an animation of the sun route. With computer animation, using every possible computer...
option, we can perfectly and relatively quickly verify and choose the best variant of space cultivation, cubes relating to color and the way of lighting them.

REFERENCES

A VISUAL SIMULATION SYSTEM
USING SCALE MODELS AND COMPUTER GRAPHICS

Shigeyuki Seta
Toshiki Kohno
Naoji Matsumoto

Tobishima Corporation, Technological Research Institute, Japan
Nagoya Institute of Technology, Department of Architecture, Japan

ABSTRACT It is very important to simulate the landscape when planning large scale buildings, such as skyscrapers and high-rise condominiums, and high-level visual simulation is anticipated in Japan. A landscape simulator using scale models which we have developed is useful to obtain eye-level images. Computer graphics is also useful to obtain eye-level images because of the high quality. This paper reports on a visual simulation system using a new image composition technique to combine the scenery of scale models recorded by the simulator with computer graphics images.

The video images of scale models are obtained using eye-level images from a small CCD video camera controlled by a personal computer. The background images including the sky and clouds, are created as CG images. A real-time image composition technique has been developed by means of a video editing system to combine the video images, of scale models with the CG images. We show the potential of this hybrid simulation method as a useful technique for visual simulation.

INTRODUCTION It is very important to foresee the image of an area after the construction in the stage of planning when designing landscapes including large scale buildings, such as skyscrapers and high-rise condominiums, and when assessing the environmental impact of land development, such as golf courses and resort hotels.

Visual simulation is necessary for the designers and engineers to show the project objectively in an easily understandable form to the neighbouring community of the development areas.

Using a small CCD video camera, we can easily present the future images by observing and video recording the scale model space from the eye level. In this case, the background, such as the sky, clouds, mountains, and trees, cannot be reproduced as models and has to be simplified.

On the other hand, computer graphics (CG) has recently become a useful visual simulation technique to obtain photo-realistic images, thanks to the advanced computer hardware/software technology. However, it takes many hours to make 3D models, and CG images production time depends upon the data processing ability of the graphic workstation.

This paper reports on the capability of the new technique to make photo-realistic images relatively easily compared with former methods. The technique comprises chromakey image composition of the video camera images of the scale models of a building and surrounding area with the distant view of CG images of the sky and clouds.
Figure 4 'Detail of roof prism and CCD video camera'

Figure 5 'Figure Block diagram of visual simulator'
**VISUAL SIMULATOR**  The visual simulator we have developed is a computer controlled moving system for a small CCD video camera attached to a special-cut roof prism. It has five axes: horizontal motion (X, Y), vertical motion (Z) and horizontal and vertical rotation. It provides real-time photo-realistic images of the scale model space on a TV monitor or HMD as if the viewer is standing in the space. (see figures 1 - 4)

Each axis is movable by a DC servo motor. The CCD video camera motion control is the feedback control, with the hardware being a DC servo motor driver for each axes, DC servo control boards and a PC (PC-98, NEC). The programming language of the control software of the visual simulator is BASIC (N88BASIC, NEC).

In order to make video images of scale models, the moving route of the CCD video camera can be manipulated by a set of sequential input data, such as the moving speed, moving distance, ratio of acceleration/deceleration and time interval to the next motion.

Users can confirm each motion of the video camera while inputting data. The input data can be revised and corrected using the function key indicating input data sheets.

It is easy to adjust the moving speed of the video camera by using the “Help Menu” indicating the comparison sheet between the moving speed corresponding to the scale of the models and the pulse counts.

Movement conditions are as follows:

- Movable area of the small CCD camera head: 2.0 m x 1.5 m x 0.3 m (x, y, z)
- Range of rotation angle: +180 - -180 (horizontal), +45 - -45 (vertical)
- Range of velocity of the CCD camera head: 11-50 mm/sec (x, y), 2.8 - 28 mm/sec(z) (see figure 5)

**CG SYSTEM**  The hardware is a graphic workstation, SILICONGRAPHICS, IRIS 4D, and the software is The Advanced Visualizer (TAV), WAVEFRONT TECHNOLOGIES.

The sky and clouds of the CG images are made by processing real scenery copied by an image scanner, and the CG images are recorded on videotapes using video recording function for individual frame - 30 frames per second.

The video-recording system and the monitor system are as follows:

- **VTR SYSTEM**
- An S-VHS video recorder, M2 video recorder and editing system.
- **MONITOR**
- A color TV monitor.
- A Head mounted display (SONY, GLASSTRON)
IMAGE COMPOSITION TECHNIQUE  

Scale model images obtained by the visual simulator and background CG images are recorded on videotapes respectively, and the composition videotape are made from these two videotapes using a Special Effect Generator (SEG) and video-editing system.

The working processes are as follows:

First of all, video camera motion data (motion pattern), such as the viewpoint and motion data for the scale models of a subject, are prepared for each motion based on the script.

When filming model images, the model space is surrounded by blue background paper.

The models are recorded on video tape against solid blue or green color to provide vacant background to accept separately prepared background images by video chromakey.

Background CG images are then created from the same viewpoint and same moving data of the visual simulator.

Finally, the composite images are made for each motion pattern by incorporating the CG images in the uncolored background, both images being synchronized with each other. (see figure 6a and 7b)

STANDARDIZATION OF THE VIDEO CAMERA MOTION PATTERNS  

A motion sequence is an assembly of images recorded with many motion patterns. Actually, it takes many hours to input data for background CG and synchronize composite images for a video tape of only a few minutes, because many motion patterns are included in such a tape.

We therefore tried to standardize the video camera motion in consider-
ation of the fact that the viewpoint and motion of the viewer are limited in the case of visual simulation of architectural and civil structures.

All of the video camera motions are determined by the combination of five axes (X, Y, Z, Horizontal rotation, vertical rotation), which are independently controlled.

The numbers of combinations of the motion data are as follows, in consideration of the moving direction (+,-) and rotational direction (+,-) of the video camera, on the assumption that the speed and travel distance from the start point to the end point are constant.

numbers of combinations of 1 axis : \(2 \times 5/1 = 10\)
numbers of combinations of 2 axis : \(2 \times 2 \times (5 \times 4) / (2 \times 1) = 40\)
numbers of combinations of 3 axis : \(2 \times 2 \times 2 \times (5 \times 4 \times 3) / (3 \times 2 \times 1) = 80\)
numbers of combinations of 4 axis : \(2 \times 2 \times 2 \times 2 \times (5 \times 4 \times 3 \times 2) / (4 \times 3 \times 2 \times 1) = 80\)
numbers of combinations of 5 axis : \(2 \times 2 \times 2 \times 2 \times 2 \times (5 \times 4 \times 3 \times 2 \times 1) / (5 \times 4 \times 3 \times 2 \times 1) = 32\)

total numbers of combinations: \(= 242\)

The actual total number of types of motion pattern images is \(242 \times n\) where "n" is the number of directions of the CCD video camera.

These combinations include those that are empirically considered impossible with the motion of human eyes. Therefore thirty patterns were selected. Video tapes recorded in the past were reviewed to select simple patterns that frequently appeared in the tapes.

(see figure 8a and 8b)

The number of combinations of motion patterns included in the background CG images is 242, the same as the video camera filming the models, provided that the speed and travel distance are constant.

The motion patterns of background CG were recorded on video tapes in advance and retrieved as required to make up respective background films. This significantly saved the time for creating backgrounds, which had previously been created each time from scratch.
EXPERIMENT TO CONFIRM THE EFFECTIVENESS OF IMAGE COMPOSITION

A simple experiment was conducted to confirm that the composite images create a more realistic impression. Two minute video films were made with and without CG background based on visual simulator images of models of apartment houses with a scale of 1:50.

In the experiment, 8 subjects sat in front of a 29-inch TV monitor and watched the films on it. They were then asked to answer questionnaires consisting of 20 pairs of expressions with 7-notch scales in between to quantify their intuitive impressions of the images. (see figure 9)

EXPERIMENT RESULTS AND DISCUSSION The average scores were calculated to compare the ratings between the films with and without the CG background. There were clear differences in the expressions concerning the evaluation of the space, such as “simple - complicated,” “realistic - unrealistic,” “brisk - gloomy,” “involving - not involving,” and “likable - dislikable”. On the other hand, no marked differences were observed in the expressions regarding the consistency and stability of the space, such as “unified - scattered,” “natural - unnatural,” “rhythmic - unrhythmic,” and “regular - irregular.” (see figure 10)

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![Figure 9 'Video image for experimental use'](image)

![Figure 10 'Difference of the evaluation between images with background(CGI) and the no background images'](image)

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CONCLUSIONS  This suggests that composite images of the models and CG background cause little sense of mismatch. Though the experiment is not sufficient for obtaining statistically significant conclusions, this hybrid simulation method can be an effective technique for creating more realistic images by adding background CG images to scale model images. We examined a useful technique to create realistic dynamic images for visual simulation by the hybrid simulation method. We confirmed that model images and CG images can be easily composed by the standardization of movement patterns. We combined the advantages of using models and CG, which have conventionally been used separately for landscape simulation, and found that the hybrid simulation method can be very effective in evaluating spaces and simulating landscapes.

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DEVELOPING A NEW ENDOSCOPY LABORATORY WITH DIGITAL TOOLS

Ilkka Alavalkama, Petri Siitonen
Architectural Media Laboratory AML, TU Tampere, Department of Architecture, Finland

ABSTRACT Tampere School of Architecture had to leave its old down-town building and move to the TU Tampere university campus in Hervanta, 10 km away. In this process, the 20 years old endoscopic system “The Urban Simulator” was one of the victims. Old mechanical parts and especially the original home-built microcomputer system were too old to compete with modern computer-aided methods.

A new endoscopic system is now under construction, using all of the 20-year experience, new technical components and computers for camera control and picture processing. Real-material modelling is used together with computer-aided planning and visualization methods taking the best from both sides.

THE SCHOOL The Department of Architecture in TU Tampere is a quite small educational unit taking only 35 new students each year. These students are chosen in very strict national tests together with the two other architectural schools in Finland: Helsinki University of Technology / Department of Architecture (HUT) in Otaniemi/Espoo and University of Oulu / Department of Architecture. After a quite long study time (median 9 years) over 90% of students are graduating. The school has a good international reputation based on numerous prizes in international competitions for architectural students (recent list on the web-site).

The Department of Architecture was for 20 years situated in an old down-town factory building. This building is owned by a private company and the rental rates are following those of the neighborhood. In recent years, the center-point of the town has moved to these quarters raising the value of all commercial space.

The strict money policy of the Finnish government led in october 1995 to an order to move the whole 4000 sqm educational unit to the university main campus in the satellite-town of Hervanta. This led to the total re-valuation and re-planning of all the technical equipment and laboratory units of the department.

THE OLD TRAINING SYSTEM Our old working methods were based on hand-made architectural presentation posters. Most of the material was made with half-technical methods photocopying separate fragments to the size needed for final artwork.
Photographs, computer renderings, video prints and grabbed video frames were commonly converted to paper halftones before the photocopying process. Flatbed and slide scanner were used only on limited numbers of professional projects. Videotapes and computer animations were used only for some specific projects.

The endoscope system and the video editing were linked together and separated from other picture processing services. For space-economical reasons, the photography studio and art teachers were using the same studio rooms (only one day / week for art teachers).

(see figure 1)
EARLY SYSTEM “URBAN SIMULATOR” Tampere School of Architecture has been using endoscopic model photography systems since 1978. The main tool has been a computer controlled camera rig, “The Urban Simulator” with its video output to a video recorder or a grayscale video printer.

In recent years, however, the endoscopic photography has been considered an effective alternative to other photographic and computer presentation methods. Main reasons in choosing a proper tool for a specific project have been the picture quality and output format, time schedule and process speed, amount of picture material needed and the number and skills of the persons willing to proceed the project.

THE NEW BUILDING The new location of the department of architecture is a 12 years old university building used originally by the Department of Civil Engineering. The wings were built for office and seminar rooms. Only minor wall and electrical modifications were needed, where space was used for basic teaching or research. Most of our old furniture was moved to the new building and rebuilt or repaired for interiors.

The building grid is 6 by 6 meters. For lecture rooms 12 meter span beams are used in one direction. Small lecture rooms are arranged in pairs using 2 by 3 grid units. Light walls are built of gypsonite board, which makes room modifications quite easy. Lecture room height is 3.5 meters, which is enough for normal 3 m studio light statives (Manfrotto # 231). Office rooms are 3 meters high.

The auditoriums and laboratory rooms needed a total rebuilding in order to be suitable for the technical and audiovisual level maintained already in our old building (originally these laboratory rooms were used as water and concrete laboratories). New technical equipment and especially the need for sound-isolated recording space added some aspects to the list of modifications.

Laboratory spaces are reserved for a computer class, a photographic studio, traditional photographic laboratories, digital page and poster layout, video editing and presentation, and a model workshop.

The computer class is big enough for teaching an entire class and also has a separated
space for printers and network connection units. All technical units are located very close to each other and the staff rooms.

All students have alltime access to the computer classes and to the photography laboratory. Doors are controlled by personal access cards and number codes. (see figure 2)

AIMS FOR THE NEW SYSTEM  The new architectural media laboratory AML is offering all students a possibility to do a complete project in digital format. Final work can be printed out or presented in digital format from a computer screen or a data projector.

The laboratory controls all presentation systems in the department of architecture. Some page layout computers and printers are located in the faculty wings, but the entire system is maintained by the laboratory.

The capacity of this system is big enough for all current publication projects. More server and printing capacity is needed, when all students and teachers are ready for digital working methods.

COMPUTER NETWORK AND WORKSTATIONS  All operational units of the original computer network were removed with the earlier laboratories. The only remaining part was a built-in thin-ethernet cable connecting the staff rooms. We had a free field to choose an effective solution.

A new network connection center was built next to our computer classroom. This place gave us the best possibilities to connect our laboratories and staff rooms to the university network. Future connection to the faculty wings was prepared by building connection frames ready for extra cables.

The new cabling solution was a CAT-5 twisted-pair star network. Currently we are using
mostly 10base network adapters. Some of our connection units are ready for the future 100 Mb information transfer rate. This should be enough for transferring moderate-quality compressed video in real time.

A new basic level computer system has a 17" screen with 4 Mb display and 64 Mb system memory. Both Mac and WinNT operating systems are used. For everyday use all computers have a software package consisting of Microsoft Office, Adobe PhotoShop and Adobe PageMaker.

"TOTAL DIGITAL CONTROL OF ARCHITECTURAL PRESENTATION", THE BASIC SCHEDULE  The space reserved for PC workstations in the new building is big enough for teaching an entire class (15 machines / 30 seats). Data projection on a 100" screen is used for teaching the programs. A separate room with 5 workplaces is reserved for page layout and picture processing (Mac/20" screens). All staff rooms are equipped with computers and network connections.

All new computers are equipped with large-capacity hard disks and removable disks. This is the only solution for the high disk capacity needed for full-color photographs, CAD renderings, publications and posters. A good quality scanning of a photograph can produce a 18 Mb file and a poster artwork can be over 50 MB! It is impossible to maintain system disks big enough for all of our 200 active students and 50 teachers. With all important files on personal disks, there is no need for safety copies from system disks.

Our basic recommendation is a 100 Mb Iomega Zip drive. The Zip removable media is formatted either for Mac or PC, but Macs can read and write on PC-formatted disks. For greater flexibility and compatibility with the outside world SyQuest (88 Mb), Iomega Jaz (1 Gb), Panasonic PD (640 Mb) and Imation A-drives (120 Mb) are assembled to some computers.

"COMPUTER-AIDED ARCHITECTURAL PRESENTATION"  Computer-aided presentation is a combination of imaging, layout and output. One set of original material can easily be shared and modified for different output formats, if the basic work has been done in a correct way. Images can be produced by computer (rendering and painting programs) or with image capture systems (digital photography, scanning and video captures). Combinations of different picture materials are possible. Video and multimedia formats can use sound capture or computer-created soundtracks.

Project layout is done inside the computer (poster layout, page editing, www pages, multimedia production or video editing). All these formats can use computer effects and automatic digital tools.

Output format is chosen for a suitable final product (saving to a presentation or printing file format, printing, CD production or video recording). Large format ink-jet printers are used for traditional poster presentation.

If the original material is shared through a computer network, it can be constantly updated. There are no problems with out-dated information material. New digital presentation formats make sharing and paper output by the user easy and practical. Adobe Acrobat .PDF-files for printed pages and the new FlashPix for large picture files are the best tools for sharing pictorial material. (FlashPix is now on beta level and has at the moment only Win NT support, see http://www.photo.net/photo/ or http://image.hp.com)
Final presentation can be done directly on a computer screen or through other presentation methods. Data projection systems and a high-capacity computer network can transmit information to large auditoriums in different places.

**THE COMPUTERS FOR INPUT MATERIAL**  
A lot of drawings and picture material is produced by CAD programs. We are using ArchiCad, AutoCad, AutoVision and 3D Studio Max. Good-quality light simulation is achieved through importing 3D files into Lightscape for final rendering. For simple 3D modelling and virtual reality we have Virtus Walkthrough. All these programs are installed in our computer class.

The input of picture material is done mainly in the page layout studio room. Both flatbed and slide scanners are used. All scanners can work with a 24-bit color depth (30-bit color with HP Scanjet 4C). In house, we can scan 35 mm slides in resolutions of up to 2700 dpi. This is practical for an instant need, but quite a slow process. Larger amounts of photographic material are transferred to Photo CD disks by a local professional laboratory.

Video grabbers are used in the photographic studio and in the video editing room. Truevision video cards can use 16-bit and 24-bit color depths for .TGA (Targa) files. Some other grabber cards use .BMP or .TIF file formats. The picture file can be a square pixel 768 x 576 map for picture processing or a smaller rectangular pixel map for video editing (740 x 576 for ATVista/RGB or 512 x 576 for Targa+/S-VHS). These rectangular pixel maps can be used for picture processing after resampling the horizontal resolution to a full 768 pixels.

In the near future, we are starting to use direct digital picture material. We are planning to use still cameras and digital video. The transfer from camera memory to the computer is done through a direct cable contact (SCSI or a special connection). A docking port for a PCMCIA memory card is possible with some camera models.

Computer stations for image grabbing and basic processing are ready. These computers are built in 19" boxes and assembled in rack frames together with all other electronic equipment needed for a specific part of the process. This kind of a presentation system or a workstation is easily transportable with all of its accessories and can be used as a part of the picture taking process.

**THE COMPUTER FOR PRESENTATION ARTWORK**  
A group of 5 Macintosh PowerPC computers is used for page layout projects. Large 20" trinitron displays and 64 Mb memory capacity make truecolor work possible. Adobe PhotoShop, PageMaker and Freehand Graphics Studio software are used for most of the projects. The project files are saved on the network disk or on removable disks.

An easy and good-quality perspective correction of architectural and endoscopical photographs is possible in PhotoShop. Round endoscopic pictures can easily be framed and enlarged. A very wide picture angle and a clean framing is possible, when some picture information is added to the black picture corners with the rubber stamp tool.

There are laserprinters for b&w documents in formats A4/A3 and color printers for A4 and roll material (max width 900 mm). All printes are PostScript capable.

**THE COMPUTER AND RECORDERS FOR VIDEO AND AUDIO**  
The video material can be edited in digital (AVI or MPEG) or analog (S-VHS) format. Computers are used for audio, graphics and...
titling even in analog video editing.
A special computer system with big disk capacity was built for semi-professional digital video editing (Fast AV-Master video card). Medium-capacity removable disks: Imation A-drive (120 Mb), Iomega Zip (100 Mb) and Iomega Jaz (1 Gb) and a CD-recorder add capacity for short video projects. The ready-made video file can be printed back to a videotape or used on the internet or for CD-recording.

The sound-isolated video editing space is now operational, but not finished. We plan to build a new rack and table system for the equipment. The small sound recording and AV-presentation room is ready for use. There are 5 seats, CDi, S-VHS and computer presentation equipment and a Dolby ProLogic sound system. (see figure 3)

The new photographic studio is equipped for both photographic and video work. Collecting and rebuilding all old lighting and supporting tools gave us a practical toolset for a professional studio. Only some minor updates were needed.

The studio ceiling was rigged with a 50 mm tube grid (1 by 1 meter square) and an Erco 3-phase power supply system. A maximum power consumption of 30 kW was estimated. An air-conditioning system was built for keeping the room temperature on a normal level. Manfrotto Expan (#046) studio background system is used for photographic work. Hanging hooks for background paper rolls are fixed on the studio walls. A Manfrotto Autopole2/SuperClamp support system (#432-3.7 / #035) can be used outside the normal background and light support points.

The studio space is big enough for 2-3 student photographers to work at the same time (82 m²). All surfaces are painted black for killing straylight (Rosco Supersaturated Velour Black #6003). This makes it necessary to build all light, because the wall reflections in a big black room are minimal.
The studio is equipped with a 3-channel speaker system and a 3 m wide screen. The space can be changed quickly to a multimedia lecture room (50 seats).

**THE LIGHT SYSTEM**  
Our old Redhead/Bluehead (800/2000W) halogen light system is used in the new studio. The system can be used for all photography and video projects. Nearly the same color temperature with good color reproducing quality is chosen for the fluorescent tubes (Osram/32 or Philips /930, 3000 K, Ra=95). For working space and secondary use we have a set of halogen workshop lights equipped with barndoors (Frame Tools/Finland). The new endoscope optic has a bigger aperture than our older systems. Only a fraction of our old lighting level is needed. This makes it possible to easily create good simulations of real sky and light situations.

The sky background system presented in the second EAEA conference is used for architectural model photography. We have some 20 different cloud pattern gobos for the cloud projector and a cyclorama light set for the blue sky. For interior models, a Lastolite diffuse tent with 3-4 halogen spotlights is used for soft shadowless light.

For photography, Ektachrome 64 T tungsten film with good reciprocity characteristics is still used. The automatic Olympus SC-35 endoscopic camera is capable of time exposures up to several minutes.

The new automatic video camera has a good basic sensitivity. With automatic gain, a minimum illumination of 1 lux on the target surface can be used.

**THE ENDOSCOPE**  
An Olympus Modelscope M 100-033-090-80 wide-angle endoscope is used (80°). This optic is free of optical deformations and has a very even light distribution. Aspherical elements and multicoated lens surfaces are the solutions for a good optical performance.

The focusing is done by an ocular adjustment ring. The endoscope is connected to the camera with an adapter from the same manufacturer. For video, a full screen picture is achieved. The photographic adapter uses most of the round picture clipping only small parts of the picture top and bottom.

**THE PHOTOGRAPHIC SYSTEM**  
A full-automatic Olympus SC-35 endoscope camera is used for student projects and other every-day works. The camera body has a manual exposure correction (±3 steps in _ step intervals) and exposure speed override.

For special projects, a Nikon body with a motor drive and a data back can be used. Both systems have bright aerial-image viewfinders. Focusing is done by using the central haircross of the viewfinder. The disadvantage of this viewfinder is the lack of depth-of-field information.

Olympus AK-1M optical adapters with suitable bayonet ends are used for connecting the endoscope to the camera body. The adapter has a round 32 mm quick-coupling for the endoscope. There are no optical controls in the adapter. The full width of the round picture is visible (φ32 mm). Some parts of the picture are framed from top and bottom.

The Nikon system is used in all of our photographic tasks. We have nearly all components of the macro photography system, PC-optics and a wide selection of lenses from wide-angle to medium telephoto. For maximum picture quality, we use only fixed focal lengths.
THE VIDEO SYSTEM  An automatic surveillance camera is used for student projects (JVC TK-C1380). The camera has composite and Y/C-video outputs. Camera resolution is on the level of S-VHS recordings (440,000 active pixels). The camera functions and output parameters can be adjusted by an on-screen menu.

The endoscope is connected to the camera with an Olympus AK2-10C optical C-mount adapter. This combination gives a full-screen video picture (1/2" CCD in the camera). This camera is used for both frame grabbing and video recordings.

THE CAMERA RIG  For normal photography and video grabbing we still use studio statives. The endoscope is fixed to the stative arm with a conical adapter slipped around the ocular end which is formed for this purpose.

The stative is equipped with a cordless keyboard and a trackball. This makes it possible to control video grabbing, digital photography and the basic computer controls from a distant 800 x 600 resolution 20" computer screen.

The new simulator frame is planned to fill one building grid frame. This means maximum dimensions of 5.4 by 5.4 meters and a frame height of 3 meters. Travel distances of nearly 5 meters are possible. The used model space is selected by using curtains on different circular tracks. With the maximum model space, a narrow sidewalk and the other grid frame are reserved for control and workspace.

The camera wagons are driven by stepping motors and are running on linear ball-bearings. The drive system is controlled by a computer and operated by a direct hand control or by a computer program.

The rig is used for both photography and video. An extra vertical and horizontal arm system converts the camera head from the video column to an “upside-down” studio stative. The arm system is rigid enough for a large-format view camera (Toyo 4" x 5").

CONCLUSIONS  Building the total modern laboratory and computer system for an architectural school is a hard and time-consuming task (even in a small school like TUT). The new computer system has been built in winter 96/97 and it is now fully operational. The new page layout system has a constantly increasing number of users. We are going to have problems with the printing capacity in the next season. The new studio is almost completed and has been used for all kinds of photographic tasks. The first test and calibrating shots with the new endoscope system are very promising. The next interesting, but complicated task is the construction work of the computer-controlled camera rig for endoscopy and other photographic purposes.

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44 / CURRENT DEVELOPMENTS OF USE
RESULTS OF RESEARCH ON
SIMULATION AND ARCHITECTURAL
REPRESENTATION
16 years of research, teaching ... and since 8 years even services, all-around environmental simulation....
That seems far too much time for the attempt, to till a field, that people often for quite different reasons like to shun, asseverating at the same time steadily and everywhere, that they would use its fantastic facilities at the very next occasion....! I say it to you very frankly: Most times I am waiting until today.
On the other hand 16 years are a very short time in presence of the complex problem - particularly in the field of urban planning- to produce conclusive pictures; that means to produce pictures under the consideration of all essential facts, resulting from most different planning contributions, which all cogently take influence on the later reality of living-conditions in urban space. Not seldom those contributions even pursue conflicting aims.
So I have to confess now, that a very long time is gone, until I finally realised the decisive preconditions, giving a legitimation to speak of what we call a good or a nice place: I am sure now, that we can only do so, where
• the functional,
• the ergonomic (that means user-appropriated) and
• the aesthetic qualities as shape-factors of the same degree may conjunct to a lucky unit, and evoke well-being likewise to all those concerned. In a reverse conclusion (in Germany we say “im Umkehrschlufl”) this recognition does clear the destructive consequence for that quite normal case, in which architects, engineers and other concerned people, all in pursuing their personal contributions, shun each other in the just mentioned manner: They fear realistic pictures more than they wish to see them and they are anxious to be frightened of what they are planning. Very often they don't even feel ashamed of fearing the risk, that - as we say in Germany - “someone would wake up a sleeping dog”. (A real platitude, isn't it?)
To cut my 16-years story short: A real source opened and opens itself for him, who is serious with environmental simulation, because he conceives, that urban planning always and in general is environmental simulation. Urban planning simulates, however, since it has been invented, in plans and words - but in the course of time on an increasing
abstract level ..., just without pictures. Everyone, who is involved, pursues his special job independently and nearly sovereign; he is sure and insists on the rightness of his isolated solution, although it is - in any case - only part of the whole,. (to say nothing of the shady groundwork, on which he is working). Everyone speaks his special language, making plans only for his equals more, than to be interested in a performable understanding and/or synchronisation of his work for all those concerned. This is, in like manner, the main topic of our contribution and our request.

To describe the result of that deplored behaviour everywhere would mean, to repeat what we tried to show and to say in the first chapter of our report. This report has got - as you can see - a real book, which is now to be presented on the occasion of this conference. After demonstrating the hard “reality”, on which we give a detailed analysis (Chapter 2), we strike an intermediate balance. Than we name our demands for the future, giving a new definition of the problem (Chapter 3). In chapter 4 we generally describe - out of our experience - a functionable communication-medium, including - above all - functional pictures and we explain - at the same time - their non-refuseable importance as a common denominator in the plait of above mentioned planning contributions. - Chapter 5 at last gives a summary of environmental simulation as a solution to all the formerly discussed problems.

In our projects documentation (Chapter 6) we demonstrate in a book-reproduction our understanding of environmental simulation. We do it by three functionally very different video-productions, from which most of you have seen the two last ones during the second EAEA-conference at Vienna. So, above all, you can find out the important difference between looking at pictures in a film or - as we wanted to make performable - in a book.

We hope confidently, that you will have - or will have had - a lecture of plentiful cognition that might or can be furthermore even exciting. So perhaps our Fazit - you may read it as our last comment (Chapter 7) - will lead in the beginning of a generally new development and/or comprehension of urban planning and urban design: including town-pictures instead of plans, to which from now onward all people are entitled to get them. So it is our main concern to provide an essential contribution to the creation, nationally and internationally, of a common basis in the field of environmental simulation.
DESIGNING AND DIRECTING VIDEOGRAPHIC PRODUCTION TECHNIQUES

Jaap Drupsteen,
Graphic designer/director
The Netherlands

You are gathered here to enjoy the expertise issuing from an impressive row of specialists in Architectural Endoscopy.

On seeing my name between theirs I feel not a little displaced, because in your field I am totally ignorant.

The reason I was hired, was primarily to irritate you. To distract you from your most important field of interest. Your poor heads, heavy with new impressions, have to be harassed by information for which you will have no direct use. Prof. Jan van der Does deems this healthy for you, and I am loath to disappoint him.

We have little in common, you and I, except perhaps our working in fields that are being infiltrated by New Media. In mine, this infiltration started about thirty years ago. In yours - it seems - it is only just beginning.

I started as a graphic designer in what was then black and white television. By the end of the sixties, color TV was introduced. The design department happened to be next door to the color studio's, where technicians experimented with the electronic special effects so suddenly available to them. Whenever my workload permitted me to do so (and probably more often), I assisted them by creating masks, color fields and other graphic material. Thus, in a playful way, I became intimately acquainted with the possibilities of this medium. In those days, however, it was obviously seen as an extra tool for regular TV-production. Television was used to record goings on by pointing a camera at them, and the new special effects were used only as an amusing means to change from one shot or scene to another. One could, for instance, jokingly have an anchorman fly through the air, or sit on a tree branch. Most television directors soon tired of these toys, because everybody seemed to be doing the same tricks all the time.

To me there was no doubt that here was a new and important development in my profession: graphic design. The principle of an electronic special effect is the cutting out of a specific color or shape. The electronic hole thus created can be filled out with another image. The hole itself can become blurry or hazy, or even change shape. This procedure can be endlessly repeated and added to. Making holes and filling them, cutting and pasting. Many layers of video suggest a new imaginary reality. The basic ingredients can be so-called normal images of people, rooms or things. They can also be artificially generated 3-d objects, buildings or landscapes; or simple graphic elements like stripes, geometrical shapes, graduated colors or drawings. If these basic elements are not especially created according to a carefully prepared design, something goes terribly wrong. Factors like lighting, form, color, movement, speed, size and the relations between all of these are essential if the image is to
have any meaning or strength. Whenever I saw images done with disregard to these rules, I was itching. A graphic designer is cutting and pasting, blending and superimposing images all the time, albeit with static images. As television designers we already used moving designs for leaders, trailers and title sequences. We used film animation, adding music and sound effects. So we were experienced and I felt we were the true inheritors of the new medium. But that was not to be. Video techniques were being used by television directors, not by designers. It took some time before I grabbed the first chance to prove that when a graphic designer worked with the new video techniques, the images and programs would be entirely different. I shall spare you the story of how this came about - as usual, through luck and coincidence. I will show you a couple of shorts from my very first programs and leaders. This is a real antique show. These examples are produced between 1969 and 1974. (see figure 1 to 3)

Working in a television studio means that one does not everything on one's own, like working at the drawing board, or under the animation camera. Every step is executed by a technician. People who know which button or switch is for what. They have to make your ideas work. You come in with a plan. You start working, give directions, and at the same time you think, you watch, you judge. You decide it has to be done in a different way, you try to explain how, you blurt out a badly constructed metaphor, in short - you communicate. Designing aloud, I call it. Was I always understood? It became clear that technicians do not always have a very well developed ability to visualize. As a designer I sometimes forgot. At those moments words fall hopelessly short. An inevitable first step was needed: storyboards wherein I designed the building of the images and animations, step by step, image by image. (see figure 4 on next page)
Ira IIMOlt SVEGLIA'l'O
Sonacch10.1 eha fata?
A che tedlo earetta?
$va911atevi dall'ot10,
entrata 1n bare.
B p191iata
buon
luogo
.. ntr' •• earea
Bcc:oal a VOl Nndato
eh a 60n l'Humor Sve91iato
Sol per dirv! eh'udrate
belle botte
Soleando la palludl qua. ta notte

U MOR SVEGLIATO
Sonacchiosi che fate?
A che tediio cercate?
Svegliala da l'otio,
entrate in barca
E pigliate buon luogo
mentr' è scarca
Eccomi a vol mandato
Che son l'Humor Svegliato
Sol per drivi ch'udrete
belle botte
Solcando le palludì questa notte

Wat is er slaapkopjes?
Waarom vervelen jullie je?
Word eindelijk wakker
en stap in
Zoek jezelf een goede plaats
zolang de boot nog leeg is
Ik ben naar jullie gestuurd
Ik ben de wakkere Humor
Om jullie te vertellen
dat jullie van alles beleven zult
als we vannacht door de kanalen
en moerassen varen.
So sketches do help. Sketches make clear. Sketches save zillions of operation time. When you show all the stages, one by one, nobody will wonder if you know what you want. And my examples show you that being a good draftsman is not specifically required. Another example. When I was directing one of the first 3d animations on video - this was in 1984 I think, when it was not yet possible to create them on my own computer - I told the technician what I wanted. The animation was to be a visualization of the alternation of waking and sleeping in humans over the 24 hours of a day, a cycle of which I had only sketched the end stages. I had no idea how to program these 3d figures, so I had to trust the technician with much of the interpretation. The end stages I sketched were layers of shapes, getting narrower at the back, locking into each other and bending further and further until the last one locked into the first one's back end. The technician looked at the sketches for a long time. “It can't be done”, he said finally, “The system cannot rotate the perspective per shape in such a way that it locks in the background. And then you want the whole structure to lock exactly in the foreground. Impossible, forget it. You can only do this in a straight row.” I asked if he could construct a circle of a specific size and then divide it into segments. He could do that. Could he give it depth? Yes he could. Could he cut away certain segments? Of course. Within 10 minutes he had constructed a rough outline. I asked him to tilt the construction by 90 degrees. To his amazement, he saw the impossible segments appear on his screen. I shall show you some of the result. (see figure 5)

This may seem like a simple and straightforward example, but it is very effective in showing that insight into form and the interconnection of forms is not always to be taken for granted. It is something that needs to be developed by a lot of training. That is my first point.

In these twenty minutes I cannot show you anything much of my total body of work. I could show you examples, and give explanations of video graphics, titles, leaders, documentaries, corporate videos, interactive productions, interfaces, drama, dance, mime, opera, pop music and contemporary music programs. No style or category was spared my application of videographic production techniques.

(You don't believe this, of course. I wouldn't believe it either if I were you.)

What I really want to show is how a tiny little expansion of a profession can have large results. This Architectural Endoscopy is something you apply with an obvious goal. You want to be able to communicate your ideas better and clearer. Suddenly you find yourself dealing not only with the quality of a building, but also with the quality of your
presentation. You will have to make enticing images, choose strong frames, create cosmetic lighting, calculate effective camera movements, choose blends, wipes or other inventions to go from one image to another in an appetizing way. If you want to do that really well, which means if you don't want to ridicule yourself in the eyes of professionals that have been working with moving images for a long time, you will have to become a skillful director. If you happen to like that, and if you happen to become really good at it, it could lead you into lots of different worlds and work - and don't say I did not warn you. Why not show the functioning of a building more clearly? People, animals, traffic, office activities, a hairdresser in his salon, a couple of junkies in front of the main entrance. You could show your clients how beautiful graffiti looks on the walls. Behind Architectural Endoscopy virtual reality lurks. You will notice how I try to convince you of the virtues of my own madness. You might see it as an invitation to be adventurous, but it might be more prudent to regard my speech as a serious admonition not to go too far.

I would like to show you how far I wandered from my original profession by showing a couple of minutes from my last television project. Only the recordings were done in a studio. All special effects, all post-production have now become within reach of a designer. In a PC-based environment I can control the whole procedure without technical assistance. Have a look at it. The translation of the title is: Picturing Music. Contemporary music explained by images. (see figure 6 and 7).
A HISTORY AND APPLICATION OF VISUAL SIMULATION IN WHICH PERCEPTUAL BEHAVIOURAL MOVEMENT IS MEASURED

Naoji Matsumoto
Nagoya Institute of Technology
Shigeyuki Seta
Tobishima Corporation

ABSTRACT For our research on perception and judgment, we have developed a new visual simulation system based on the previous system. Here, we report on the development history of our system and on the current research employing it.

In 1975, the first visual simulation system was introduced, which comprised a fiberscope and small-scale models. By manipulating the fiberscope’s handles, the subject was able to view the models at eye level.

When the pen-size CCD TV camera came out, we immediately embraced it, incorporating it into a computer controlled visual simulation system in 1988. It comprises four elements: operation input, drive control, model shooting and presentation. This system was easy to operate, and the subject gained an omnidirectional, eye-level image as though walking through the model.

In 1995, we began developing a new visual system. We wanted to relate the scale model image directly to perceptual behavior, to make natural background images, and to record human feelings in a non-verbal method. Restructuring the above four elements to meet our requirements and adding two more (background shooting and emotion spectrum analysis), we finally completed the new simulation system in 1996. We are employing this system in streetscape research. Using the emotion spectrum system, we are able to record brain waves. Quantifying the visual effects through these waves, we are analyzing the relation between visual effects and physical elements. Thus, we are presented with a new aspect to study: the relationship between brain waves and changes in the physical environment. We will be studying the relation of brain waves in our sequential analysis of the streetscape.

INTRODUCTION Perception of space has been studied in a classical manner by empirically analyzing actual plans to determine optimum proportions of public squares and streets. However, how people are concerned with a space or how they feel about the space differs from person to person, and the appearance of a space depends on the position and direction of the viewer. It is therefore dangerous to conclude simply by empirical methods. Such a conclusion can be highly subjective. Can there be any approach whereby the perception of architectural space can be analyzed on the basis of the sensitivities of humans, or a more scientific methodology leading to an objective conclusion that convinces everyone?

Since around 1970, the methodology of environmental psychology has been actively adopted as an objective method in the architectural field. This study is also descended therefrom, being a part of a study aiming for the objectification of the relationship between human sensitivities and space forms.

Studies on perception and judgement of architectural space generally deal with actual
spaces. However, these are not sufficient as materials for analysis. Even if there exist architectural spaces which have appropriate forms for analysis, experiments in such spaces can often be difficult. They also have other difficulties. For instance, the conditions presented to the subject people tend to be difficult to standardize, and actual spaces tend to include complicating conditions other than their forms. Accordingly, it becomes necessary to present a simulated space instead of a real space. In our series of studies, scale model spaces were adopted as a simulation technique. The use of a model makes possible space configuration that does not exist in reality, as well as standardization of experiment conditions and simplification of space elements. This paper reports on the three-stage process of developing a simulator that makes scale models look more realistic.

OUR HISTORY OF SIMULATION

Introduction of fiberscope The year 1975 was the starting point of our study on simulators. Up until then we had studied on the proportions and unity of a space by observing scale models from bird's view. In real life, however, people see an architectural space mainly from the ground. Even a scale model should be observed by subject people from the eye level of the scale model. We therefore planned to devise a simulator using a fiberscope.

Figure 1 shows a manual simulator completed in 1976 through several improvements. The fiberscope head fixed at a location allowed the observation of the model space by being rotated around horizontal and vertical axes. The head was rotated up and down with a handle attached to the eye piece, and right to left by being manually rotated simultaneously with the eye piece. These rotating operations allowed a sufficient field of view ahead of the view point. The subject observed the image 1 cm by 1 cm in size with a naked eye directly from a close range.
Introduction of a CCD TV camera  In 1987, we introduced a CCD TV camera of a pen-size, with which we developed a computer-controlled simulator in 1988. The aim of this device was to enable the viewer to move freely in the model space looking in every direction. The device was completed after two improvements in 1989 and 1990 (see Figure 2). The CCD TV camera was effective in observing a model space, as it produced a clear color image with lighting of normal indoor lightness. Looking-up images were also obtained easily by turning the camera upward from the viewpoint-level, as the length of the shooting head was only 5 cm. The viewer was able to look up and down, turn from right to left, and move forward and backward by touching the keyboard of a personal computer. The viewpoint was maintained at a certain distance from the ground by means of a sensor. Therefore the viewpoint-level was maintained even when going up or down a slope or a stairway. This apparatus enabled the operator to move the viewpoint freely in a model and look in whatever direction he/she wanted. This apparatus substantially increased the degree of freedom of space study and enabled researchers to investigate the problem of space forms and space perception of streets as well as to investigate space perception by sequential observation of a space.

Simulator directly related to perceptual response  In 1995, we commenced developing a simulator for space observation in which the perceptual response of the viewer is directly related to the perceived image. This equipment was completed in 1996 by adding new features to the existing simulator fitted with a CCD TV camera and by modifying the existing features. The newly added features include the following:

1. The movement of the head of the viewer is sensed and simulated by the simulator head in real time.
2. A feature to create composite images is added to show a natural scenery or a landscape of a real city as the distant view of the model space.
3. The viewers can watch sequential images on a head-mounted display (HMD).
4. The effects of changing images on the viewer can be analyzed by an emotion spectrum analyzer.

These features made it possible to relate the human perceptual response to images while presenting before the viewer's eyes images corresponding to his/her movement in the virtual space. In addition, the incorporation of the image of an actual space in the model space realized highly realistic simulation. Emotion spectrum analysis is also considered to broaden the horizons of conventional space study. Figure 3 shows the overall constitution of the simulator.

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Figure 3 The Constitution of the Visual Simulator
The simulator comprises the following 6 elements:

- **Operation input** This element detects the motion of the viewer and transfers the data to a personal computer. The viewer sits on the chair and observes the model space as if he or she walks in a real space. A 3-D position calibrator detects the direction of the eye by the rotational motion of the head of the viewer, the traveling direction by the rotational angle of the chair, and the walking speed by the front/back travel of the right-hand lever.

- **Drive control** This element converts the detected motion data to the pulse signals driving the stepping motors. The model shooting component receives all motion signals, while the background shooting component receives only the rotational motion of the head.

- **Model shooting** This element shoots the architectural model space against a blue background with a CCD TV camera. The drive comprises a linear motor that controls the travel and rotation according to the detected front-back and up-down motions while maintaining the CCD TV camera automatically at the eye level using a sensor.

- **Background shooting** This element shoots the background for the scale model space. A CCD TV camera is rotated in a motion linked with the model shooting element, incorporating the surrounding background.

- **Presentation** The images from the model shooting and background shooting components are taken as the foreground and background images for the composite images, respectively. The resulting composite images are shown on the HMD.

- **Emotion spectrum analysis** This component extracts and analyzes the contents of perception observed as the HMD image in terms of brain waves. The differences in the brain waves between the positions and in the amplitude between the bands are measured and compared, to analyze human sensitivity. (figure 4)

**APPLICATION OF THE SIMULATOR** Can the human sense of space actually be grasped and measured accurately by a simulator directly related to perceptive response? Here the relationship between the changes in the space form and the changes in the human brain waves is analyzed to examine the effectiveness of brain wave measurement, one of the newly added features of the simulator.

**Emotion spectrum analysis** Brain waves contain unnecessary information, such as noise and are difficult to grasp quantitatively. In this study, the attention was focused on the correlation coefficient of the measured potentials of pairs of electrodes attached to the scalp of the viewer during the analysis time.

The correlation coefficient, which is determined by Eq. 1 (figure 5), shows the similarity of the potential changes at given two points on the scalp.
during the analysis time, which are affected by the activity of the brain and position of the person. The system outputs $10C2 \times 3 = 135$ pieces of data per unit analysis time for three frequency bands, i.e., $\alpha$, $\beta$, and $\theta$.

**Experiment method** The architectural model used in the experiment consisted of a space surrounded by buildings and a public square simply connected with each other. The subject views the images of the model through the simulator directly related to perceptive response as if he/she was walking along the street in the model (see Figure 6).

A narrow, enclosed space was followed by an open space, or vice versa, to present a dynamic change of the image to the subject as the viewpoint moved along. In Experiment 1, a video film was presented, in which the camera proceeded forward at a constant speed. In Experiment 2, the camera proceeded forward at a constant speed while scanning around at a constant speed. In Experiment 3, the subject manipulated the simulator to view the model while proceeding forward at a constant speed. In Experiment 4, the subject watched the video film recorded during Experiment 3. The images were presented on an HMD in all cases.

In each experiment, a sequence from the enclosed point, $P_1$, to the open point, $P_2$, (N-W movement) and the opposite sequence from $P_2$ to $P_1$ were repeated three times (6 sequences in total). The traveling speed was 4 km/h in all cases. Two people were subjected to the tests. To investigate the brain wave data for the space enclosed by buildings, transitional space, and open space, the cross-correlation coefficients were determined for the first, middle, and last 30 sec during the travel of 90 sec, each reflecting the three zones. The positions of the electrodes are shown in Figure 7 on page 58.
Results Comparisons between the correlation coefficients for each electrode pair and each of the three frequency bands revealed that there are electrode pairs that show characteristic tendencies in regard to the sequence and the method of presenting the images. Figure 7 shows the changes in β waves between electrodes on the forehead. In the experiments showing video films, the changes in the correlation coefficients showed similar tendencies between the two subjects; they decreased when traveling from the narrow to open spaces (N·W movement), and remained relatively constant when traveling from the open to narrow spaces (W·N movement). These tendencies were particularly evident in Experiments 1 and 2, in which the images presented were the same in all three times. In Experiment 4, the results slightly varied each time, presumably because the images differed each time due to being the recorded films of Experiment 3. Experiment 3 consisting of the free observation led to tendencies different from other experiments showing video films. The tendencies in N·W and W·N movements were similar to each other. The changes in the correlation coefficients varied depending on the position of the electrode pairs and frequency band. There were electrode pairs that did not show any specific tendency.
The positions of the electrodes were divided into three parts: the fore part, middle part, and rear part. Figure 8 shows Patterns 5 and 13 in each part, which showed evident changes among the 13 increase/decrease patterns of the correlation coefficient. In the N-W movement of Experiments 1, 2, and 4, the correlation coefficients between electrodes in the fore part tended to show "all decrease" when the scene changed (Pattern 5) in regard to \( \alpha \) and \( \beta \) wave bands of both Subjects A and B. However, this tendency was weak or conversely "all increase" (Pattern 13) in the W-N movements. Between electrodes in the rear part, Pattern 13 was evident in the \( \beta \) band of both Subjects A and B in the N-W movements. This pattern was evident in the \( \theta \) band as well for Subject A. Focusing attention on the difference between free observation in Experiment 3 and video film presentation in Experiments 1, 2 and 4, free observation tended to lead to smaller differences between the N-W and W-N movement than video presentation.

Summary In regard to the relation between space changes and brain waves, the following results were obtained.

1. As a result of video presentation, the correlation coefficient between electrode pairs when the space form changed constantly decreased in the N-W movement and remained unchanged in the W-N movement. Changes in the view sequence are therefore considered to affect the brain waves.

2. The significant differences between correlation coefficients resulting from the video film presentation and free observation suggest that active observation affects the brain waves.
CONCLUSIONS AND DISCUSSION  When developing a simulator, images of small spaces and indoor spaces can be obtained by reducing the size of the camera head, developing a mobile camera head, and incorporating computer graphic (CG) images. This equipment can well incorporate CG images by adding software and a large capacity computer and modifying the operation program. CGs have become so advanced that fine animated images can now be obtained in real time. It can therefore be adopted when the purchase cost has been reduced in the future. However, this does not necessarily eliminate the necessity of scale models. The advantages of models cannot be overlooked, as they are substantial and provide an instinctive grasp of spatial configuration. Scale models also enables a number of researchers to discuss the experiment plans together and reach an agreement. Models and CG should continue to be used in combination.

In order to make the images more realistic, efficient work is required, such as to incorporate real images and utilize photographs, in addition to create precise models efficiently. As for the realistic appearance of the distant view, our equipment has already solved the problem by being capable of incorporating a natural scenery in the images of the model. As for the angle of view, the narrowness and the gap between the angles of view of the TV camera and the HMD are the problems. This will require the use of a TV camera with a wide angle of view and adoption of a wide angle HMD accordingly.

We have concluded that space evaluation by brain wave analysis is basically possible, but we have just opened the door to this field. The technique should be worked out step by step in consideration of such factors as differences among individuals. A more comprehensive approach will be required, such as to investigate the effectiveness of physiological measurements including perspiration, respiration rate, heart rate, along with conventional verbal approach based on psychology.

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ENDOSCOPY AT THE UNIVERSITY OF STUTTGART

Antero Markelin

Department of Urban Design and Architecture, University of Stuttgart

Endoscopy has been an important part of the activities of the Department of Urban Design at the University of Stuttgart since 1970. It started with a concentrated effort on the Theories and Methods on Urban Design, including Meetings and Symposions with internationally known Colleagues like Kevin Lynch, Gordon Cullen, Derk de Jonge, Marc Emery, Michael Southworth, Arnold Whittick and many others, under the Direction of Michael Trieb, then a young assistant, working on his doctorate theme about Urban Design Theory in the years 1970-1973 (today ass. Professor of Urban Design on the Department, Städtebauliches Institut). Soon it was obvious to search after technical tools to simulate the reality, giving a chance to comparative studies about Urban Design Projects. This question was additionally actualized through the growing Interest of public participation in many kinds of Urban Projects. Here came the Endocopy as a useful tool. Through different informations and partly through the literature there was some knowledge about already existing activities, where the endoscopical simulation with architectural models was practiced.

So the next step was to visit these Institutions and to see what is already going on. First of them was the Agricultural University of Wageningen in Holland with Prof. H. van Leeuwen, one of the pioneers of the Endoscopy. Then the University of Lund in Sweden with Prof. Acking and Mr. Küller, further the Technical Universities of Delft and Eindhoven, both in Holland, the Bouwcentrum in Rotterdam and at last the Office of the famous Dutch architects van den Broek and Bakema, who used a very simple, hand-driven rig with an endoscope to visualize their projects. All these laboratories were in 1975 able to produce animated movies on video or film of urban situations in models.

These visits were accomplished in 1976 by visits to the University of California in Berkeley, which then had the largest machinery, called "Environmental Simulation Laboratory" under the advisory of Donald Appleyard. Of course the problem there was the lack of suitable projects for this technique, Later, as I heard, small projects were found in the field of Public Participation. The next stop was Los Angeles, where Bill Mitchell - today Dean at the MIT - had started his first experiments on simulations Computer Graphics in the UCLA. Very exciting was the the visit in the studio of Charles Eames, who produced his famous movies simply by first making slides with his Hasselblad and then filming them with a movie camera. These were the fundamental experiences, which were used on the work, which was to follow in Stuttgart.

The next step was to construct a simple rig, a machine to transport the camera, something as we had seen it in the office of Bakema, a hanging construction, moved by hand. Soon the first orders came in and this helped to accomplish the equipment, specially with Cold-Light-Lamps, which did not heat up and break the models. It was finally possible in 1980, through governmental financing, to construct a full movable electronic-mechanical driven Endoscopy Simulator of the size of 4,5 x 2,5 meters, which in 1997 still is in use and which provides perfect imagines, sharp and without any vibrations.
THE USE OF THE SIMULATOR From the beginning the first question concerning Endoscopy was the practicability of the technique. The simple presentation of architectural projects seemed to be the first and also the most lucrative way to use the technique. Next was the problem of the architectural education, mainly in the design of spaces, where the students could bring their own models and experiment with their own design schemes. As a third field was seen the psychological research, which maybe could use the technique in testing human behaviour in artificial (simulated ) environments.

The first results of the search for the good simulation technique were published in a book called 'Umweltsimulation' (Karl Krämer 1979). Next was in 1980 - 83 a research-project by the name “The Efficiency of Endoscopic Model Simulation”, worked out with the emphasis on psychological aspects of Endoscopy, like the validity (how real is this?), or the choice of Media (slide or movie?), or the manuscript (what is the story?) and so on.

As typical results of the research I would like to mention:

• The use of Endoscopy in the education prefers simple technique, easy to use by the students,
• The use of Endoscopy in the participation with citizens prefers a high grade of validity (reality), which means the need of a very qualified model, then a story, and, at the end something like a movie director.

After that the problems about Endoscopy seemed to be solved. As also the technique (endoscope, light, movement a.s.o.) seemed to have reached its limits, the question was to widen the field of search into new problems for the use of Endoscopy. One very real and actual was the one of the Street Lighting or the Lighting of the Urban Environment. This is a new and a fascinating field of Urban Design and it has found large interest in the Laboratory and also among the students. Some of the results will be presented here at this Conference.

At last I want to mention a co-operation with the National Institute of Technology of Taipei, where an endoscopic Laboratory has been constructed, following the experience made in Stuttgart.

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COMPUTERISED ENVIRONMENTAL SIMULATION AND PERCEPTUAL EVALUATION - 
ON THE PERCEPTION OF PICTURES OF BUILT ENVIRONMENTS PRESENTED ON COMPUTER SCREENS

Jan Janssens
Environmental Psychology Unit, School of Architecture
Lund Institute of Technology, Sweden.

ABSTRACT In this study, the perceptions of photographs of streets, displayed on a computer screen, were compared with the experiences of their real-life counterparts. Using a semantic descriptive method, SMB, experimental subjects assessed eight urban environments, presented both in field and on computer screen. Assessments were made in different light and seasonal conditions. It was shown that the perception of street pictures, presented on computer screen, did correspond well with the experience of the outdoor originals in most of the used semantic descriptive dimensions. Discrepancies between the two presentations were generally small and comparable with the minor perceptual differences between the various light conditions. Deviations could also be ascribed to certain non-perceptual factors, like the subjects' backgrounds or the environments' cognitive peculiarities. The findings also indicated possible improvement of the computer presentation technique by widening the pictures' informational content.

INTRODUCTION Since the late sixties building and town plans, drawings and scale models have been supplemented by various simulation tools for communicating and evaluating planned environments. These new visualisation methods have been used and tested on a large number of locations. Environmental simulations with different representation techniques are used and compared to each other in order to find the most fitted or suitable for the different needs. The results of these efforts are not seldom presentations that do resemble photograph-like pictures of a planned or altered built environment, displayed directly on a computer or TV screen. Only rarely the perceptions of these simulations are compared with their real full-scale counterparts in order to investigate the computer pictures' predictive value for the environmental experience. However, all comparative assessments will fail if no appropriate methods for systematic evaluations are at hand.
In Lund at our department, in the early seventies, several environmental evaluation techniques were elaborated, one of them based on Osgood's, Suci's and Tannenbaum's (1957) work on a semantic descriptive model using factor analysis. It was hoped to obtain dimensions which would be meaningful to evaluate an environment and easy to interpret, as well as measurable through a standardised approach. We started using seven-step unipolar semantic scales for a total of about 200 adjectives, assessing a wide range of man-made environments by numerous subjects of different age, sex and occupation. It could be shown that each of the adjectives related to one or more of the following eight dimensions: pleasantness, complexity, unity, enclosedness, potency, social status, affection, and originality. These eight perceptual qualities have then been used as a means of characterising architec-
ture and the built environment. The most reliable of the rating scales used have been compiled in a test where pleasantness is measured with eight different scales and the remaining dimensions with four scales each (Küller 1972, 1975, 1979). Thanks to numerous validation studies including comparisons of perceptual and neuropsychological responses, the knowledge about the eight dimensions has increased considerably and the scales have become part of a theory of environmental psychology (Küller 1980, 1991).

At the same time, an environmental simulating apparatus was constructed and used in a number of simulation projects. In this simulator, a camera, provided with a relatoscope, moved around in naturalistic models and was monitored from another room where filmers/subjects could see the dynamic relatoscope eye-level picture on a TV-screen. Simultaneous registrations could be made of experimental subjects' evaluations of the presentation, as well as their eye movements, as they proceeded in the models. The apparatus was used fruitfully in many professional and educational design applications. For a number of reasons this work was discontinued and the simulator is now for sale, but the equipment gave valuable experience about environmental simulation. One result of this work was that the more realistic the simulation was made, the more accurate became the evaluation of the predicted reality. Another finding showed the semantic method to be a good tool when comparing visually different alternatives for a projected environment (Janssens & Küller, 1986).

New developments initiate the use of computer-made simulations. The computer has become the main tool for planners and designers and its potential as environmental simulating device is almost unlimited. The latest progresses in image-rendering software programs facilitate the use of visually naturalistic "real-life" surface patterns, colours and light conditions. By combining digitised photos from reality with computer-made pictures, the observer may be more or less convinced to see photos of the real world. More and more of the planned environment will be conceived, communicated and evaluated by means of computer pictures. This may imply that decision making on environmental issues becomes more easy, even for ordinary laymen. House owners, for instance, can drop a photo of their house in almost any paint shop, and get a computerised simulation for a number of more or less suitable alternative colour schemes to choose from. But how well do the subjective perceptual impressions of these computer pictures, as realistic as they may seem, predict the perception of the real world presented? Although much work has been put in the perfection of computer simulations' technical and functional aspects, only very little research has been done in testing the computer pictures' informatory or perceptual validity and reliability.

THE STUDY The aim of the present study was thus to investigate the predictive power of computerised visualisations of built environments. Several questions were focused. Are there any systematic discrepancies in the perception of computer simulated environments and their real-life counterparts? Are different environmental qualities more or less problematic in these respects? Do more accidental environmental circumstances, like changes in weather or light conditions, have any importance for the overall impressions? Do differing observer groups display varying evaluative patterns?

In a recently completed research study, the importance of colour for the perception of urban spaces has been studied by means of computer-displayed stimuli. A large number of digitised naturalistic street pictures were colour manipulated and evaluated by groups of experi-
mental subjects. These evaluations of the computer pictures were then compared with assessments by other subjects of slide presentations with the same pictorial contents and of the real life situations. In a separate part of the study, here presented, a number of assessments were gathered to test the validity and reliability of the presentation and evaluation methods used. In this part, only computer pictures of unaltered street situations were compared with their real-life counterparts.

THE STIMULI As stimuli for this study, eight urban environments were selected. They were all located within Malmö city, a south Swedish town. Over one hundred street environments were examined and photographed, of which an expert group selected the final eight, fulfilling a number of prescribed criteria. They had to contain common usual street spaces with predominantly ordinary architecture and representing both large and small scale environments, varying in age, function, complexity and building materials (Figure 1 to 8).

In each environment, a particular looking spot was selected from which the experimental subjects had to view and evaluate the scene. From the same spots, colour slide photographs were made and digitised for computer presentation. These pictures were taken on two occasions, one during a sunny summer day and one during a dull winter day, and were presented unaltered on a computer screen. Although, in this study, they were not manipulated in their contents, they shall here be denoted as “computer pictures”.

METHODS, PROCEDURES AND SUBJECTS The original study consisted of three parts, using several experimental methods: a field study, a study with colour slides and a computer study. Only portions of the first and last part will be presented here.

Semantic rating scales (SMB, Küller, 1972) were used for comparing the results from the field and computer studies. They provided us with a semantic descriptive profile for the perception of each of the rated street environments by various subject groups at the different occasions.

This standardised test consists of a paper form with 36 seven-step scales, by means of which experimental subjects have to assess their overall perception of the presented street environment. In the analyses of the answers, the ratings are compiled within eight factors, each describing a certain quality in the physical surrounding (Table 1). The resulting perceptual profiles may be complemented with written comments, and will facilitate the understanding of the experience and perception of the studied environments. Extensive practical and theoretical work has made it possible to relate SMB-profiles to specific properties.
in the built environment. The method as such has also shown a high reliability and stability over time.

<table>
<thead>
<tr>
<th>Quality</th>
<th>Description</th>
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<tbody>
<tr>
<td>Pleasantness</td>
<td>The environmental quality of being pleasant, beautiful and secure.</td>
</tr>
<tr>
<td>Complexity</td>
<td>The degree of variation or, more specifically, intensity, contrast and abundance.</td>
</tr>
<tr>
<td>Unity</td>
<td>How well all the various parts of the environment fit together into a coherent and functional whole.</td>
</tr>
<tr>
<td>Enclosedness</td>
<td>A sense of spatial enclosure and demarcation.</td>
</tr>
<tr>
<td>Potency</td>
<td>An expression of power in the environment and its various parts.</td>
</tr>
<tr>
<td>Social status</td>
<td>An evaluation of the built environment in socio-economic terms, but also in terms of maintenance.</td>
</tr>
<tr>
<td>Affection</td>
<td>The quality of recognition giving rise to a sense of familiarity, often related to the age of the environment.</td>
</tr>
<tr>
<td>Originality</td>
<td>The unusual and surprising in the environment.</td>
</tr>
</tbody>
</table>

Table 1. The eight environmental qualities, as described by the SMB-method (Küller, 1993).

In the field, the eight street environments were assessed with semantic rating scales by two groups of subjects, architects and laymen. They were driven by car to the locations in small groups (2-3 persons) but made their observations and evaluations individually on standardised rating forms. The presentation order of the environments was randomised and light and weather conditions were noted. This part of the study took between two and three hours, car transportation included. Four of the environments were also evaluated in the same way during the winter season, but only by laymen.

On the computer, the street pictures were assessed by laymen for the two seasonal occasions. The eight stimuli were presented to the subjects individually in a darkened office room on a standard 17"-trinitron screen with good colour rendering. Both the stimuli and the rating scales were presented on the screen and the experimental presentation and evaluation were handled by the subjects themselves by means of an interactive computer program. Also here, the presentation order of the stimuli was randomised, but the standardised rating scales were presented on the screen directly under the pictures. The subjects had thus to make their evaluations by clicking the computer mouse on answer alternatives on the screen. All responses were registered automatically and no time limits were given. This part of the study took generally between 15 and 30 minutes.

The subjects in the field study, evaluating all eight environments, consisted of two groups: one being 6 architects from the local community planning office (4 men and 2 women) and 5 teachers in architecture (4 men and 1 woman), the second group consisting of 24 volunteering laymen (12 men and 12 women), all matched within the same age range (21-70 years). The winter evaluations of four of the eight street environments were made by 40 casually passing-by laymen (20 men
and 20 women), each evaluating only one of the environments. Subjects in the computer study were 48 laymen (24 men and 24 women, aged between 20 and 65), half of them evaluating the summer pictures, half of them assessing the winter pictures.

**RESULTS** Based on the semantic ratings, perceptual profiles were calculated for each environment assessed in the field study. By dividing the experimental subjects in subsamples, intergroup variations could be studied by means of variance analyses. The results show that all eight environments were perceived very differently from each other by both laymen and architects (p < .000 for all factors). Each environment showed a specific profile (Figure 9 to 12).

Architects found several environments to be more enclosed than what laymen did (p = .03) and also somewhat higher in potency (p = .01). More irregular discrepancies between these two subject groups could be noticed for perceived complexity (p = .005), unity (p = .01) and originality (p = .002) (Figure 9 to 12). Dividing and comparing the subjects in gender and age groups did not show any statistical differences in any of the descriptive factors between men's and women's perceptions, or between older or younger people.

Half of the subjects made their assessments in bright sunny conditions, the other half on cloudy occasions. A comparison between the evaluations in these two light conditions showed no statistical differences in any descriptive factor. Assessments made during winter for four of the eight streets by passing-by subjects were also compared with the summer evaluations. Neither here any statistical discrepancies between the two seasonal assessments could be established. Some minor variations between evaluations of summer and winter conditions could mostly been ascribed to various biases: the environments had changed...
somewhat over time, the experimental subject sample was more heterogeneous here and the assessing conditions were differently, making a proper statistical testing cumbrous. For these reasons, the later findings will not be commented further.

In the computer study with only laymen, similar perceptual profiles were calculated for the environmental assessments. Also here all environments showed clearly distinguishable specific patterns. Neither in this study, the gender and age of the subjects did affect the environmental assessments in any statistically significant way. Half of the subjects evaluated computer pictures of the eight environments photographed during summer, the other half assessed pictures of the same settings taken in winter season. Some minor differences between the two seasonally variegated stimuli groups could be noticed. Most of the summer environments were perceived as somewhat more pleasant, less enclosed, higher in social status and lower in affection, as compared with their winter representations. Generally these differences were rather small and not consequent for all environments. In some cases, they could almost entirely be ascribed to discrepancies within only one single environment.

In the comparison of the field and the computer assessments, for the later only the summer evaluations of the eight environments were used. Five of the eight descriptive dimensions showed strong positive correlations between the two presentation types ($r=0.84 - 0.94, p<0.01$). Only unity ($r=0.35$), complexity ($r=0.48$) and social status ($r=0.66$) showed weaker correspondences. For almost all environments, the pleasantness ratings showed high correlations between field and computer evaluations. In only one case (environment 6: the oldish down town street with new infill), the field evaluations were significantly higher than the computer assessments (Figure 13 and 14). The complexity of the environment was generally assessed lower on the screen than in the field, whereas the opposite was true for the perceived environmental unity. Especially in environment 2, the suburban car sales building, the picture's unity was rated significantly higher than in the field (Figure 15 and 16). The perception of environmental enclosedness tended also to be somewhat greater when judging the computer pictures than when assessing the field situations. The same was true for the perception of potency and social status, although environment 6 showed a higher social status evaluation in the field than its pictorial representation. The perception of the environments' affection and originality was also somewhat higher in the field than on the computer screen, except again for environment 6, where the computer picture was assessed as higher in affection than its real-life counterpart.

Except for the assessments of complexity and enclosedness for some environments, none of the above discrepancies between the two methods were statistically significant. It seems that the largest discrepancies in these respects can be related to the pictorial content of the computer stimuli. The wider the visual angle for the picture is made, i.e. the more environmental information is given, the better the perceptual correspondence between reality and picture becomes. Accordingly, the correspondence for the environmental assessments between the computer and field presentations was highest for environments 1, 5, 7, 8, and lowest for environments 6, 2, 3 and 4. Although serious efforts were made to use the same visual angle when taking the photographs, looking distances were not always the same, thus affecting the amount of surrounding visual information.
CONCLUSIONS  The study clearly demonstrated the power of computer pictures in predicting the perception of their real life counterparts. As mentioned earlier, in the original study also a slide presentation of the same environments was used. It could be shown that computer pictures mediated a generally better impression of the real environments than their slide counterparts. Consequently, presentations on a computer or TV screen may give a more persuasive or correct perception than slide shows. It was also found that more occasional effects like weather or seasonal conditions showed a somewhat stronger influence on the environmental perception than the used presentation technique. However, none of these differences showed a significantly consequent pattern. Most of the variations in the assessments should probably be ascribed to other than perceptual factors. So were most of the persons, assessing the environments in the field more familiar with these environments than the computer subjects. Their presumably higher environmental engagement has almost certainly "coloured" their perception.

It is surprising how well a purely visual cue, like a computer still picture, may mediate so many other perceptual factors, like street and traffic life, movements, sounds, smells and so on. It is also surprising how large agreement could be found between various subject groups concerning environmental perception. No disagreements were found between gender and age groups for the used descriptive parameters. Even architects and laymen agreed on most of the perceptual dimensions, not least about the main evaluative aspect, the environments' pleasantness ratings. But they evidently displayed different concepts of environmental complexity and unity. It was also demonstrated that the computerised assessment technique did not seem to affect the outcome of the environmental evaluations. More testing is needed.
however to validate this conclusion. Links were found between the amount of pictorial content and the picture's predictive value for environmental perception. More visual information seems to have given better predictions. Broader overviews of surroundings would probably improve the perceptual assessments of the presented street environments. This can evidently be achieved in various ways. General overviews could be combined with selected detail pictures, sequential presentations of parts of the whole environments could be used, or even more or less dynamic approaches could be developed, handled spontaneously by the subjects or in a pre-set manner. There may be even more intricate ways, "less could be more". However, all these extensions must be tested and compared in order to assess their degree of improvement, validity and reliability. There is an apparent danger in supplying too much information; the human capacities are, unfortunately, limited here too. Finding these critical perceptual thresholds is an important research task.

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ABSTRACT  The subject-matter of this contribution is the presentation of the non-conven­
tional didactical methods applied in architectural education and research at the Faculty of
Architecture of the Slovak Technical University in Bratislava. It is an application of a labora­
torial method of architectural endoscopy, based on a model urban space simulation princi­
ple and on the acquirement of an electro-optical visual display, showing image information
from a recording periscope unit interaction in real time and the real model space, with the
option of spontaneous semantic evaluation of the output on a video-monitor and of a syn­
chronic timing process recording on a magnetoscope. Application of a consequential power­
ful PC-configuration with creative software enables further digital sequential processing
both on the graphical output and for multimedial presentation.

INTRODUCTION  Urban spatial structure showed to be the most sophisticated form and the
most complex manifestation of vital activity of a man. An inhabitant develops an individual
relationship to all component parts that represent the notion of dwelling to him. By sensual
communication, focused mainly on iconic manifestation of individual urban structural compo­
nents, the inhabitant stores in his/her mind a mental conception of its image 1,2. Significant
components of this conception are also spatial quality and complexity which are subcon­
sciously confronted and evaluated in subjective identification. Alongside the quantitative and
qualitative aspects and the expression aspects there activates an image of acceptable scale,
of spatial proportions, of space division, its differentiation, continuity, polarisation or of gra­
dation. The basic category of qualitative analysis and appreciation of urban structures and
urban environment is urbanity, by which we characterise and perceive the components' signs, differentiate their properties necessary to comply with the criteria (image) of urbanity.
Rational or numerical quantification of the urban environment level is ever so difficult. It is
however possible to enregister it in the psychic background of visual perception in particular
images that evaluate mainly the positive (cultural) attributes of an urban environment in
complexity and with correspondence to the life style and taste of the society. Urbanity is
thus perceived as a qualitative aspect of an urban structure or an urban environment reflect­
ing, in a subjective consciousness, a concept of possibilities of choice and satisfaction of
individual or social demands 3.
Our department has proved that model (artificial) representation of spatial conception is a
base for effective and notably creative method of design 4. The improvement of electronic
media graphical representation systems brought possibilities of didactical applications and
development of architectural endoscopy in urbanism by making it possible to medially
processs the simulation outputs immediately in real time and real environment 5. The above
mentioned principles, aspects and experience are the basis of the model simulation and
endoscopy application in research and in the teaching process at our Faculty, namely in the laboratorial verification programme taken by our students in Urban composition classes in the 4th term of their studies. The goal of the programme is visual application and verification of compositional urban spatial structural design principles, and also to contribute to the quality and complexity of urban environment reception training, to develop a feeling for space and a more complex dimension of urban environment creation, transformation and evaluation.

**METHODOLOGICAL APPROACH AND CONTENT OF LABORATORIAL VERIFICATION**

Verification of urban environment completion ideas, as a didactical programme topic, is done by a specialised laboratory equipment which enables an interactive spatial experience simulation both without and with movement in a chosen horizont on models with an image output on a TV screen or a PC display. The main parts of the simulation lab-unit are as follows shown in figure 1:

The students become familiar with the principles and with the practical spatial endoscopy method of application. Individually, or in groups, they carry out the situation survey, verification and appreciation of alternative ideas for compositional completion or urban structure completion on models trying to find and evaluate the spatial and image impact in the sense of conception crystallisation. The verification itself is realised spontaneously by visual judgement of the image information change on the output, in compliance with the urbanistic creative concept process criteria and principles\(^5\) (see figures 2 and 3).

What is of a special importance to the observer from the psychological point of view in real spatial perception is the *cinaesthetical experience* (the perception of motion and position in the space). This is what is reflected the most emotionally in the psychic experience processing in his/her consciousness\(^7\). The simulator mechanics is therefore adapted for interactive way of gaining visual information and spatial perceptions, but it has to respect the principles of sensorial (sensual) perception in a real environment\(^8\) in the same way as a camera directing in the cinematography. By the monocular receptor transposition within the frame of random side and directional sequences in interactive form (see figure 4) the students control the simulation process of perception experience on a model in a walking horizon, and according to a prepared scenario.

**SCENARIO**

The idea sketch of the scenario contains a brief comment of idea intention with exploitation and application of theoretical urbanistic composition knowledge acquired in the lecture cycle and practised in seminars. Apart from dimensional parameters of a chosen or
designed area, as well as the image of both spatial and space-creating components of its urban structure (squares, street routes, urban blocks, block corners, buildings in free locations, individual buildings, structural elements of the buildings, entries and passages in urban parterre level, urban furnishing, trees, highlighting and others), the verification objects are also themes representing spatial manifestations of applied kinds of design and compositional categories (dimensional, positional, hierarchical or sectional). The route of the movement, the positions of characteristic viewpoints and view directions on the route are explained in the end.

In the graphical part of the scenario the route of the chosen sequential motion and view directions are marked into the situation plan of the verified area in M 1:400 or M 1:500 scales in connection with the idea concept and the verification goal (see figure 5).

The route and its direction are designed from the spatial experience dynamics point of view, while the viewpoints and view directions are designed synchronously with the ideas of compositional completion or regarding the characteristic settings and wider spatial compositional relations.

**MODEL ELABORATION**  
By artificial model construction in urban and architectural design the model simulation is traditionally realised, when relevant spatial demonstration of planned reality are displayed in scale reduction, represented by urbanistic and architectural design. By working with the model in the studio the students are spontaneously becoming aware of internal spatial structural aspects, and thanks to imagination they carry out a simplified form of spatial perception anticipation and of subjective interaction in the designed environment. The endoscope optics on the simulation lab-unit enables the real perception transposition into the model, its temporal anticipation as a simulating interaction of a participant in simulated conditions. The statement value (validity) of simulation endoscopic method on the screen output is determined by the quality of the models. The information content increases...
according to the applied scale. Suitable are models elaborated in 1:200, 1:400, 1:500, 1:1000, or in 1:2000 scales.

To support the simulation participants' sensual identification in the model interpretation we recommend graphical elaboration and application of all building facades that are in sequences component parts of the viewing sceneries. The easiest way to obtain a good result is to acquire a shadowless facade image, or to draw one's own design and then contact-scale it down to a required scale, or to process the representation by computer graphics. In case of remarkably dynamic facades and details it is good to make more copies right away, from which it is later possible to model characteristic structural elements like the gantrees, marquises, corner towers, stairs, balconies, cornices, stocks, cover arcades, roof wells and such. Advisable is also presentation of paving design and decorative areas (fine raster, structure, colour), as well as an elegant colour model interpretation. The spatial imagination will be enhanced by designing representative urban furnishing components (waterworks, works of art, information columns, lighting), stylized vegetation (in summer or in winter), in low-scale models also figures, cars, etc. (see figures 6 and 7). Some elements can retard imagination while the simulating receptor is in motion, such as e.g. figures that are in reality usually in motion. This fact, however, is not an obstacle because it gives a true picture of the reality anticipation process as the main goal of urban simulation.

AESTHETICAL AND COMPOSITIONAL APPRECIATION Validity of the described procedure results meets the requirements for simulation results evaluation application by means of a method based on aesthetical and compositional analysis of visual changes in continual urban interior experience as elaborated by K. Wejchert. He assembled in fact a perception differential manual, with values classified in decimal scale according to subjective classification. The value scale gives the possibility of graphic comparison of spatial scenery emotive visual experiences during the motion on the route of the urban interior section which is being evaluated. The aesthetical and compositional hierarchy of spatial experience is differentiated to the following urban characteristics:

- spatial monotony, non-interconnection, weak architectural expression,
- marks of spatial interconnection and expression richness,
- spatial richness, interconnection, urban and architectural value of elements, absence of dominants,
- variety and urban space interconnection, presence of dominants,
- high urban and architectural value, dominancy of characteristic elements and units in the spatial structure, in the image and the skyline of the city.
By calibration of destined values at y axis of the graph, where in x axis direction the experience values vary on the route in particular points or in temporal observation distances, the resultant is the so-called *perception trace (curve of experiences)*. The students process this trace individually for their programmes. They generally adjust the manual of the trace elaboration to the character of the programme also according to their subjective approaches (see figure 8).

![Figure 8 Graphic representation of subjective spatial experience values - perception trace](image)

To objectivize the evaluation results of each locality (route) it is possible to elaborate various graphs - perception curves in groups.

According to the experience in group evaluation the particular graph curves have similar tendencies. On routes directed in opposite directions a certain difference of values is understandable.

**CONCLUSIONS**  Application of endoscopy in architectural research and education became an important tool for gradual assertion of exact aim dimension in the sphere of revitalization, valorization, humanization and urban environment completion. The computer graphics development significantly contributed to the possibility of e.g. immediate editing of graphical sequence output, the possibility to correct the image parameters by means of digital photographic software (see figures 9 and 10), to create composite images, retouch, to create one’s own library of urban spatial elements (figures, vegetation, paving, sky, background), to transfer images intermedially, to create dynamic sequences and to make use of many other achievements of the modern world of electronic medial communications. It is possible to state that the interoperative effect of *the original endoscopic optical information* and its further digital interpretation is at the moment suitable for architectural verification and arbitrary medial creative programme presentation.

However, there is another sphere in which we would like to see some more development.

It is generally known that spatial (stere) perception of all living beings
is accomplished via a double channel (stereo). Spatial orientation and the feeling of existence in a space are synchronically determined, besides the acoustic (stereophonic) perceptions, mainly by binocular visual perceptions which are evaluated in mind on the principle of two synchronic monocular images perception, and on continually accommodated eye parallax as a real environment spatial experience, as an exact position and importance perception of its elements in it. In urban interior this effect considerably enhances the directional motion, when a dynamic spatial continuum in time (the so-called dynamic perspective) is experienced\(^2\)\(^3\). Therefore it is effective to direct ocular systems of endoscopy to the double-channel principle of scanning (stereo-endoscopy). We had the possibility to ensure ourselves of these facts during the presentation of the firm Storz at the 2nd EAEA Conference in Vienna. For the conventional technology of laboratorial endoscopy of today it would be advisable to use a binocular endoscope with the 90° angle of the entrance optics. Further double-channel elaboration of real video and stereoscopy signal is basically resolved (picture transfer and conservation), though the costs are doubled, compared to the standard.

The present aim of the architectural endoscopy horizon is a good sign for us, and I believe not an inaccessible one.

NOTES

1. Norberg-Schulz, Ch.: Genius loci, Odeon, Prague, 1994
ABSTRACT Never before have architects and principals been so interested in the application of different design presentation techniques. More and more imaging techniques are coming on the market to assist in tasks such as the production of 3D sketches, the construction of endoscopic models and the preparation of video and computer visualisations. More insight is now needed into the effect the use of media techniques, such as moving endoscopic video or computer images, has on the design process. The assistance of nine architects and an equal number of clients has made it possible to carry out comparative research to help to provide such insight.

The research had first to make clear how information is transferred between those directly involved in the communication process. To do this, a record was created of the way people actually worked. Nine two-man teams, each consisting of a client and an architect, were asked to carry out the same previously specified design task, to record a commentary on each phase of the design's development and to provide individual replies to two sets of questionnaires. Each process was considered complete when the architect presented his or her final sketch design to the client.

In summary, this research project is concerned with the design process followed when the same architectural task was approached in nine different ways. On nine occasions and in nine different ways the design requirements of the client were tested against the architect's solution as expressed in an interim and a final presentation prepared using predetermined media-techniques.

INTRODUCTION In the proceedings of the first EAEA conference, 1993, I mentioned our first study focused on refining endoscopic video images of a detailed architectural model and drawings. The study was based on work with 900 subjects, of which 200 were professional architects. It has led to a number of technical improvements.

In the second study we compared computer-aided design techniques with two techniques from the first study, endoscopic video recordings and coloured and black and white elevations and perspective drawings.
Four different groups of 50 subjects took part in this research. We found that computer images were invariably judged to be of moderate value, while drawings yielded consistently high scores (figure 1).

Endoscopic video recordings of the scale model received high scores as far as emotional response is concerned, and moderate scores when the participants were questioned on the actual content of the recordings (figure 2).

In professional architectural practice, designs for housing and other buildings are often drawn up under pressure and presented in the form of digital recordings or as simple scale models of an initial sketch design; detailing is then carried out as an addition to the specifications. The continuing development of design and presentation techniques, though, raises the pace at which the design process proceeds; designs for housing and other buildings can be conveyed more rapidly to the client. We have noticed a demand in the market for artist's impressions to enable users to gain an adequate impression of the buildings from the sketch designs.

Specialists in architectural simulation or rendering can easily create attractive images and make any architectural design changes the client may wish, whatever the medium. It is the architect's responsibility to ensure that the wishes and requirements of the end-users are adequately taken into account in the final design (figure 3). If the architect does not do this himself, he or she must delegate, under close supervision, the execution of any alterations to a specialist in the use of the presentation medium.

This interaction between the creative design process and the application of modern media techniques, may be the first indication of more far-reaching changes in the design process. One thing is certain, architects are having to meet the demand for more concrete impressions of the design at an early stage in the design process, at the point when the sketch design is nearing its final form.

DESIGN COMMUNICATION AND IMAGE PROCESSING

This brings us to the goals of our present research. We concentrated on the design process and the final presentation of the design. We wanted to provide more insight into the effects of using certain media techniques (sketches, endoscopic video recordings and computer animations) on the design process. It was therefore sensible to adopt presentation techniques currently used in education and professional practice. We identified two goals:

- The first goal was to obtain more insight into the effects and utility of employing endoscopic video recordings and computer images during the design period and in the presentation of the final sketch design.
• The second goal was to test and adapt these instruments in order to facilitate better visual representations of spatial concepts.

We formed the following hypotheses:
• The image the client wants to project becomes altered during the exchange of information between the client and the architect, who then has a different image in mind.
• These alterations vary according to the type of visual information concerned.

THE DESIGN PROCESSES
Support from the professional community was necessary to observe the use of the media during the design processes we wanted to start.

Over the past year we have used interview rounds to closely follow the process of designing nine different solutions to one brief: to draw up a design for 60 homes on one particular site. Nine clients briefed nine architects on the design requirements, independently of each other, (figure 4) making use of photographs, the features of the site, and the protocol. In addition, they discussed progress and the final result of the design process during an interim and a final presentation, and whether the use of either endoscopic video or computer images had generated added value.

ELEMENTS OF THE WORKING METHOD
• Establishing architect-client pairs
• The media
• The design process in three phases
• Two interview rounds per case
• Additional facilities
• Available material
• Summary and thematic comparisons per case in table form.
Establishing architect-client pairs  After visiting different clients and architects we found eighteen participants to establish architect-client pairs. Nine architect-client pairs were formed in total.

The media  Materials common to all pairs: maps and cross-sections at scale 1:200 and a sketch of the site at scale 1:500, of perspective all on A3-size sheets (figure 5). Chosen medium: either an endoscopic video of a model at scale 1:200 taken at eye level, or computer animations or stills at eye level and on video; each visual presentation had to last from one to two minutes. Attention had to be paid to details, three-dimensional representation, information content, mood, colour, and a variety of vantage points. Five endoscopic videos and four computer animations or series of stills were planned.

The design process in three phases

1st phase: client briefs the architect on the commission  A protocol was drawn up, including a code of conduct, a site for which a design for 60 houses had to be made, a schedule of requirements, and the same set of regulations for each architect-client pair. The clients had to adopt the protocol within their own working practices. The clients delivered the commission to the architects assigned to them and discussed it with him or her. The clients recorded this meeting on tape, which they passed on to the research team directly afterwards (figure 6).

2nd phase: the architect informs the client of progress during an interim presentation  The architects presented their preliminary designs to the clients, who assessed them against the schedule of requirements. Both participants then agreed the time of the final presentation. The discussing during that meeting has been recorded (figure 7).

3rd phase: the final presentation by the architect  During the second presentation the clients saw the final sketch design. At this stage it was expected
that the architect would make use of an endoscopic video or computer animation, possibly in combination with other presentation media. The presentations and subsequent discussions during this third phase of the commission were also recorded on audio tape. (figure 8)

Two interview rounds per case  The participants were interviewed by the research team on two occasions: directly after the client briefed the architect on the commission (1st phase) and after the final sketch design was presented by the architect to the client (3rd phase). The replies were also recorded on audio tape.

Additional facilities  A neutral grey block model of the adjoining buildings at scale 1:200 was available to any participant making use of an endoscopic video presentation. A DXF file of the adjoining are with elevation points at scale 1:1500 was available for those using computer/video images.

Available material  The nine architect-client pairs produced drawings and endoscopic video or computer images of nine different designs for the same situation. The audio tapes can be used to obtain an impression of the following from each pair:
1. communication of the commission to the architect (briefing);
2. the replies to the first series of questions,
3. communication between the client and the architect during the interim presentation.
4. communication between the client and the architect during the presentation
5. the replies to the second series of questions.

Summary and thematic comparisons per case in table form  From the transcripts of the tapes a short summary and thematic comparison has been drawn up for each case in table form. A number of keywords were listed under the themes COMMISSION, MEDIUM, and MEDIA, such as: expectations and experience of computer-based visualisations, endoscope, or other media; opinion on the use of the medium in the interim presentation; opinion on the presentation of the plan; observations concerning the media used; added value to the client; added value to the architect; positive and negative impacts on detailing; three-dimensional representation; impressions; information content; colour and viewpoints. The use of these keywords also allowed clusters of relevant comments by clients and architects to be assembled. These are of considerable value when comparing the design processes and drawing conclusions.

PRIMARILY RESULTS  In this paper a summarised thematic comparison is given as an example of our working method. It shows the opinions of one client listed under seven keywords from one of the nine tables drawn up for the architect-client pairs. These comments concern the
application in his own case of the medium "computer animations, or stills on video".

**THE CLIENT, MEDIUM: COMPUTERANIMATION OR STILLS ON VIDEO**

**Expectation concerning the presentation of the design**
- open spaces and building masses as seen by an observer walking through the design.

**Use of the medium during the interim presentation**
- medium not yet employed
- was being prepared according to detailed agreements

**Opinion on the role of the medium on the process design**
- by the final presentation it was clear that it was a good plan

**Opinion on the role of the medium during the final presentation of the design**
- spatial characteristics of the design were conveyed primarily by the computeranimation
- complete plan came across best on the drawings

**Evaluation of the medium**
- surprising, in that sense informative and an aid to visualisation
- more abstract than expected

**Positive and negative aspects of using the medium**

<table>
<thead>
<tr>
<th>DETAILING</th>
<th>3D REPRESENT.</th>
<th>INFORM.</th>
<th>MOOD</th>
<th>VIEWPOINT</th>
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**Remarks concerning the medium**
- direction and editing unfortunately excluded alternative viewpoints

The following summarised comparison shows the opinion of one architect listed under the same keywords as mentioned before. These recorded comments on 5 different moments during the design process concern the application of the medium endoscopic video recordings.

**THE ARCHITECT, MEDIUM: ENDOSCOPIC VIDEO RECORDINGS**

**Expectation concerning the presentation of the design**
- has not yet formulated the expectation
- in any case, the medium good for non professionals use of the medium during the interim presentation

**Use of the medium during the interim presentation**
- no use of the medium.
- We made a choice between 1:500 models to know what to do in the final presentation

**Opinion on the role of the medium on the design process**
- It can be of great help in decision making.
- We could make our choice between two models on eye level.
Opinion on the role of the medium during the final presentation of the design
- first edited videorecording; model and drawings afterwards.
- You need them all in that order

Evaluation of the medium
- experience on eye level and movement are essential.
- Endoscope must fulfill these

Positive and negative aspects of using the medium

<table>
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<th>DETAILING</th>
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<th>INFORM.</th>
<th>MOOD</th>
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<th>COLOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>±</td>
<td>no option</td>
<td>+</td>
<td>±</td>
<td>± movement</td>
<td>+</td>
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Remarks concerning the medium
- depth in sharpness must be better, also the movement and lightning is not perfect

These were just two examples, drawing on a clients' opinions of a design process in which CAD was used, and opinions of an architect from summaries of cases where an endoscope was used. Similar short summaries for each case will, together with the thematic comparisons and the visual presentations, allow us to take our research an important stage forward. The complete set of results can be used to test the hypotheses, and provide more insight into the effect and utility of endoscope and computer techniques during the design development period and in communication and presentation of the design. The publication of the complete research project promises to be interesting and instructive for both the educational and professional communities. We therefore intend to pursue our second goal, the assessment and adaptation of these instruments in order to improve the representation of spatial concepts. Important decisions in that direction are already made.

28-8-97

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A STUDY OF WAYFINDING STRATEGIES USING A VISUAL SIMULATOR

Masashi Soeda
Ryuzo Ohno
Ohno Laboratory
Department of Built Environment
Tokyo Institute of Technology, Japan

ABSTRACT In the previous study, the influence of the visual characteristics of the street-scape on wayfinding performance was investigated by an experiment using a user-controlled space-sequence simulator. Since it revealed that the performance was quite different among the subjects, the present study intends to clarify the influence of wayfinding strategies which are expected differ with individuals. Three scale models (1/150) of an identical maze pattern each with different visual information were used in the simulator which was designed to allow a subject to move through a model space and visually experience a travel sequence. Three conditions of visual information were:

1) no characteristics, with monotonous surfaces and uniform width of streets,
2) variations in spatial arrangements, with changes of street width and corner shapes,
3) symbolic information, provided by letters and photos from newspapers on the walls.

Each of three male and three female subjects was first asked to memorize the route by viewing a predetermined continuous sequence of model street as shown on the screen, and were then asked to take the instructed route. This procedure was repeated until the subject could reach the end of the route. After the subjects reached the goal, they were asked to draw a cognitive map of the route. This series of experiment was conducted four times: 5, 12, 36 days after the first experiment. On and after the second experiment, the subjects were asked to explain the route verbally at the beginning of the experiment. An analysis of the results shows that some people shift their wayfinding strategies reasonably according to visual information on the route, and other people tend to rely on mainly one type of information to memorize the route at any situation. It also showed that people can take the right route by obtaining elemental information on the spot even if they have no clear memory in advance.

INTRODUCTION The previous study (Ohno, Sonoda and Soeda, 1995) investigated the influence of visual characteristics along streets on wayfinding performance, and found that a route with significant visual characteristics was easier to memorize, although there was a large difference in the performance among the subjects. In this study, it was hypothesized that wayfinding performance depends on wayfinding strategies that are different in person and spatial characteristics.

Many studies have been made concerning the individual difference in wayfinding performance. Galea (1993) and Lawton (1996) investigated gender difference in wayfinding, and Anooshian (1996) explored diversity within spatial cognition. Kozlowski (1977) and Bryant (1982) examined the relationship between self-reports of spatial cognition and actual
wayfinding behavior. These studies have tried to classify people according to their knowledge for understanding spatial configuration, but have not discussed how individual wayfinding strategies shift as the visual information available along the route varied.

**EXPERIMENT** An experiment using a space-sequence simulator was conducted to examine individual wayfinding performance and strategies. The User-controlled Space Sequence Simulator was designed to allow a subject to move through a model space and to experience a travel sequence visually. With a set of "joy-sticks", the subject controls an endoscope connected to a CCD color TV camera supported by a gantry while viewing the model scene as projected on a 40-inch TV screen. The maximum size of the scale model is 2.36m x 2m in horizontal and movable area of the CCD camera head is 1.6m x 1.6m. Maximum speed of movement is 30mm/sec, and the angular velocity of rotation is 72 deg/sec. The control system of the simulator records an exact position and a viewing direction of the endoscope within the model space every 0.01 second. This record provides data for analysis of the subject's behavior.

Visual information which were considered to be available in wayfinding were classified according to their characteristics as shown in Table 1. Based on the classified information, three scale models (1:150) which had different street plans and different street-scape were made (see Fig.4 and Fig.5). Table 2 shows the spatial characteristics and available information of each model. Each route of the three models are different in plans and total number of intersections, but are same in the number of 12 intersections which the subjects have to make a turn. Each subject was first asked to memorize the route by viewing a predetermined continuous sequence of model streets as shown on the screen. While the movement of the endoscope was controlled along the programmed route at walking speed, the subject can stop the endo-
### Classification of Information

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
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<tbody>
<tr>
<td>Numerical memory</td>
<td>Information for numerical memory of intersections e.g. &quot;third corner&quot;</td>
</tr>
<tr>
<td>Plan configuration</td>
<td>Information based on plan configuration e.g. T-shaped intersections and oblique ways</td>
</tr>
<tr>
<td>Spatial variation</td>
<td>Information based on the changes of spatial volume e.g. changes of street width</td>
</tr>
<tr>
<td>Numerical memory</td>
<td>Elemental information provided by signs and characteristic objects</td>
</tr>
</tbody>
</table>

### Table 1: Classification of Available Information for Wayfinding

<table>
<thead>
<tr>
<th>Type</th>
<th>Name of the Model</th>
<th>Spatial Characteristics</th>
<th>Available Information for Wayfinding</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Streets with no characteristics</td>
<td>same</td>
<td>numerical memory 0</td>
</tr>
<tr>
<td>II</td>
<td>Streets with spatial variation</td>
<td>vary</td>
<td>numerical memory 0</td>
</tr>
<tr>
<td>III</td>
<td>Streets with symbolic information</td>
<td>same</td>
<td>numerical memory 0</td>
</tr>
</tbody>
</table>

### Table 2: Characteristics of the Three Models

- **I Streets with no characteristics**
- **II Streets with spatial variation**
- **III Streets with symbolic information**

### Figure 4: Plans and Street-scape of the Three Models

**I Streets with no characteristics**

**II Streets with spatial variation**

**III Streets with symbolic information**

Results of Research
scope motion and control viewing direction. Thus the experience of the route was not in a absolutely passive mode, but the subject could voluntarily acquire information. After viewing the sequence of the street scenes, each subject was asked to take the instructed route by his/herself. This procedure was repeated until the subject could take the instructed route to the goal successfully. After the subjects reached the goal, they were asked to draw a sketch map of the route. Each subject was asked to do the same task in three models on different days. This series of experiments was conducted four times: 5, 12, 36 days after the first experiment. On and after the second experiment, the subjects were asked to explain the route verbally at the beginning of experiments and then to take the route by oneself without the route instruction. Six graduate students (three male and three female, non-architectural students) were employed.

RESULTS AND DISCUSSIONS Figure 5 shows two examples of sketch maps of “Streets with symbolic information” drawn by the subjects. The sketch map drawn by Subject C shows much information about the number of intersections but not so much about symbolic information at each intersection. On the other hand, in the sketch map drawn by Subject F, the symbolic elements have been drawn at almost all the intersections, but little information about the number of intersection was drawn. These differences in the sketch maps seem to reflect individual differences in the wayfinding strategies. Therefore, we examined the content and amount of information on the sketch maps to analyze individual wayfinding strategy.

Figure 5 Examples of sketch maps drawn by the subjects

We first counted the number of each type of information separately, and then calculated the ratio of drawn information to the number of available information at the intersections. The
reason for calculating the ratio is that all intersections have information of "Numerical memory" but do not necessarily have information like "Plan configuration" and "Spatial variation". Figure 6 shows the ratio of each information type drawn on sketch maps of each subject. Subject A and Subject B have frequently drawn every type of information in all types of street. This suggests that they have remembered the routes by various types of information. Subject E and Subject F have drawn "Numerical memory" frequently in "Streets with no characteristics", but rarely in "Streets with symbolic element". In this street model, they drew much "Symbolic information" instead of "Numerical memory". It is clear that they shifted their wayfinding strategies reasonably as the change of available information along the streets. On the contrary, Subject C and Subject D have drawn "Numerical memory" frequently in all types of street and have not drawn much information of other types. This shows that they always tend to rely on only one type of information, namely such numerical memory as "turn the third corner", even if available information along the route have been changed. As for the recognition of "Spatial variation", there were some subjects like Subject B and Subject F who drew it at almost all the intersections which have information of spatial variation. However, other subjects like Subject C rarely drew it. This suggests that there are large individual differences in utilizing such spatial information as changes of street width for

Figure 6 Ratio of information drawn on the sketch maps
memorizing a route. Thus it was clarified that wayfinding strategies differed in persons, however the relationship between wayfinding strategies and wayfinding performance was not clear as we expected.

Protocols about memorized elements along the route, which were mentioned by the subjects at the beginning of each experiment, were compared to actual wayfinding behavior recorded in the control system of the simulator. In the experiment using “Streets with symbolic element”, it was noted that all the subjects could take the right route by looking around at intersections, even though they couldn't tell any clue elements. This suggests that people can take the right route by obtaining information on the spot, even if they have no clear memory in advance.

CONCLUSIONS Although the relationship between individual strategy and wayfinding performance was not clearly obtained, this study resulted in the following conclusions.
1. Wayfinding strategy differs in persons and available information along the streets.
2. Some people can utilize various types of information and shift their wayfinding strategies reasonably according to visual information along the route.
3. Some people tend to rely mainly on one type of information to memorize a route at any situation.
4. People can take the right route by obtaining symbolic information on the spot, even if they have no clear memory in advance.

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ANALYSIS OF MENTAL MAPS FOR IDEAL APARTMENTS TO DEVELOP AND SIMULATE AN INNOVATIVE RESIDENTIAL INTERIOR SPACE

Yeun Sook Lee Ph.D.
Yonsei University/Housing and Interior Design, Seoul, Korea

Sun Mi Lee Ph.D.
Jeon Nam University/Home Economics Education, Seoul, Korea

ABSTRACT Even though results of applied research have been ideally expected to be read and used by practitioners, written suggestions have been less persuasive, especially in visual field such as environmental design, architecture, and interior design. Therefore, visualization of space has been frequently considered as an ideal alternative way of suggestions and an effective method to disseminate research results and help decision makers. In order to make the visualized target space very solid and mundane, the scientific research process to define the characteristics of the space should be precedent. This presentation consists of two parts: first research part; second a design and simulation part. The purpose of the research was to identify the ideal residential interior characteristics on the basis of people’s mental maps for ideal apartments. To achieve this goal, quantitative content analysis was used, using an existing data set of floor plans drawn by housewives. 2,215 floor plans were randomly selected among 3,012 floor plans collected through a nation-wide housing design competition for ideal residential apartments. 213 selected variables were used to analyze the floorplans. Major contents were the presentational characteristics of mental maps and the characteristics of design preference such as layout, composition, furnishing etc. As a result, current and future possible trends of ideal residences were identified. On the basis of the result, design guidelines were generated. An interior spatial model for small size unit using CAD was developed according to the guidelines. To present it in a more effective way, computer simulated images were made using 3DS. This paper is expected to generate the comparison of various methods for presenting research results such as written documents, drawings, simulated images, small scale models for endoscopy and full scale modeling.

INTRODUCTION Until recent year, it was common for construction companies to focus only on the quantity of housing in Korea. Also the uniformly mass-produced apartment interior environment has caused to frequent mobility as well as indiscreet renovation (Kim, 1993). Recently, however, rapid development of apartment complexes has had a significant impact on the consumers’ ability to choose preferred residential interior environments. Moreover, the increase in remodeling of uniformly mass-produced apartments has also had an overwhelming effect on consumer taste. As a result, housing construction companies in the competitive housing market have become eager to satisfy the interests of changing consumer demands. In addition, it has promoted many researchers and construction companies to consider a new methodological development that is more in touch with residents needs.
If we consider
a) the significance of the housing interior environment for the quality of life as an everyday living setting
b) the lack of mental environmental image research about micro level space, it becomes easy to see how the development of a mental map analysis method would be worthwhile.

PURPOSE OF THE RESEARCH  The purpose of this research was to scrutinize the characteristics of the present housing culture, to predict the future housing culture and to suggest useful concepts in housing development by using 'housewives' mental images' of ideal apartment. This is considered as a fundamental research to justify the validity and solidity of the designed and simulated interior.

METHODOLOGY  Content analysis was used as the method. The data were mental maps, that is, floorplans drawn by housewives. The mental map is a kind of paper and pencil test in the environmental psychology, which shows a person's experience and need by drawing. Compared to the questionnaire and interview, this relatively new technique can be used very effectively to identify user needs. Data were provided by a housing construction company that held nationwide competitions every year for housewives. Participants were recruited through advertisements using various mass-media outlets, such as daily newspapers and popular magazines. Of the total 3,012 floorplans, 2,215 floorplans were selected by Proportional Stratified Random Sampling Method. 213 selected variables were used to analyze the floorplans. They consisted of residents characteristics, presentational characteristics of mental maps, design preference characteristics, such as layout, composition, furnishing, aesthetic and traditional aspects. The analyzing instrument was developed through reliability test in three times.

RESULT OF THE RESEARCH  Taking into consideration the degree of popularity and cross historical trends, the results were divided into two parts: one to describe the present trends and the other to predict the future trends. The conclusions are as follows:

1. In terms of the characteristics of present housing cultures, the research revealed that respondents wanted more rooms that could accommodate various functions. They still preferred 'south faced' houses, but the proportion decreased. They also preferred bedrooms to be located at both sides of, or scattered around, the central public space. Some placed importance on the effectiveness of housing functions, while others urged for gardens in the interior space.

2. With regard to predicting future housing, the respondents wanted to eliminate the closeness and overcome the limited space by expanding the verandah for active and visual use. Also there was a tendency to emphasize the number of bathrooms; that is separate the facilities by function. The respondents were also enthusiastic about some of the more traditional aspects of older housing designs, such as type of main entrance door, garden, aquarium, floor materials and seating style arrangement. Some progressive and diverse design features appeared more in the facades than the interiors.

3. If we take into consideration of objectives of housing construction companies and user needs, it becomes clear that future building projects will require more advanced features,
such as additional rooms, more kitchen and bathroom space and various other ways to achieve a sense of spaciousness, effective functioning, and tradition.

**DESIGN DEVELOPMENT** The significance of this research lies in that it used mental map data and content analysis technique to access user needs and housing norms of current Korean society. Since the floorplans gave information about what consumers/users wanted for their interiors, the results were expected to be used to develop user-oriented unit designs of mass-produced apartments. To give more practical and specific information, data were further analyzed according to house size, since floorplan characteristics largely depend on house size. Four popular apartment size ranges were selected: small (app. 850 sq ft), lower middle (app. 1200 sq ft), upper middle (app. 1700 sq ft), and large size (app. 2500 sq ft). Data were sorted by house size to give a clearer picture of the residents and their preferences. On the basis of analysis, checklists for relevant size of house, design concepts and guidelines for new alternative were generated. As results, four prototype floorplans were developed. Among them, a small apartment plan is introduced here.

**SIMULATION** Since the design concepts used here were innovative compared with ones found in existing plans, it was necessary to simulate the interior environment to give clearer picture and to communicate with relevant decision makers more effectively and to help them make decision in easier way. As examples two perspectives are shown in figure 3. Since residential interior is a micro space which requires some imaging ability to project the space in 3-dimensional way to clearly understand its 2D plan, 3D simulation seems also very effective. Judging from the researcher's past experience in presenting research result to decision
RESULTS OF RESEARCH

makers in the field in various ways such as in written form, graphic form, 2D CAD form and scaled model in parallel with oral presentation, this one with additional simulated computer images was found very successful. It leaded the discussion very active and interesting, generating lots of questions and feedback, prompting energetic decision for implementing the suggested idea. It was very useful to show interior images such as spaciousness, color, texture and flexibility which can hardly be shown through conventional scaled model. The model, however, can be more effective if computer is used to produce the surface images for mapping and the endoscopy is used to view it more realistically. (see figure 3 and 4)

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HIGH-END-DEVELOPMENTS WITHIN THE FRAMEWORK OF DYNAMIC-ENDOSCOPIC VIEWING OF MODELS

Bob Martens
Vienna University of Technology, Department for Spatial Simulation, Austria

ABSTRACT As far back as the seventies the first experiences with endoscopic viewing of models were made in the field of architecture and urban construction by introducing an endoscope into the model of the planned architectural and urban space. The monitor shows an approximation of a real view of the new portion of a building or city, resp. The endoscopic picture provides the viewer with the usual height of viewing and roughly the perspective of a pedestrian, whereas very often planning models of houses and city quarters are evaluated predominantly by means of the bird's eye view. Meanwhile, mechanical installations of relatively limited means have been installed at several university sites making for a simulation of spatial experience by means of endoscopic rides through a construction model such as from the view of a car driver. This paper presents a sketch for a research proposal which is aimed at anticipating high-end-developments based on the experience acquired so far using low-cost-simulations.

SURVEY ON SIMULATION TECHNIQUES In 1993 a survey titled "Fields of Application of Simulation Techniques" was performed by the author, which also supplied unique data regarding architectural endoscopy. When stock-taking the first question arising is which equipment is available for the various tasks in the field of endoscopy resp., spatial simulation and which of the available is really being put to use. The inquiry regarding the combined use and the integration resp., of simulation techniques was particularly aimed at the specific requirements in the architectural field. The questionnaire thus attempted to determine the state of the art in the field of spatial simulation empirically while compiling unique data enabling cross-connections for evaluation purposes. The investigation only included users in the academic area, a majority of those questioned being members working in a branch of a scientific organization dealing with simulation.

The question as to which combinations between simulation techniques were missing listed animation (simulation of motion), multi- and hypermedia, real picture simulation (overlapping of computer-aided and endoscopic simulations with real pictures and film sequences resp.). All of the specified combinations would have to be considered accordingly in the case of future research work. As for endoscopy also pragmatic arguments in favor thereof such as availability, simpleness and expense-profit ratio were issued. This technique also bears the great advantage that e.g. "traditional" working models can be used immediately and that training of improved spatial imaginative power is promoted. The endoscopic image is obtained rapidly and supports an interactive mode of working (representing, checking, improving, etc.) providing a relatively high level of reality. Even in complex architectural modelling the production of a low-cost video film by means of endoscopy may prove useful.

The question "Which developments and improvements resp. seem desirable for the future regarding the various simulation techniques?" was related to the considerations as to medi-
um-term developments. The endoscopic spatial simulation as such seems increasingly to be being replaced by other simulation techniques. More and more users are convinced that scale models are only produced for the purpose of presentation. Great interest, however, has arisen for the developments of light-intense rigid endoscopes with simultaneous improvement of the image. This optical improvement will also enhance the combination of stereoscopy and endoscopy. The process of miniaturizing of the camera periphery is surely not over with. Further developments are to be expected towards a computer-controlled control of animation (including the number of degrees of freedom and coping of terrain jumps). The mixture of endoscopic exposure techniques with computer simulation and with real image fading over resp., will gain in importance.

DEFINITION OF SPECIFIC LINES OF RESEARCH On account of the findings of the survey on simulation techniques the following items of interest were selected and subjected to careful studies. Finally, four intended lines of research are determined as follows:

A.Connection to Peripheral Media (High-end Transmission) Individual viewing through the ocular does not require a periphery-device, as only one person can look at the circular picture. As soon as the spatial impressions are to be stored in a medium (e.g. connecting a video-camera to the ocular) more costs are involved. The inconsistency in use of endoscopy in architecture and urban construction is mainly due to the mediocre picture quality in transmission by the peripheral equipment. The picture quality is satisfactory when viewing an architectural model by means of endoscope. The mental impression received is not easily conveyed. Improvements in communication are attempted by connecting the endoscope with peripheral recording media.

Line of research “high-resolution and stereo-endoscopy” The field of endo-photography has been covered by careful research work (Markelin-Fahle, 1979). The development of CCD-camera technology since the eighties has only been partly registered. A further field of research deals with endoscopic optics. The development of light-intense rigid endoscopes resulting in improved image seems very interesting. These optical advancements will make for a connection of stereoscopy and endoscopy as an effective stereoscopic representation calls for extremely high resolution granting depth of field.

The problem of mediocre quality in picture transmission could be coped with 3-CCD-cameras. These make a recording technology being considerably less light sensitive and less susceptible to sudden light fluctuations. The connection of endoscope and CCD-camera is rather problematic and will require specified test series with precise measurements. Instead of the ocular a small opening is used being significantly smaller than conventional camera optics. Simultaneous vision with both eyes is the prerequisite for 3D-perception. Both monocular visual impressions are united to a joint perception. Fusion processes result in binocular single vision. Fusion impulses emerging from the object unconsciously lead to the adjustment of fixation lines of both eyes to the object. A technical 3D-video-system will thus have to transmit two images displaced to each other to the two eyes. Therefore, the pictures are to be taken separately and subjected to further processing. In line with this the stereo-endoscope comprises two optical systems transmitting two different video-images via a double-camera. In a “Viewing Box” the single-pictures are transferred to the monitor and are super-
positioned by means of an optical system. Thus both eyes receive an authentic spatial
impression. Several patents (e.g. US 5381784 - Stereoscopic Endoscope / US 4926257 -
Stereoscopic Electronic Endoscope Device) have been registered, ready-to-use installations,
however, still are in the prototype stage and mainly concern medical applications (e.g. Storz
on the occasion of the 2nd EAEA-Conference '95).

B. Control of Motion Sequences (High-end Animation) The control of motion sequences
principally involves two problematic issues. A dynamic shadow is cast if the endoscope is
mounted with its camera periphery while the model is moved on a “trick table”. This rather
unnatural shadow cast is due to the fact that the required lighting elements are mounted
and the endoscope with periphery and mounting casts a shadow. Therefore there is a prefe·
rence for mounting the model to be viewed and moving the endoscope with its camera
periphery. Then, however, the vibrationless drive of the endoscope becomes the issue.
A camera rig is a bogie wagon moved on horizontal static rails. The endoscope with its
mounted camera-periphery is suspended from this bogie wagon, electricity and video signal
communication being supplied by continuity contacts. A remote control turns the endoscope
by 360 round its center and moves it from left to right on the bogie wagon while the
bridge is driven laterally on the static rails. Thus every part of the model becomes accessible
and can be viewed from every side. The device also controls the endoscope drive at the
respective height (eye position) and speed. Adjustments of degrees of freedom make for a
drive “straight ahead” with an angle of view from the side. Tracers can be implemented to
react to possible jumps in terrain. A such equipped camera rig makes for exploring a model
in a certain mode (as a pedestrian, cyclist, car driver, etc.). Mechanical plants of own make
presently have been mainly in use (UCLA Berkeley, TU Delft, University Essen, University
Stuttgart, TKK Tampere, etc.).

Line of research “robotized camera rig” Robotized camera rigs have been so far neglected
regarding research work. An installation using industrial robot components being assembled
after adequate adaptations into a plant is characterized by a significantly higher degree of
manoeuvrability during model drives. Computer-assisted control makes for programming of
motion sequences.

This item will call for more involvement and personnel resources than the concentration on
high-resolution video-endoscopy. Experience in the fields of machine construction and infor­
mation technology will prove very useful in this respect. Based on the traditional concept of
a mechanical camera rig investigations aimed at determining how industrial robotized com­
ponents can be adapted for the purpose of animated endoscopy considering the design- and
planning work with construction models will be required. An installation with six degrees of
freedom nearly matches human perception. The precise control of driving speed should be
combined with the development of a computer-assisted animation control. This means that
one ride can be repeated as often as desired by means of program storage. The develop­
ment of such an interface is completely new. The future group of users, however, should not
only include experienced computer experts, but also untrained users, this accounting for the
fact that the use of endoscopy does not require years of intensive training. Faulty program­
ming leading to a (punctual) destruction of model and/or endoscope is to be avoided by all
means.
C. Computer-assisted Image Processing (Real Image Mixing)  Computer and endoscope serve as supplements for each other. The popular mixing of endoscopic recording processes with image processing techniques demonstrates this clearly. Scanned-in masters and photo-CD's act as secondary sources of images. When connecting the endoscope with peripheral media digitizing of the recorded endo-picture is to be accounted for. A computer plant with image processing software can be equipped with the appropriate digitizing hardware for this end. Such hardware can process e.g. PAL- or NTSC-video signals in the computer. Provided only single stills are to be stored relatively simple and inexpensive means will prove sufficient. As far as animated pictures are concerned the computer-assisted recording and editing of endoscopic sequences seem rather limited for the time being as an enormous data transfer (l/O-rate) is required despite compressing processes.

Line of research “bluebox- and mapping-processes”  Detailed models of physical nature normally are pretty costly. Moreover, “empty”, rough mass models can only be used throughout a short period of the planning project for preliminary decisions. Therefore, nowadays supplementations of e.g. urban artefacts are mainly implemented and the unit is to be integrated precisely into the real existing surroundings (Thomas, 1987). The bluebox-technique (chroma-key-process) positions objects having been shot with a specific blue color in front of a background subsequently in front of a different “scenery” (real image). This video-trick-mixing is everyday use on TV, in the field of model simulation, however, it is rather rare. Human figures in motion can be shown in simulated environments with this technique. A similar performance using computer animation would cause unduly high expenses. Visualized design details and contexts such as color, texture, material are to be regarded as significant simulation details. They can be taken from a digital library and be “pasted” on the surface in their appropriate scaling (e.g. Breen/Stellingwerff on the occasion of the 2nd EAEA-Conference '95).

Integration of model simulation in the real image calls for profound knowledge in photogrammetry, particularly when a high degree of accuracy is desired. Therefore it is necessary to collect any relevant experience and to investigate in which way a digital library with various categories of artefacts could be compiled. It has already been pointed out that physical models with a great variety of details will result in lots of work. By using mapping processes e.g. the facade structures of endoscopic mass models could be provided. What is not clear is how more exhaustive data quantities could be handled in large city models.

D. Validity- and Impact Research (Evaluation)  The point is to what extent the product of simulation as such may mutate to be the message. How is the message presented? Or: is the wrapping itself regarded as the message. We may be running the risk that the substance is not being conveyed at all and the wrapping, as it were, is not even opened. Therefore, the intrinsic effects of the simulation techniques implemented are to be dealt with. Environmental psychologists specializing in architectural psychology offer “user needs' assessments” and “post occupancy evaluations” enhancing communication between users and experts. To compare the efficiency of building walkthroughs, regular plans, simulation, and direct, long-time exposition, evaluation has to be evaluated. The provocative question may be put to what extent communication problems in architectural representation and - instruction may be traced back to the simulation technique put to use or to the unaware-
ness of the user. Very often techniques are only used for the purpose of illustration, i.e. after completion of design work and not as a checking device during the architectural design work. Tools have to be combined with one another and be at hand, quick alterations should be feasible without problems. Not the medium is to determine the decision.

**Line of research “accompanying impact research”**  Computer visualizations and virtual realities grow more important, but studies on the effects of simulation techniques upon experts and users are rare (Grund, 1979; Hardie, 1988). In 1995 a user comparison of endoscopic versus CAD-simulations of a Vienna city project was realized in the framework of a joint research between the Institute for Psychology at Salzburg University (Alexander Keul) and the Department for Spatial Simulation at Vienna University of Technology on the occasion of the EAEA-Aspern-Workshop. A digital Aspern-model was configured as a referential object. Based on these digital data a 1:500 city model was produced in block-design. The respective heights of storeys were additionally specified by means of the building-up structure. As it principally was not to be an evaluation of the Aspern-project far-reaching details within the model were not shown (trees, persons, vehicles, facade features, etc.). Finally, an endoscopic and computer-aided picture of the main street corridor and an accompanying overall view was made. The experiment showed that - counter-intuitive to expert opinions - framing and distraction were prominent both for experts and lay people. A position effect (assessment interaction of CAD and endoscopy) was present with experts and non-experts, too. With empirical evidence for “the medium is the message”, a more cautious attitude has to be adopted towards simulation products as powerful framing (i.e. perception- and opinion-shaping) devices.

Each of the aforementioned topics is to be accompanied by evaluation studies. The scope of the comparison study on Aspern (Keul-Martens, 1995) was limited: no multimedia, no photo-realism, no animation was used. Further research will be directed to these aspects on both sides. Where does the endoscopic model drive accomplished by a robotized plant range in comparison to a professional computer-assisted animation? How is the real image fade-in accepted? Which use for the planning process can be accounted for regarding implementation of stereo-endoscopy? The possibilities and limits of architectural endoscopy in a broader sense will be thoroughly determined and the disadvantages and advantages of joint use of endoscopy and additional simulation will be dealt with in more detail. Cultural and subcultural value systems of simulation technology are important for people and should be considered in evaluations. Economically, architectural simulation methods are an innovative product. To develop successful and socially useful marketing strategies, target group-specific user research is necessary. Simulations suited for architects could be bad ones for lay-people, and vice-versa. Evaluation research tips the scales in that respect.

**CONCLUSIONS**  Though 3D-computer simulations are presently in fashion the short training time for getting acquainted with endoscopy is still striking. The evidently great availability of low-end-endoscopy-facilities proves particularly useful. Concerning endoscopic viewing physical models with very differing degrees of detailing seem suited. Apart from insignificant adjustments of models the quick and uncomplicated implementation possibilities without “strings attached” are to be stressed. Thus endoscopy proves meaningful already at an early stage of design.
A robotized camera rig would furnish considerably more authentic motional sequences; therefore, a suited computer-controlled installation based on industrial components is to be developed within the course of this research project. Furthermore, an effective implementation of high-resolution video-endoscopy (CCD-recording technology) is to be achieved. Developments within the related Bluebox- and Mapping-Processes would lead to a first full-scope elaboration of the entire field of real picture simulation. Stereo-endoscopy in architectural planning is also to be regarded as unexplored territory. Three-dimensional aspects of spatial planning could be conveyed very impressively by means of stereoscopic representation. The accompanying impact research is to be implemented throughout all project stages as a control instrument.

This contribution being a rough sketch for a research proposal makes any reactions very welcome, as no claims of completeness have been asserted. Possibly some aspects have not been duly considered and other developments might have been achieved a long time ago. Specific research might have already been performed in this field, but disappeared in the “grey literature”. Last, but not least, the possible usefulness of scheduling the procedure into phases is to be considered, as well as the great advantages resulting from participation of several EAEA-sites.

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DEVELOPMENT AND VISUALIZATION OF INTERIOR SPACE MODELS FOR UNIVERSITY PROFESSOR’S OFFICE

Yeun Sook Lee Ph.D.,
Yonsei University, Seoul, Korea
Hwa Kyung Shin Ph.D.,
Sangmyung University, Seoul, Korea

ABSTRACT When visualization is required in academic areas, the sound mundane realism ideally defined through scientific research is a requirement to make the testing of the visualized model worthy. Spatial model development is an essential part in every space type. Without space standards, architecture cannot exist. Lack of space standards causes some confusion, delay of decisions, and trials and errors in building practice. This research deals with a university professor’s office space model. Currently in Korea, university building construction has been increased because of rapidly growing quantitative and qualitative needs for better education. There has been a wide range of size preference of the office space. Because of Korea’s limited land availability, deliberate consideration in suggesting the minimum space standards without sacrificing the function is needed. This is especially important since professors traditionally have been highly respected from society, thereby rather authoritative with strong territoriality and privacy need and relatively sensitive to space size. Thus, presenting the 3D visual models to convince professors that the models accommodate their needs is important as well as the search process for ideal space models. The aim was to develop a set of interior space models for university professor’s office. Therefore three research and one design simulation projects were implemented with the objectives:
1) to identify the most popular office space conditions, architectural characteristics,
2) to identify the most popular office space, use type,
3) to identify user needs for spatial improvement,
4) to develop and suggest interior design alternatives systematically and present them in three dimensional computer simulation. This simulated images will be a basis of scaled model construction for endoscopy research and of full scale modelling in the future.

INTRODUCTION As office environment is becoming a major living space, there is strong awareness of that it should satisfy physical and psychological needs for efficiency and quality of life (Sundstrom, 1987; Konar et al., 1982). This paper covers a comprehensive research project which consists of 3 consecutive smaller research and 1 design project, carried out from June, 1995 through December, 1996. The aim of this project was to develop a set of interior design models to encourage the professors to improve the offices and show them the ways to satisfy their needs. To make the model more realistic and more practical, the existing office conditions, current space use characteristics and needs for improvement were examined. Yonsei university, the leading private university in Korea, was selected because it has been under this social climate and considerable number of professors have shown evaluative minds toward their work environment which also has been expanding the campus with substantial new constructions.
OBJECTIVES AND RESULTS OF THE 3 RESEARCH PROJECTS

1. To identify the most popular office space conditions — architectural characteristics — the existing floorplans of several buildings were analyzed. The plans had been kept at the facility management department at Yonsei University. 725 professors offices (out of 1069) were measured because of missing documentation. The architectural check items were size, shape, location of doors, size of windows etc. The most common offices were selected on the basis of these features. For example, the most common condition had the following characteristics: the size was about 22m²; the 1:2 proportion rectangular shape whose window side wall was the shorter wall; the door located at the left side of corridor wall from inside view; the size of windows was about 4.7m².

2. To identify the most popular space use type, a physical trace method was used. Site visits and measurements, photographs, sketches and CAD drawings were used to trace 118 professors offices which were available during the scheduled data collection period. Everything in the office, from furniture to educational equipment, was recorded. The analysed features were the user characteristics, the size, characteristics of space (such as composition, layout, furniture etc.), the appliance and the instrument characteristics. To categorize the 'space use' characteristics, three variables were used: 1 territorial characteristics; 2 the spatial relationship between the professor's work area and entrance; 3 the layout of the work area. Offices were categorized by combining these three variables. The most popular space use types were identified. For example, the most popular one had the following characteristics: the office was composed of three territories — professor's work area, assistant area and sofa area; the professors' work area was located in the far distance from the entrance; the work area was composed of two work surfaces. The types were reflected in developing new interior design models.

3. To identify user needs for spatial improvement, a questionnaire survey was administered in the month of November, 1995. 859 questionnaires were distributed (there were 210 absences because of sabbatical leaves and international conference commitments). 294 (34%) responded within the set time limit. Among them, 279 were used for data analysis. The contents of the questionnaire instrument consisted of the professors' background characteristics, space use condition, space evaluation, attitude and recognition of the importance of office environment and desired improvement features. Data were analyzed using the SAS package. The fact that wide range of activities occurred in professors' offices and people spent considerable hours there showed their office environment was a major behavior setting and also a living space for them. Therefore a systematic design as an environmental affordance system needs to be developed. Professors' increasing volume of books and documents and the intensive needs for storage and filing system indicate that a systematic space for storage and filing should be provided primarily and flexibly. The need for improvement was expressed very strongly, but time, cost, and lack of knowledge prevented professors from actively pursuing for improvement. Therefore, design alternatives which allow improvement that are feasible, economic, popular and time saving should be provided. They also should contribute to creating professional images.

OBJECTIVE AND RESULTS OF DESIGN PROJECT

To develop and suggest interior design model systematically, physical condition type and space use types were crosstabulated. All previous
research results were gathered and reorganized to define the character of new interior design models. Several major areas and parts were selected for efficient operational control to differentiate the design alternatives. Modular unit characteristics were generated. Among the possible models, 16, by combining two common conditions and eight popular space use types, were designed and suggested. Among them, as examples two design alternatives are shown in Figure 1 and Figure 2.

Figure 1 A1U1 type

A1U1 type: A1(22-28m²-12-left-(4.7m²) - U1(P's work area+assistant work area+sofa area-far-2-sided)

A2U3 type: A2(22-28m²)-11.5-left-(6.2m²) - U3(P's work area+sofa area-far-2 sided)

A(Urban condition): Office size-Proportion of depth by width-Location of door-Window size

U(Space usage): Territorial composition-Distance between professor's work area and entrance-LAYOUT of professor's area

Additionally, two universal design — one a small office and the other a medium size office (very flexible interior design models) — were developed. Even though the work range of interior design includes space planning, furnishing, material, color, lighting and accessory coordination, space planning and furnishing were mainly considered in this stage. Since environmental experience emphasizes moving and viewing from various standing points when responding to interior space, five different perspective views were rendered per each model type and presented on one page to give more thorough reviewing opportunity. An example which reflects the most common architectural condition, the most popular space usage, and the most important improvement needs is shown in Figure 3.

SUMMARY AND DISCUSSION The projects introduced here presumed that for more valid and reliable simulation research, a scientific process to establish and define the characteristics of simulated settings is essential along with the simulation technique. In the field of environmental design, since the physical environment which is composed of the tangible items and
conditions that comprise the world around us, is the target for simulation, it should reflect realistic conditions and needs for improvement. In this regard, this article emphasized the mundane realism. Besides this, the authors of this article believed that simulation of interior space would enhance buildings imageability, regardless of its inherent imageability, and thereby would help users' decision making, and also show the potentiality of using simulation for interior research. Since this research provided solid foundations telling what to create and simulate, further simulation researches using various techniques can be developed. Besides computer simulation introduced here, full scale experiment is planned for the future research. Modular plastic bricks were developed along with a moving system which allows the manipulation of office size during the experiments. To furnish the office lab., the research results were thoroughly used. Additionally scaled modelling will be planned for endoscopy research. Once all three different simulation researches are planned and carried out well, the comparison of those techniques will be compared.

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TEACHING, PLANNING AND
ADAPTING VISUAL MEDIA
FOR ARCHITECTURAL DESIGN
MODELLING FOR EYE LEVEL COMPOSITION
DESIGN MEDIA EXPERIMENTS IN AN EDUCATIONAL SETTING

Jack Breen and
Terenja van Dijk
TU Delft, the Netherlands

ABSTRACT In order to simulate the visual effects of designs at eye level, it is necessary to construct models from which (sequences of) images can be taken. This holds true for both Optical Endoscopy and Computer Aided Visualisation techniques.

In what ways can an eye level approach stimulate spatial awareness and create insights into the workings of a design concept? Can Endoscopic methods be used effectively as a creative environment for design decision-making and teamwork and even to stimulate the generation of new design ideas? How should modelmaking be considered if it is to be of use in an ‘impatient’ design process, and how can students be made aware of the opportunities of both direct eye level observations from design models and of the more sophisticated endoscopic imaging techniques?

This paper explores the theme of eye level modelling by focusing on a number of formal exercises and educational experiments carried out by the Delft Media group in recent years. An attempt is made to describe and evaluate these experiences, in order to draw conclusions and to signal possible new opportunities for eye level composition for the benefit of both design education and practice...

THE DYNAMIC PERSPECTIVE IN DESIGN EDUCATION The most common form of notation for architectural or urban design proposals is two-dimensional: as a set of drawings showing different ‘flattened’ projections (plans, sections and elevations). This is however obviously not how a design is perceived or conceived.

A built design is not considered from one specific viewpoint, but as a spatial and material complex of forms, proportions, textures and colours. Built environments are ‘taken in’ while in motion, as sequences of visual (and other sensory) impressions: experienced from an eye-level point of view in dynamic perspective.

Similarly, the designer (hopefully) does not consider a plan in progress solely in terms of the reduced, two dimensional images which form the output of the design process, but rather as a spatial composition which will offer a certain variety and richness of spatial experiences to future users, visitors and passers-by.

Whilst working on a concept, a designer may choose a range of different hypothetical viewpoints, from which to ‘approach’ the design. Such virtual design views do not necessarily have to correspond with images of the plan as seen in ‘real’ life (typical ‘other’ views are for instance: functional or structural schemes, axonometric projections or exploded views).

Besides such specific techniques of design enquiry and presentation, imagined observations from a simulated eye level often play an important role in design development. According to certain architects, such design ‘imaging’ takes place exclusively in the imagination: in the designer’s mind. However many architectural and urban designers make use of a range of different visualisation techniques which can serve as media (and as such mediate)
in searching for - and choosing - different appropriate design solutions, which together shape the overall design result. An important ambition of design education should be to familiarise students with the different techniques by which design concepts may be captured and communicated. This involves teaching students to use a range of different design visualisation techniques, including technical drawing, freehand drawing, model making and computer aided drafting and modelling. In professional design processes, such techniques are often used side by side or in different combinations. During their studies, future designers therefore need to come in contact with all kinds of different techniques so that they may develop the personalised 'handwriting' which suits each of them most and can be used in practice.

ASPECTS OF THE MEDIA CURRICULUM  The educational curriculum of the Media sector at the Faculty of Architecture of Delft University of Technology is involved actively in teaching design visualisation skills. From the beginning of the first year students are involved with integrated courses in freehand drawing (by the staff of the Hand Drawing section) and model making (in the faculty's central model making workshop). Exercises continue during the study trajectory both in basic educational Blocks of the first two years and in more specific Modules later on in the study. In Media's Form Studies curriculum the emphasis lies on the study of different aspects of elementary formal composition and methods of creating spatial insight. Three dimensional modelling - both using elementary sketch modelling techniques and more sophisticated model making applications - play an important role in the Form Studies programme.

In addition to the two aforementioned courses there is a Design and Presentation Media programme, focusing primarily on latter year students, where multi-media techniques such as Video, Endoscopy and CAAD are utilised. For the student who is particularly interested in design visualisation and presentation, these different educational lines come together in the Media sector's Differentiation Module D11 - 'Media'. In this paper some recent activities in the direction of design visualisation and simulation by the Media staff are presented.

FORM STUDIES - EDUCATIONAL EXERCISES  The first part of the Form Studies programme forms a course which runs through the whole first year of the basic study (the first six eight week Blocks which have as their titles: Space; Building Process; The City; Construction; Service Systems and Region). In each Block the students pay one visit to the Form Studies department. The students participate in an exercise, developed by the Form Studies staff, which reflects on the scale and typical compositional aspects, concerning the subject of the specific Block. In most
cases the students are confronted with the relevant terms and concepts (illustrated by examples from the built environment) in a lecture in the first week of the Block, which is meant as an eye-opener both for the following ‘practical’ exercise and for the Block as a whole. Typical themes in the exercises are: form and space; dynamic perspective; context; wholeness and contrast; size, proportion, dimension and scale; detail, material expression and colour. The sessions only last one half day per Block, but are experienced as intensive by the students (and also by the teaching staff). A typical session will begin with the reading of an illustrated text prepared by a member of the staff (as a kind of ‘starter’), followed by an explanation of the task and the (previously prepared) set of materials. The students work directly in working models, a method comparable to sketching in three dimensions, working individually while being supervised and stimulated by the teacher. The work is compared during the session and is documented and analysed afterwards - in two dimensions - in an individual folder which is marked together with the three dimensional exercise results and which is kept during the whole first year.

In all of these exercises, impressions of the composition from an (imaginary) eye level play an important role. Students are encouraged to view their work in progress from different sides and angles, in order to get an impression of what the spatial design would look like in reality, to check what is not yet in order and needs to be altered, needs to be removed or ‘fine tuned’.

Apart from looking at the model, the students are stimulated to imagine what one would experience in those places in the model where the eye cannot actually penetrate (a kind of ‘mental Endoscopy’).

Some examples of first year exercises:

Block 1: a composition using a maximum of nine pieces of white cardboard, which can acquire the qualities of a ‘reduced’ pavilion, comparable to Rietveld’s Sonsbeek pavilion or Mies van der Rohe’s Barcelona pavilion (in Block 2 there is a follow-up where a selected student’s work is used as a starting point for an exercise where variations in proportion and dimension are coupled to the expressive qualities of a ‘palette’ of different material tones and textures);

Block 3: an urban ‘infill’ exercise (comparable in scope to a simplified version of the Imaging Imagination task of the 3rd EAEA conference workshop), using a removable inset piece per student, working in a simple Styrofoam and cardboard model, which allows the students to ‘look in’ via the different entrances but needing to imagine the dynamic perspective sequences one would encounter when moving around the newly designed (sub)urban space;

Block 5: alteration of an imaginary loft of 1000 m² by introducing three types of relatively abstract service elements which together add up to 100 m² (which means that 9/10 of the space will remain ‘open’), working in a basic 1 : 50 model which allows the student to ‘look in’ through the entrance and openings in the facades, allowing for a surprising ‘sense of place’.

This method of studying composition by approaching working models from different viewpoints is continued in longer exercises later on in the study programme, which allow for a more in-depth approach.
Findings The experience of these first year practical exercises is that students are greatly stimulated by such an ‘eye level’ approach and that this method is very effective in creating insights which are quite new for young people who have only recently left secondary school and have not previously considered the built environment from such a perspective. An added value is that this approach stimulates an inquisitive attitude to design and familiarises students with the technique of constructing relative simple 3D design ‘testing’ models and makes them aware of the ‘dialogue between 3D form and 2D notation.

DESIGN AND PRESENTATION MEDIA - EDUCATIONAL EXERCISES A latter year exercise, where active use is made of eye level modelling for the development and presentation of design concepts, is the SV Module exercise offered by the Design and Presentation Media section. The educational programme of this section focuses on the active implementation of different media techniques, such as video, endoscopy and computer visualisation for the benefit of design communication. As such the Design and Presentation Media curriculum is concerned with (multi media) productions intended to highlight the context, image quality and conceptual meaning of a design.

In previous years a number of video based design communication exercises have been offered which documented building projects in progress. More recently, in the SV Module the method has been to assist students throughout a design evolvement process, from the first analysis and design concepts to the final presentation and documentation.

The theme of the ‘combination’ Module SV is the interaction between Urban Design (S: for ‘Stedenbouw’) and Housing Management (V: for ‘Volkshuisvesting’). The students’ task concerns the development of large housing projects, consisting of entire neighbourhoods at a time. The chosen sites in recent years have been a number of locations on the old, changing harbour front of Amsterdam (such as the peninsula of Borneo and Sporenburg) and an exchange project organised by the ‘Architects Without Frontiers’ group, focusing on the redevelopment of Sarajevo.

The Media contribution is integrated into the full eight week cycle of the Module. Running parallel to the general progression of the project as a whole, two Media teachers offer exercises combining different techniques, reflecting the central themes of the Module and furthering the development and documentation of design concepts.

In the first four weeks, the endoscope is used in the Media sessions to study different design options for low-level, high density housing proposals. The first Media session is an introduction to the workings of the video studio and the endoscope facilities, following which in the
next three to four sessions, the students, working in groups, experiment directly in the endoscope laboratory by creating and analysing different configurations of fragments for the proposed urban plan, using specially made wooden blocks.

In this way several types of street profiles and housing clusters can be composed and altered very easily. Different options can be viewed directly on the video screen and registered on videotape.

Each group chooses a variant and in the following sessions the students are busy making their proposals communicable, using selections from recordings made previously, adding new images, schemes, spoken text etc. These video documents are shown during the Module's final presentation sessions as part of the total result. They are marked separately by the Media staff. Criteria are group effort, quality of the storyboard and the way in which video is used in the working process and the presentation.

Findings This exercise demonstrates convincingly that working directly in the endoscope can be rewarding in an educational project. By trying out different possibilities and impulsively trying out variations and introducing sudden, novel impulses, the design imaging process may be activated, often in unexpected ways.

Working with a new technique, such as video, is in itself often an exciting experience for students and the studio atmosphere can be beneficial in ‘focusing’ the group activity. Each student has a clear role to play, yet can contribute freely to the creative process.

Working with the relatively simple wooden blocks which create a sense of scale yet are very easy to manipulate, also has made it clear that it is not necessary to use sophisticated models in the endoscope. On the contrary, this very basic ‘game’ situation has proved to be very stimulating in design decision making and for the benefit of communicating design ideas.

DESIGN MODELLING FOR ENDOSCOPY One of the problems with scale models is that they generally tend to take such a lot of time to make - often more time than foreseen. This has at times also been a problem in the Media sector's Differentiation Module D11. Students often tend to ‘lose themselves’ in a model they are busy constructing to such an extent, that they can easily lose track of other planned activities aimed at a project presentation. The fact that the model is often only ready at the very last moment is also often a problem when wanting to use Endoscopy for a presentation. The model is by then so ‘fixed’ that there is no time to alter things even when views using the endoscope indicate that something ought to be altered.

Another experience is that students seem to forget all the video lessons they have had previously, concerning camera standpoint, movement, timing, editing and the use of sound (background noise and/or music) when bringing their model into the endoscope laboratory. Endoscopic video presentations are all too often long, rambling, sweeping motions though and around the model, with someone's favourite piece of music put indiscriminately on the soundtrack. Often the viewer completely loses track of what is happening due to a lack of orientation (this is also a problem with many computer animations).

Planning is of paramount importance. If a student knows beforehand that he or she wants to use moving endoscope sequences, it is important to create a storyboard well in advance.

In this way the model is considered as a scenographic instrument: as a film set in a movie. This means that only the parts which are of importance for the presentation need to be
made and the *level of detailing* can be reduced to a large extent, so long as the subject matter will come across well (enough) in the final video production (again a similar situation holds for students preparing computer animations).

In view of the experiences with modelmaking 'bottlenecks' in the D11 Module, an exercise was set up in the first part of the module with the aim of studying how simple, yet suggestive, a model can be for it to work well in an endoscope environment. For this a link was created between the modelmaking exercise and the video exercise in the module. The students were confronted with a design situation using a 1:200 scale model. The design task called for the addition of a number of new buildings in a 'set' situation. In a video exercise in the studio the students first of all made a small film explaining the assignment. Subsequently, each student created a design for the facade for one of the types of buildings to be included in the plan. Next, a model was made with the explicit intention of presenting this in the endoscope. The basis for each of these models was a piece of transparent plastic bent into shape to form the front facade and two side facades of the new building. Only the most necessary information was worked out. Using relatively simple materials, such as thin plywood, coloured paper, wire mesh and even structures or patterns copied on (coloured) paper, the models were made. The different design solutions were then viewed in the endoscope and - in a group process - were incorporated into a dynamic sequence registered on video.

**Findings**  This exercise showed that an effective urban model could be made relatively quickly (basically one half day for making the model) which yielded video images of surprising quality. This experience proved to be an effective introduction to the opportunities of eye level design exploration and presentation using optical Endoscopy and video, and at the same time introduced a number of time saving modelling techniques, which proved a valuable lesson towards preparing the final presentation for the D11 Module in the next weeks.

**THE (IN)VISIBLE CITY EXPERIMENTS**  A specific study by members of the Dynamic Perspective research group and the Form Studies staff concerns the '(in)visible city' projects. This study was carried out in two parts: a first step as part of the workshop sessions of the 1995 EAEA conference in Vienna and a second step in which the models prepared for the conference were worked out further in an experimental educational exercise as part of the sector's D11 Module.

The central theme of both exercises was to explore how *optical* and *digital* Endoscopy can be employed in an active, creative design process and how these two techniques compare. The following is an overview of the most significant experiences and findings.5
The EAEA workshop project  The Dynamic Perspective research programme of the Delft Media group is concerned with the study of composition and perception and of methods and effects relating to design visualisation and communication techniques, including Simulation Technology (Breen, 1996)².

In this particular study an attempt was made to explore the possibilities and boundaries of existing imaging techniques and, where possible, to attempt to shift the boundaries and find new methods for indicative design visualisation on the scale of the urban ensemble. The study explored the potentials of simulation techniques (which are generally implemented in the concluding phases of the design process) as creative tools in the idea phase of design. The study aimed to include both optical endoscopic techniques and computer aided techniques.² The ambition was to not only compare the two types of environmental simulation technologies, but where possible to attempt to employ them in combination, in a form of creative symbiosis.

The study was prepared for the Workshop ‘The (in)visible city’, which was a part of the second conference of the European Architectural Endoscopy Association (EAEA) held in Vienna, Austria in September 1995. For this workshop a number of European universities, active in the field of architectural simulation, were invited to prepare contributions which would be presented and discussed at the conference (Martens, 1996)⁹.

Starting point for the projects was a masterplan by the Viennese architect Rüdiger Lainer for a city extension on a former airfield at Aspern. A scale model scale 1:500 travelled around the participating universities.

Inspired by a preliminary study of a number of recently completed urban plans, the TU Delft Dynamic Perspective research group¹⁰ developed a critical reaction and translation of the original, somewhat ‘restless’, deconstructivist masterplan. The design simulation focused on the segment of the general masterplan indicated in the travelling scale model. Whilst attempting to maintain the dynamic qualities of the original plan, the number of directions was reduced, an attempt was made to structure and diversify the qualities of different public spaces and the qualities of a number of visual axes was intensified.
If one wants to simulate impressions with an endoscope one needs a model. After initial experimentation, a 1:500 model proved unsatisfactory and the decision was made to build a model scale 1:200. Because of the size of the site, this eventually amounted to a physical model of approximately 2 by 4 metres! Because of the design character of the study, the model had to be relatively simple, quick to build and easily to manipulate. After preparation of the underground, simple strips of Styrofoam in different dimensions were prepared be used for the building blocks.

To apply facades onto the building blocks a method of visual 'sampling' was used, comparable to techniques used in contemporary music production. In the initial steps, simple geometric patterns, made on the computer, were applied. Subsequently a distinction was made between open and closed parts in the elevations by introducing a tone difference, which greatly improved the effect. In the next steps samples were taken from realised projects. This involved scanning parts of buildings into the computer from photographs and then 'straightening' the perspective using a photostyler program. Such basic patterns were then multiplied into greater patterns. In this way a number of types of 'urban wallpaper' scale 1:200 was created. These could be glued onto blocks in a very similar fashion as the application of texture maps in the computer.

The Delft educational project The results of the (in)visible city pilot study became the basis of the subsequent educational workshop offered by the Media group. It took place in the first four weeks of the eight week 'Media Module', parallel with a number of other exercises meant to acquaint the students with several types of design visualisation and communication techniques.

In the exercise, three groups and their tutors were brought together into one big group. The metaphor of the design office was used to create the proper atmosphere: the three teachers acting as the managing directors", the students as the design staff members. The 'office' had received a commission and an initial plan would have to be ready in four weeks time. The staff would split up into groups of three to four designers. Each group would work out a 'scenario' which would be presented in four weeks time, the deadline was set. The winning proposal would in theory be adopted by the office and worked out further.

The site was a tricky, triangular area, a 'wedge' bordered by two routes and with another cutting across it (the central triangle in the (in)visible city 'design', which had been removed for this purpose). Reacting to the different directions present in the adjacent parts of the masterplan (which had been 'realised' by others and as such were set) and the system of the visual axes would be required. An indication of elevations and material expression would have to be presented and ele-
ments such as trees would have to be incorporated into the presentation if they were important for the design concept... A 'previous proposal by another office' had failed to become a success. The floor space of that plan was given as an indication, but as this had not worked out, there was considerable freedom in creating a new proposal...

The student teams were stimulated to visualise and discuss different design strategies and to document these. They could use any traditional techniques they wished such as sketches, scale drawings, collages and models. In addition they were able to use the endoscope and the 2 by 4 meter model for the Vienna with the triangular design 'site' removed and computer aided visualisation techniques. During the first three weeks the students were also be acquainted with CAD texture mapping techniques in a separate course, practising in the same digital model, which they could subsequently use as a basis for their plan presentation. The facade patterns created for the Vienna workshop were available to the students, both in the computer and as prints which could be copied and used in endoscope proposals.

**Findings**

The students set about their tasks with considerable enthusiasm and the workshop produced results of surprising quality and originality, considering the limited time which was available.

Nine different teams presented a proposal, each with its own motto. The results were eventually a reason for the 'managing directors' to commend not only one plan but four, each of which excelled in a particular way:

- an elegant and compositionally strong 'landscape concept';
- a realistic and compact plan with articulated spaces and facade treatment;
- a plan incorporating theatrical effects and an impressive use of video;
- a proposal making innovative use of computer visualisation techniques.

For such a limited number of groups the results were surprisingly varied, both in content and presentation. Some tendencies worth noting:

- The different group-structures of the teams influenced their progress, some teams were good at organising and dividing tasks, for instance splitting up into sub-groups of two, other groups got collectively 'stuck' in the first phase, only getting out of the deadlock with difficulty.
- Although both endoscope and computer were actively utilised, a number of other techniques were used in unison, specifically in the initial development phase, collages and sketch models scale 1:500 were used rather than going straight into the 1:200 endoscope model. In a survey held among the students about their preferences concerning media techniques via a questionnaire, there proved to be considerable differences amongst them.
- Other techniques being taught at in the Module at the same time also proved a stimulus for the presentation of proposals, notably Video pro-
duction.
- The use of texture maps proved a to be a success. However not enough different types were available and the same sorts tended to be used extensively. Nobody took the time to create their own patterns!
- The textures offered standard with the texture mapping computer software did not prove stimulating. On the contrary they could lead to mis-steps (like the use of bricks of 1 by 2 metres or worse). In an exercise like this they should ideally be 'removed' from the menu.
- The lack of computer experience and particularly the lack of available computer time formed a handicap for those students who had decided on using computer visualisation.
- The computer option attracted both students already proficient at CAD (which in one instance led to the kind of semi-transparent volumes floating in the air with which we have become so familiar) whilst for others this was the first real experience in the creative use of Computers. The experience stimulated a number of students to continue with CAD in the second phase of the Module, leading to further creative applications.
- The ‘real’ model, being vulnerable, was completely ‘finished’ after the educational workshop, while the digital model survives on the hard disk, new renderings and animations can in principle be made whenever needed.

CONCLUSIONS AND OPPORTUNITIES  As is argued in the previous chapters, it is extremely important for students to be made aware that their designs will be appreciated in real life through dynamic visual experience, and to keep this in mind whilst designing. Models (both scale models and computer models) can offer very useful information to the designer and to others involved in the design process.
A model can be extra effective if it enables one to view the design proposals as if from eye level (the way in which we would also experience the finished product). This can be achieved relatively easily by constructing a model in such a way that it is possible to look into (parts of) it, or by making certain parts removable so that one is able to glimpse inside. This is possible by viewing the actual model or by taking photographic images from it, in which case special attention can be paid to lighting, creating an optimal impression of the designer’s intentions.
A very useful method is to employ (optical) Endoscopes. These can either be mounted directly on a photographic camera or connected to video equipment. Advanced Endoscopy facilities allow for flowing motion through the scale model.
If motion is required it is important to view the undertaking as a video production. In this case a well thought out - scenographic - approach
and creative planning is essential, if the result is going to be interesting (and indeed accept-
able) to a critical (and often spoiled) audience. The quality of the model and ‘secondary’ information, such as ‘meaningful’ elements placed in the model environment plus, for instance, background sound will enhance the effect of an endoscopic production.

If models are made specifically for the endoscope, this can potentially limit the amount of time and work needed to make the model. This is an extremely important factor as model-making is notoriously time consuming.

If Endoscopy is to be effective in creative design, the models have to be kept as simple as possible and have to be easily changeable, in order to test different options, take in changes in direction and facilitate group decision making. Texture mapping techniques can be particularly useful in creating - interactive - urban design models, both in scale models using optical Endoscopes, but also in models created using digital Endoscopy. Interesting opportunities for enhancing more traditional visualisation techniques through the introduction of computer based techniques are still developing.

Lastly, the physical relationship between scale model and endoscope is an important one. The endoscope should be as ‘available’ as possible during a modelmaking process. Just as it is both practical and stimulating for someone creating a model in a computer to make intermediate 3D views, and one always has one’s eyes available for eye level observation when working on a Form Studies exercise, so the ideal situation would be to have a (perhaps simpler) endoscope readily available at all times in the modelmaking workshop.

NOTES

1. That this is not always the case was illustrated somewhat painfully during a project based video exercise, held by Terenja van Dijk some years ago. Students set out to make a video documentary about a building under construction on the edge of the historic city of Delft, just opposite a busy - raised - railway line. The students focused particularly on the aspect of viewing the new building from passing trains. When the video was subsequently shown to the design team of the architectural office involved, this proved to be a bit of a shock to the designers who had apparently not been fully aware of the importance of this way of perceiving the building and the visual impact which the - rather under-designed - upper stories and roof of the building would have daily on thousands of passing train passengers.

2. For Le Corbusier’s views on the subject of design imagery see: Breen and Stellingwerff: A Case For Computer Assisted Creativity through Clarity in: Approaches to Aided Architectural Composition, ed.: Asanowicz and Jakimowicz, Technical University of Bialystok, Poland, 1996.


5. In the SV Module, Terenja van Dijk and Fas Keuzenkamp have been responsible for both video and endoscope implementation.

6. The results of the (in)visible city experiments were presented earlier at the 1996 ECAADE conference. A more extensive documentation of the backgrounds and findings is included in the Proceedings of this conference: Breen, J.: Learning from the (in)visible city, in: Education for Practice, Proceedings of the 14th ECAADE conference, eds.: Ekholm, Fridquist, af Klercker, Lund University, Sweden, 1996.


10. Working on this project were Jack Breen (design, scale model and optical Endoscopy) and Martijn Stellingwerff (computer modelling and VR experiments) in collaboration with Professor Jan van der Does.

11. The ‘director’s’ role in the educational exercise was played by the Form Studies staff members Bernard Olsthoorn, Jeroen van de Laar and Jack Breen.

12. For a more extensive description of both the Vienna Workshop project and the educational exercise, see also: the 1998 Yearbook of the Faculty of Architecture, TU Delft.
SOME SUGGESTIONS ABOUT THE ROLE OF TEXT INFORMATION ON VIDEO SIMULATION

Professor Michael Matalasov
Moscow Architectural Institute (MARCHI), Moscow, Russia

ABSTRACT In the initial project of our laboratory on video modelling it was not thought necessary to seek permission from the authors of the architectural designs discussed in the accompanying scenarios and scripts. We would like to propose that the authors participate in the presentation of the video work by commenting on their designs as they are shown on screen. The difficulty of presenting a commentary on work, improving the quality of design modelling and its presentation, depends on the thorough working-out and consistency of scripts and textual information. Our presentation will illustrate through video examples our present approach to the problems of video-modelling in this field.

INTRODUCTION In this work I’d like to describe our approach to the role of textual information, accompanying video-rows in works on video-simulation of architectural designs. When considering the role of a scenario we know how complicated (in our field) the problem is, though at first sight it may appear very simple: it is enough to see-write-edit - that’s all there is to it. This idea was present in our first works, which in fact reflected the chain ordered by the client: model - initial video-shooting - the same frames but with the model ‘built’ into them. There was no text accompanying the frame, as in such a simple situation the explanations were given by the clients themselves when they were demonstrating the video-material. This situation was due not to our lack of skill, but to the users’ scant knowledge about the possibilities of video-simulation methods. Because of this, these possibilities were not exploited.

We notice that this problem also intrigues Mr. Ph. Thiel, Director of the Center for Experimental Notation, Seattle, USA(1), but the level of democratic development in our country today makes us approach problems in a somewhat different way (though it’s just possible that at times they coincide). No doubt it would be useful for us to collaborate more closely and consistently with the Center at Seattle to determine common approaches with regard to different levels of development. This would also assist in introducing our ideas and making them more familiar among the public at large.

Concluding the introductory part I observe that in our work today we have to consider not only mental attitudes but also the requirements laid down by the authorities (mainly local). They are not always interested (because of personal reasons) in taking long-term decisions, based on our information, but are concerned to satisfy the requirements of a wealthy client - someone who may not possess great intellect but because of his money can dictate conditions.

TEXT INFORMATION IN VIDEO SIMULATION Thinking about the form of the statement of the problem, we chose what we felt to be an optimal variant. We shall show our approach using the example of a Workshop and illustrate some additional considerations using two important practical works that we recently made.
The Workshop task was to create a simple project for redesigning a town square from a given initial situation (a part of an imaginary small town with an unbuilt area in the centre). We were to consider it from points along a given trajectory of movement using endoscopic and computer methods. In doing this we came to the conclusion that using this opportunity (when the majority of the participants at the conference are acquainted with the initial situation) it is possible to clearly demonstrate the technology of our work. It is connected with the formation of the scenario (we use the word to mean: the formation of a logical sequence of the final presentation) that precedes the process of video-simulation itself.

So a task is defined. It is interesting from the technical and methodological points of view (comparison of technical methods of presenting design information dealing with the same initial space), and is straightforward from the architectural point of view - solution of a local architectural task on the outskirts of a small town. This means that if it is solved in the simplest way, following the task requirements precisely, the result is not likely to attract public attention to this important problem. Some kind of intrigue is necessary! What shall we do? A creative search begins (a kind of skeleton of a scenario appears).

The examination of the initial model we receive, showed - using an endoscopic device - that following the given route at a number of points we find empty spaces behind the model (between its buildings). What shall we place there? We know that the techniques we used (because of financial difficulties in the Russian educational system) are far from perfect. How shall we lessen their defects? We are searching for a way out (now it is work on a scenario or formation of a procedure - how to present what will be designed). In order to enter the situation, we watched the video Welcome to Delft many times. But our mental approach needs to be taken into account - it will help to explain some architectural peculiarities of our project. We watch the first chain (or video-row) demonstration (with wry humour) of how it could be in Russia today. It is a kind of initial psychological preparation for spectators.

After this we are initiated and have a right to enter a European town and demonstrate how we imagine transformation of one part of its territory. Creating a new space, it is reasonable to observe from real points how the proposed principal sections might appear. Our time was limited and we failed to consider alternative solutions - but they can be and sometimes must be included in a scenario (we shall discuss this later).

Suggestions were made (with regard to our technical possibilities) about individual episodes which are connected with the given trajectory.
of movement. (It is important from the point of view of the possibility of comparing the experiment’s results, which unfortunately, it is impossible to achieve completely, but still this will be considerably more than at any previous conference).

We have remembered some episodes from the Welcome to Delft video and see that some frames could fill the empty spaces on the edges of the model, which I mentioned above. Our video-computer technology helps us to realise our concept. A new trend emerges in the scenario: if the given Workshop theme is 'Image Imagination', why can’t we place ourselves on the outskirts of Delft? It isn’t difficult for us to do this, since we haven’t been there and this proves a psychological advantage - our imaginations are unfettered.

How do we do it? Choosing a video-frame from Welcome to Delft one must be carried away into an imaginary endoscopic space (something like Alice in Wonderland). Visually it will be perceived more gently than when it is done by computer methods (we aren’t considering digital video but use the available VHS-video titled Welcome to Delft). Later the scenario (or rather the arrangement plan on its base) must provide for special effects. But I would like it to come across like a gentle statement, not like a lecture; it is simply an exchange of experience.

PRACTICAL EXAMPLE Now let’s consider some characteristics of our actions in real works. One of them is video-materials we produced for the reconstruction project of Borovitskaya Square. The development of the territory near the Kremlin is determined by decisions of Russia’s President and the Moscow government, therefore the most important role in it is played by the introductory and final parts, demonstrating the necessity of making decisions. The video-simulation methods seem to confirm that the project proposition is realisable. About 30 percent of the scenario of the video-material, executed by us, consisted of a historical description of the territory and proofs of the necessity of the Moscow Kremlin Museums. The video-simulation itself (i.e. demonstration of design proposals in a real video-environment) accounted for 30 to 40 percent of the total time. The design proposal was executed by a computer and is built into a real video environment. Since purely computer video space can (by the author’s decision) differ considerably from the real one (in trajectories, points and angles of observation) we provide for a chain in the scenario in order to prove the reality of images: a real frame - its super-imposition on the model of the existing building 1:500 (demonstration of the exact siting of the future building) - replacement of a simplified model of the exact size by a computer (3DS) model. Because of the importance of the work, in the final part of the scenario detailed technical and especially economic
substantiation of the proposed buildings is provided. Turning aside for a moment from the main discussion of this article, I'd like to note that during the work on this video-material, the designers - having seen their project in a real video-environment - had to introduce considerable changes into it. This became the basis for a new scenario - information for students about the use of video-computer technologies in the process of optimisation of design solution.

Another example is a practical exercise on the creation of a big public building in the historic centre of Moscow. According to the scenario set by the client it was supposed to provide information about the project in detail (on the model 1:500) and to demonstrate in detail the functional purpose of rooms on the model 1:200. The demonstration of an intermediate video-film to the client showed defects of the project and it was decided to prepare video-material with two variants for a wide discussion. This video-material was produced, and a solution based on it (now being realised) was reached. The video-film was demonstrated many times in different administrative and public organisations and showed that the introductory and final parts were too long. As it was this video-film that was demonstrated most often in different organisations (and we have received similar opinions about it) we can draw the following conclusions.

CONCLUSIONS
1. When carrying out work for different (private and state) organisations, at least in our country, it is necessary to define accurately tasks of the video-material (e.g. advertising, business - substantiation - search for sponsors etc., historic-archive), which will influence its structure.
2. When agreeing to the client's suggestions it is necessary to define clearly on the basis of one's own experience the optimum contents of the scenario and proportions of its parts.
3. Video-films should not last more that 5-10 minutes (this is connected with people's ability to absorb specific information).

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COMBINING DIFFERENT KINDS OF PERSPECTIVE IMAGES IN ARCHITECTURAL PRACTICE.

Dmitry Berdinski,
Michael Matalasov
Moscow Architectural Institute (MARCHI), Moscow, Russia

ABSTRACT This paper is about combining photo-, video-, endoscope captured images with handmade or computer generated techniques. Practically all optical systems are known to produce more or less curved perspective (spherical or cylindrical) which depends on the angle-of-view, and a computer as a rule (as handmade) constructs linear perspective images. To combine them on any media correctly, an operator has to be a professional painter or designer, because there is no mathematically determined way to combine them.

The authors made a demo-computer program which is able to generate spherical perspectives of simple spatial constructions. It allows us to illustrate mathematically and visually the principles of optical curved perspective, laws of their combination with linear ones and helps to feel how to achieve the accordance with natural visual architectural images.

THE TARGETS One of the main tasks of endoscopy is documental truthfulness of visualization of architectural objects in real architectural environment. The best way is probably to combine “natural captured images” with anyway generated images of designed object(s). “Natural images” mean photo and video captured images of an architectural site. “Generated images” mean endoscopy of scaled models or computerscopy of mathematical models of designed objects. Some problems arise during combining these different images. Even if all the parameters (point-of-view, target point, zoom, etc.) of both pictures are the same, the result of combining is often unsatisfactory. Such misleadings as a rule are determined by different ways of creating of natural and generated perspective images.

LINEAR PERSPECTIVE The are two base methods of converting three-dimensional information into flat images. The first is usual linear perspective. It was “rediscovered” in the epoch of Renaissance and was widely used by great artists and architects. During the centuries it was thought as the only method that allowed to present real 3D space on picture surface. But some authors paid attention to inaccuracies of this kind of projection. The first one is the considerable distortion of spatial object proportions which is lethal to an architectural presentation. For example, if the vector-of-view is along a long street, the linear perspective image seems about 1.5 times longer than the real human feeling of the same real street. The second is the unnatural morphing of 3D curved lines and surfaces. For example, if a perspective image has a linear array of circles (such as tops or bases of colonnade) then the axises of the ellipses are abnormally rotated from horizontal line in the corners of a picture. The third is the deformation of angle between 3D vertical lines and line of horizon that are different from 90° when vector-of-view is not absolutely horizontal. Other numerous linear perspective distortions are the consequences of the three above mentioned.

On the other side famous artist M. C. Escher (born 1896) presented a series of pictures that visually proved the nonlinearity of human perception.
Figure 1 illustrates the impossibility of linear perspective method of representation spatial lines and constructions. A person lying under two wires can see two vertexes under his legs and above his head and a distance between them in front of him. So in this projection these wires cannot be represented as a straight line!

More dramatic situation is shown on the right side of the picture. If we see the line of horizon behind a tall building and the vector-of-view is not horizontal one then result of linear perspective projection is abnormal. It is evident, the vertical lines of the building are not perpendicular to the line of horizon. It is impossible to make them vertical and leave the linear perspective decreasing of the building's top. If we will use multiple projection surfaces, the parts cannot be constructable in one. Of course, this extreme statement is correct for the biggest angle-of-view-pictures, but normal 30° used for linear ones is not enough to present architectural space. The only way to overcome this contradiction is using nonlinear perspective principle.

**NONLINEAR PERSPECTIVE**

The idea of the nonlinear perspective in architecture is not younger than the idea of the linear one. Nonlinear perspective images are more natural for the human perception. Straight lines are the human invention — they do not exist in nature. Geometrical analysis of some famous paintings (landscapes, for example) shows that most natural effects are achieved by using the spherical projection.

The only defect of nonlinear projections is the deformation of straight lines due to different angles of view. For normal perspective images the angle-of-view should not exceed 40°. Usually viewers see such pictures with the angle-of-view not more than 15°. There are two ways to correct this mistakes. The first is to enlarge the output format, and the second is to decrease the distance between an observer and a picture.

The other image deformations become visible if the vector-of-view used in calculations is different from viewer's. Vector-of-view is one of leading factors of any perspective; changing vector-of-view results to considerable morphing of final image. Simple advice: do not look on corners of the picture. There are many ways to solve these problems. Some of them were discovered centuries ago. For example, corners fading on paintings of Rembrandt van Rijn, blurring corners or placing a number of small details near the "target point", etc.

The visual curveness of 3D-straight lines is the factor subconsciously used by observer to gather spatial information. The genius intuitive feeling of natural transformations of straight
lines in the mind of preceptor allowed ancient architects to create special visual effects. Well-known emphasis of classical columns (Figure 2) or horizontal curvatures of Parthenon (Figure 3) and vertical ones in Russian Pokrova church (XII c.) (Figure 4) are the examples.

The accurate usage of such effects gives the possibility for an architect to rule the scale, proportions of a building, etc. The design using linear perspective laws exclude such phenomena.

DEMO-PROGRAM The special computer program (DCAD) was developed for studying some visual effects of nonlinear perspective projection. The main interest was in formula of translating three-dimensional coordinates of points into a flat perspective image. It performs the simplest kind of spherical projection. The base 3D element imported from text file (*.dcd) can be freely moved or rotated in space. Vertexes calculated using nonlinear perspective formula were approximately connected by straight lines and only array of them can represent a sinusoidal line.

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PURPOSE COMPLIANT VISUAL SIMULATION
TOWARDS EFFECTIVE AND SELECTIVE METHODS AND TECHNIQUES OF VISUALISATION AND SIMULATION

Roel Daru & Piet Venemans,
Faculty of Architecture, Building and Planning, Eindhoven University of Technology

ABSTRACT Visualisation, simulation and communication were always intimately interconnected. Visualisations and simulations impersonate existing or virtual realities. Without those tools it is arduous to communicate mental depictions about virtual objects and events. A communication model is presented to contribute to a better theoretical foundation of the meaning and relevance of simulations of different types.

INTRODUCTION Some centuries ago the relevance of visualisation was (so the legend says) experienced by tsar Peter the Great, who wanted to master as fast as possible the prominent Dutch shipbuilders’ craftsmanship in those days in order to create his own contemporary Russian shipbuilding industry. For various reasons, the Dutch craftsmen used little draughting to communicate the shipmakers’ knowledge. The English shipbuilding industry used drawings to store knowledge and experience, and scaled models for simulations. It was only by this English approach that the tsar could obtain the needed transferable knowledge and experience to send home for implementation.

Visualisations do more than to communicate factual knowledge. Visualisations are also used as a means of expression and persuasion by the designers. And as a device of identification and participation by the client and others, like users or inhabitants, they also help to elicit other people’s reactions about perceptions, experiences and significations supposedly corresponding to the reactions to the original, existing or yet to be realized.

The question is whether simulations lead to correct decisions: they do so only if the behaviour shown in interaction with the simulation corresponds to real user behaviour once the design is built. This is far from evident and needs to be proven. Stimulation of the imagination about a not-yet-built environment is not sufficient for correct decisions. A seemingly realistic simulation can even lead to results which are irrelevant to the purpose pursued. The visualisation of shapes and materials should activate the knowledge and experience of designers and decision makers about the expected functioning and operation of the visualised real or virtual original.

THE NEED FOR FURTHER THEORETICAL DEVELOPMENT Due to the improved technical developments of display dynamics and virtual reality, the use of simulation and simulators is growing beyond the traditional application areas of environmental simulation. However, the theoretical and conceptual development does not keep up with the enlarged technical possibilities.

What all means of visualisation and simulation have in common, is that they are used to acquire an understanding of the effects of the intended situations and to communicate them. In order to compare, interpret and evaluate the means of visualisation and simulation on all relevant aspects, the needed theoretical development should be directed to con-
necting purposes, operational models and devices. In this paper we suggest to take a communication model as a run-up to a possible basis and scope for such a theory and a research program inferred out of it to visualise and simulate in a purpose compliant valid and applicable way.

**A TENTATIVE COMMUNICATION MODEL** The proposed communication model is derived from the linguistic concepts of Roman Jakobson (1963) about the functions of linguistic communication. Jakobson makes six distinctions:

1. the emitter,
2. the recipient,
3. the context,
4. the channel,
5. the code and
6. the message.

Six functions correspond to these distinctions:

1. the emotive or expressive one for the emitter,
2. the attention and direction one for the recipient,
3. the reference and denotation one for the context,
4. the keeping up of the communication one for the channel,
5. the metalinguistic function one for the code and
6. the poetic and esthetic function one about the style and substance of the message.

If we apply this model to visual communication about the built environment, visualisation is the combination of channel, code and message. Its reference to the architectural building (context) occupies the central role. It is related directly to to the emitter wanting to express her or himself by way of the visualisation. It is connected to the recipient as an attention calling message from the emitter to influence the behaviour of the observer, for example to direct him/her towards a certain point. The visualisation as a reference to an existing or future reality as the original building or piece of architecture to be realised should also reflect the performance of the building. Moreover on a meta-semiotic level, a scale model for example consists of spatial elements which are intended to refer to other spatial elements. Last but not least, a visualisation has qualities of its own: the same medium can be stylish or be designed in an uninspired way. Jakobson's model is a good starting point. However, it does not help us enough when we see visualisations as reference and reflection of the performance of buildings: we will come back to the complexities of visualisations as models in the following.

**THE VISUAL COMMUNICATION MODEL AND THEORY RELATED PURPOSES** There is no universal visualisation which can represents all the aspects of a built environment, or it would be the built environment itself, like in a story (by Borges) where the map becomes the country and vice versa. And even reality is not good enough a model of itself: as a predictive model, it excludes 'what-if' manipulations and exercises. Therefore we must make a choice, and to make a choice, we need theory. Such a theory should connect the types of purposes which
we aim for when making a visualisation, the types of operational models and the kinds of media we use. The visual communication model as an ordering device might be a step towards a theory connecting purposes, operational models and visual means. From the model at least three architectural purposes can be discerned from the position of both the emitter and the recipient.

1. The first type of purpose has to do with functions, its usage and workings of the built environment. The model should tell us something about how a building performs as an environment for its inhabitants and how it stands as a technical object submitted to wear and tear. Usages are specified in words like 'school' or 'classroom' and the way a building works is stated by performance specifications about for instance the permeability of the building for heat and cold or for sound or noise.

2. The second type of purpose is related to form. It has to do with establishing a relationship between the visualiser and the recipient via the visualisation. A visualisation is not neutral. It carries with it some of the values and choices of the visualiser. The recipient will judge the visualisation according to his or her own system of values as a meaning worth to accept or to reject and replace for a meaning of their own and independent of the intended one. Meanings are given by the geometric shape, position and surfaces of the building, material and constructional surfaces varying in their size, as well as in their value and color, their transparency and ornament and their texture, orientation and articulation; all these formal qualities act as metaphors, as signs and symbols. It is studied by semiotic analyses, by art criticism and the use of iconographic techniques. If the configuration of those formal qualities conforms to a coherent whole, we call it a style.

3. The third type of purpose has to do with making the deeper structure of a building tangible by expressing its topological circulation structure. Thomas Markus has illustrated the deeper structure as the driving force to experience a building as a social system of distributed controls and power and of bonds and friendships (Markus, 1993). Markus uses tree diagrams to express spatial dependency. The deeper a tree structure is, the more dependency is felt by the user and the less legible it is. And in reverse to arrive at legible buildings, one ought to allow the user control over his own circulation. To enhance bonds and friendships, shallow spaces and rings are needed instead of deep trees.

For each type of purpose there will be a more or less adequate kind of model and a more or less adequate method for communication.

**DEGREES OF MANIPULATION** Traditional scale models and projections are descriptive models of reality. They are easy to understand but difficult to manipulate in order to determine the effect of changes on the original. On the other hand a computer simulation makes such a manipulation easier to perform. The same holds for the presentation of the model to the recipient: this is a matter of the properties of the visualisation as such. The degree to which visual simulations might be manipulated differs to a great extent. They might be distinguished as:

1. passive, 2. interactive, 3. controlled and 4. generative types.

1. All photographic and predescribed (video)film productions like endoscopic and virtual reality presentations are passive simulations, because the observer is confined to looking at what someone else has composed for him of her.
2. With life shots filmed or video taped by the user or observer him/herself, it is possible to interact directly with the endoscopic equipment or the Virtual Reality system used, in order to look from every position to the still immovable 3D model and surrounding environment.

3. In controlled simulations the (2D or 3D) model itself is made movable in a fixed environment, like training telecontrolled robots for inspection in harsh environments.

4. In generative simulations the object itself is made either changeable or mutable: changeable by physical or electronical combinatorial elements for building alternative designs, or mutable by breeding genetically coded shapes within a morphogenetic computer program (Daru & Snijder, 1997).

Comparisons have already be made between some of these types of simulations. The first type, passive simulation by means of an optical endoscope, is compared with simulations of the second type by digital means by Stellingwerff and Breen (1995). Ohno, on the other hand, uses interactive simulation (Ohno & Hata, 1993; Ohno et al., 1995). When interpreting the conclusions of such research we should take into account the purpose to which each simulation can be used. A nice example of the generative type using a classical endoscope is given by Breen & v. Dijk (1997).

The possibilities for manipulating the model and the environment are different per simulation type. With passive simulations (1), one needs shots of for example (video)films of different models in order to vary the visualisation. In the case of an interactive simulation (2), the presentation (but not the model) is changed by the user of the system. In a controlled simulation (3) the behaviour of the model is changeable within the visualisation (for example the airplane model in a flight simulator). Last but not least in generative simulation (4) the model itself is changeable, allowing to study its behaviour and performances directly integrated with design interventions.

INTEGRATING EVALUATION INTO VISUALISATIONS

To simulate we should make a visualisation changeable. Every change will have some effects on values one is interested in, like aesthetic sensations, associated meanings, functions of all kinds, costs or technical performances. In scientific parlance the changes in the visualisation might be thought of as the independent variables and the values influenced by them as the dependent variables operationalised in some measurement procedures.

Independent variables are the explaining variables under direct control of the experimenter. The dependent ones are the variables to be explained, the behaviour or response we seek to measure, because we suppose that they are determined in some way by the independent variables.

Without a computer, calculating effects and making comparisons is a tedious job. Which is why it is generally left out. Once the calculation of effects is integrated in the visualisation software in the form of evaluation functions, using visualisation as experimental instruments is quite feasible. It is one of the most important conditions to produce reliable data.

SOCIAL OBJECTIVES FOR VISUALISATIONS AND SIMULATIONS

To govern is to foresee, to design is to foresee and to decide is to foresee. In all cases, we need reliable data. If visualisations and simulations will perform well to predict future reactions of users, owners and clients,
they should resemble the real environment in their most essential characteristics as related to the purpose intended. Epidermic realism is not always asked for. If sightlines are more important, they should be modelled carefully with the body sizes of the user in mind and without a lot of effort wasted in the rendering of the walls. Extreme or even exaggerated realism is not only wasteful in many situations, in some cases it can be irresponsible. When the presentation becomes overpowering, it can frustrate sensible decisions and make people take choices against their own interest.

**SCIENTIFIC OBJECTIVES FOR VISUALISATIONS AND SIMULATIONS**

What is the value of data about the way buildings are used, the feelings, attitudes and meanings they elicit when they are obtained by having people look at visualisations and simulations instead of the real thing? To give an answer comparative research is needed. After all, even the presence of some instrument is already enough to influence the behaviour of a subject and consequently to bias the results obtained. But working with visualisations and simulations we should not only take into account the purpose dependent essential characteristics of the environment to be translated in the imitation. Every imitation of reality simplifies a number of characteristics, and at the same time adds others which are not present in the reality it refers to. For instance with VR there is in principle a lack of gravitation and physical substance, allowing everybody to glide through, over, under and astride interior and exterior spaces and to traverse walls and floors. This can of course to some extent be programmed out. We cannot expect to make good predictions based upon the reaction of people to simulated or visualised environments, if we don't know exactly what the difference is between the simulation and reality, and which characteristics must be present or can be absent in the model.

**USING TECHNICAL POSSIBILITIES BEYOND EPIDERMIC REALISM**

Some of these problems might be overcome by taking into account user characteristics (such as body dimensions, weight, sight and movement restrictions). Even aesthetic and other preferences and attitudes could be added to simulate the reactions of special types of users within a visualisation on screen. Such user dependent conditions might be accomplished by:

- built-in special user interface constraints (limiting the user interaction of the interactive type of visual simulation) or
- avatars as representatives of one or more users and made observable on screen (limiting the avatar behaviour of the control type of visual simulation).

Avatars are beings arrived from the world of gaming, but they can be very useful in simulated environments as well (see for example Holtzman, 1997). Unlike avatars, constraints are working mainly in the background. They are only experienced if they prevent actions the user of the software is not supposed to be allowed. In such a case the average user for instance cannot traverse walls. In the case of a disabled person, the user interface should be adjusted to the constraints. This could mean for example that a staircase on the screen would not be accessible.

In the absence of real users from the intended population, the user interface constraints and avatars will act as virtual test subjects enabling the designer to evaluate and eventually to correct his or her design.

An avatar as an agent of the user on screen has the added advantage that it might be
observed within the scene to be studied. Each user might even have several avatars, with specialized behaviour to test different aspects of the environment.

Efforts should therefore not only be invested in ever more sophisticated (epidermic) realism of the visualisations. Attempts should also be directed towards the possibilities of simulation of special user types by either imposing restrictions on the handling of the user interface or even better by applying avatars.

Physical-ergonomic avatars, simulating body dimensions, weight, sight and movement restrictions might be implemented in the software relatively easily as they are based on formalisable hard rules. On the contrary aesthetic and other preferences and attitudes will obey to more implicit and fuzzy rules. But if those rules are used in a consistent way, they might be captured effectively by neural networks. These networks, implemented in the software, can emit visual or acoustic signals and comments within the user interface or avatar. They ought to be programmed as to adapt themselves to the changing behaviour of the user.

BEHAVIOURAL RESEARCH AND MORPHOGENETIC DESIGN

With user interface restrictions and/or avatars implemented in the simulation system, a variety of alternatives for the designed and modelled environments might be evaluated in a relatively easy, understandable and efficient way. But in order to define the interface restrictions or avatars, behavioural research should first be undertaken with real subjects in real environments and/or simulations with the most essential purpose-dependent characteristics implemented in the software.

To enable flexibility in producing new alternatives it is necessary to restrict the work in designing them. Morphogenetic design systems (Daru & Snijder, 1997) might be a solution for this type of problem. In addition it is then possible to combine designing and evaluation in a simultaneous process.

EXAMPLES IN THE FIELD OF WAYFINDING AND SPATIAL COGNITION

To test wayfinding properties of an environment the traditional endoscopic techniques are problematic. To our experience, comparing real environments with endoscopic presentations, subjects showed differences in their performance. Even when in a real environment subjects find their way easily and are able to make an accurate cognitive map, the endoscopic presentation of the same environment did bewilder a comparable group of subjects. Within a few turns of the endoscopic tube the user was already confused about the direction he or she is directed to. Moreover, building up a spatial map based only on the eye-level endoscopic visualisation is difficult to accomplish (Stellingwerff & Breen, 1995).

The endoscopic interaction method used by Ohno et al. (1995) is producing useful results, allowing for user initiated perception. This is a shift from the passive to the interactive simulation type, according to the notions of Gibson's ecological perception. User initiated viewing was found to be crucial also for tele-operation (Smets, 1995). However the literature is not very clear about the requirements of simulation in the field of wayfinding, as fundamental work in perception, cognition and learning showed the importance of movements and bodily kinesthetics, which are not available in mouse and joystick controlled interaction. To include movement and kinesthetics in simulation we can allow the subjects to move physically around in the simulated environment. This is the most direct interaction possible for the interactive type of visual simulation. This requires a body-size simulation, e.g. with a real scale model.
Such a body-size environment can be abstract or more realistic, depending on the purpose of the assessment. For wayfinding research it is important to control the interference of mental maps. As for mental maps the literature distinguishes between the spatial cognition and environmental cognition (Kitchin, 1994), and it is important to consider this difference in the simulation. Whereas in environmental cognition the subjective interpretations and preferences of the subjects are an important aspect of behaviour, the simulation should have photographic realism when assessing this aspect. However where spatial cognition would be muddled by appreciation of textures and such, we should use neutral surfaces. In this neutral environment it is possible to include only the cues and landmarks which are needed for the study. For the urban environment Ohno et al. (1995) have applied such a neutral environment with addition of some cues. On the scale of buildings Passini found useful results on wayfinding in a body-size labyrinth built-up with identical door sized panels (Passini and Proulx, 1988; Passini et al. 1990). So there is already some experience about the use of models but it is scattered. We hope that in the future it will be possible to come to a coherent body of knowledge which will make attractive visualisations also really useful and efficient.

CONCLUDING REMARKS

At the moment one buys or programs a visualisation technique assuming that it is appropriate to one's intentions. Or the administrator will burden the user with one or other technique, because it is cheaper than others, or on the contrary because it is technically more advanced and expensive and therefore it is more prestigious to have it at one's disposal. If visualisations and simulations are to help us, we must be in the theoretical and practical position to judge them according to the purpose we want to deploy them for. In order to get there, we should try to contribute to the development of a theory step by step to direct us in our choices. Available visualisations and simulations should not define our research, our research should define them.

We still have a long way to go to make visualisations and simulations into models which fit our purposes, but we can make it happen.

By the way, we wonder what tsar Peter the Great of Russia would have said about the '97-MIR? A good predictive model wouldn't have been wasted there.

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VISUAL SIMULATION TECHNIQUES ON ENVIRONMENTAL COGNITION SYSTEMS

Frue Cheng
Department of Industrial Design, National Taipei Institute of Technology, Taiwan.

ABSTRACT Findings of the simulation experiments using simple (inexpensive) simulation set-ups which were conducted by students of the fourth semester course studying the furniture design. They worked on two different examples with an emphasis on communication and orientation systems.

Research findings of lightsimulation experiments at the SI with the emphasis on the miniaturization of simulation objects and optimisation of procedures.

INTRODUCTION The need for human cognition systems derives mainly from practical, social, and historical reasons. To feel comfortable, people need to know where they are and where to go. Identification and cognition are an interdependent process of communication.

Jean Piaget identified cognition as the process of unification and readjustment. The contents of cognition systems include the processes and behaviors of gaining knowledge.

Environment is considered as the integration of all elements surrounded by human life. The scopes of environmental design cover urban design and landscape; architecture and the interior; product and visual design. While the research on environmental cognition contains the viewpoints of various observers, they all deal with the basic elements of semiotics.

Semiotics is applied whenever observers start to think what they see is meant to be. To feel,
to experience, to think before behaving are the processes of cognition. The knowledge of human beings is derived from all kinds of experience (seeing, listening, touching, smelling and mixture of the above). These particular thoughts of semiotic theory were first voiced by Peirce; Bense and Walther (in Stuttgart) followed. In this visual simulation study, the method of constructing charts is used. The process of cognition is also the process of applying semiotics.

The visual simulation allows observers to see and to feel the virtual reality in planned situation. All information gathered by the observers can be formed to an integrated image. The simulation methods can be conducted either by computers or by models, or both. The process of experiment contains two parts: constructing models and conducting the simulation. This way, the expense and constraints concerning the factors of climate can be reduced.

ENVIRONMENTAL COGNITION SYSTEM AND IDENTIFICATION OF UNITS

System is defined as the integration of all separated units. The cognition system is defined by objects, human beings and ordered information chains. The scopes of environmental cognition can be classified as follows:

1. **sign:**
   a. words (characters, numbers)
   b. pictures (photos, tables)
   c. charts
   d. arrows (direction)

2. **product:**
   The system is usually determined by the order of the operation process of the product (i.e. vendor machine). The coding system of the interdependent units of a product or a system as well as their hierarchical relationships should be clearly defined.

3. **architecture and interior:**
   The observers' images become more important in this scope. Scales, proportion and boundaries are also basic requirements of defining the system.

4. **urban design and landscape:**
   The information becomes more complicated in an urban environment. The sources of information come from three dimension. (see figure 2)

PRINCIPLES OF SIMULATION AND CASE STUDIES

Simulation is often used in the process of designing, and it is a more effective research method when a reproduction of the real world becomes crucial under controlled situations. There are three functions of simulation: cognition, decision-making and transmitting. Model simulation is used in this research. The steps are as follows:
1. To define each unit of the whole cognition system.
2. To explore the contents of semiotics theory and cognition system.
4. To design, operate and test:
   a. field study
   b. model production
   c. designing and operation simulation
5. evaluation

In this study, the simulation models consist of three cases. Two were developed in Taiwan; the third was developed at the SI simulations laboratory of the university in Stuttgart. The first two study cases were conducted by forth semester students using simple and inexpensive simulation set-ups (they were part of a furniture design course). Special emphasis was placed on communication and orientation systems. The students work on four different examples, two of which are presented at Delft. (see figure 3, 4)

The third study case at Stuttgart consisted of light simulation experiments, since the orientation marks are different during day and night (see figure 5). The research topic was the orientation by light. The same urban setting was chosen as in the Imaging Imagination Workshop at Delft.
CASE STUDIES FOR LIGHT SIMULATION  The starting-point of such a concept, can only be the urban or the relevant town quarter. In this case the light designer relies upon the same methods of analysis as urban designers.

He looks for characteristic marks such as breadth and height of the street spaces, historical, precious and monument-protected buildings. He looks for the alternations between green spaces and the built quarter, waterfronts and the urban structure, since the border areas are full of tension. He studies the general traffic-plan, as well, and takes into consideration different aspects of traffic related to lighting.

Finally he must consider all functions, since where there is activity, lighting is required.

Thus, the entrances to public buildings like City Halls, theaters, railway stations are to be lighted well in order to emphasize their role in the townscape.

Principles of design for orientation by light (according to A. Markelin):
1. The important urban landmarks should be visible during day and night: the town structure, the net of main streets, the dominants.
2. The characteristic street spaces should be visible through lighting.
3. The town lighting should emphasize the city skyline.
4. The townscape should be recognizable in the darkness.
5. Characteristic street spaces should be emphasized in their peculiarity.
6. The form of destroyed street spaces should be reconstructed with the help of lanterns.
7. The reflection caused by water should be considered.
8. Important dominants as well as single beautiful facades, pieces of architectural art can be made to attract more attention at night as during daytime.
9. Use of the street, reps. traffic participates in determining the character of street light.
10. Especially the pedestrian scale can be emphasized through lighting.
11. The view of the dominant buildings should not be disturbed by dazzling lanterns or advertisement.
12. Richly decorated historical buildings do not accommodate and need extra decoration through special lamps, but require only lighting.

The aim of the simulation was to find out, how different available lamps can be simulated in models. In this context the complicated light-distribution curves of the lamps should be reconstructed as correctly as possible. By changing the transparance and faintness of the lamp-shade and diameter of the light-transport fibre we can influence the light intensity. In case of rough surfaces the light emerges as diffused.

For our experiments at the SI simulations laboratory of the university in Stuttgart we used light-transport fibres as lightsource. Specific places...
auf situation in Imaging Imagination should be simulated by lamps constructed by use in the
scale 1:200. (see figure 6 and 7)

CONCLUSIONS
1. The processes of environmental cognition for human beings are very similar regardless of
environmental context. The process of cognition is the process of applying semiotics. Sense, experience, and cognition are the recycling steps to acquiring knowledge.
2. The usage of model simulation can compensate the traditional training method of design
education. The time-saving, and the good quality of visualization are great advantages. Visualisation aids the decision-making process and the evaluation of a study, as well.
3. The outputs of the simulation:
   a. Good quality of resolution obtained by using relatoscope.
   b. Good viewing angles, which compare with other methods.
   c. Video equipment can be operated at the same time.
   d. Good quality of resolution obtained when images are sent directly to a computer mon­
      itor.
4. In our opinion the simulation technique with the help of light-transport fibres satisfies the
   demands very well.
5. The density of the light can be adjusted to the loss of light in the selected recording
   method through the number and diameter of light transport fibres.

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FURTHER DEVELOPMENTS ON LIGHT SIMULATION

Arpad Pfeilsticker
Department of Urban Design, University of Stuttgart, Germany.

Endoscope or computer simulation? A light simulation was conducted by students on a building at night-time in Stuttgart using an endoscope as well as a computer. The findings will be presented and assessed up until now it has always been a problem how to achieve a true-to-life distribution of light in models. In the course of a study project, students tried to develop procedures for the simulation of light distribution curves of existing lighting in the models.

FURTHER DEVELOPMENTS IN ANALOGUE LIGHT SIMULATION

Objectives It was the objective of our student seminar to reconstruct an ordinary street light in different sizes and to simulate their illuminating effect according to their light distribution curve or its isolux curve in the context of urban planning. As light source we used glass fibre conductors with a diameter of 1.5 mm. We intended to obtain a simulation to a scale of 1:50 or 1:100.

Methods To begin with the students studied the illuminating effect of the glass fibre conductors, first without any kind of housing. Later they tried out different kinds of housing or shades of polished, partially mirrored or more complex ones made from "plexiglas" or perspex housing. With the help of these different lights students attempted to direct, focus or disperse the light emanating from the light conductor into different directions. The results of the tests, in which light was directed through the plexiglass housings then formed the basis of the student's concepts for the simulation of light distribution curves of different luminaires. Using true-to-scale light distribution curves the students were able to assess the findings of the simulation tests.

Findings

See Figure 1 and 2

Figure 1

Figure 2
Conclusion  The findings of the seminar clearly show how in light simulation good and realistic results can be obtained by miniaturising luminaires and by translating their optic systems into the smaller scale of the model - for example by using full mirrored housings instead of reflectors. Miniaturisation, however, also shows up the limitations (of this method). Effective control of the direction of light in accordance with a light distribution curve is only possible up to a scale of 1:50 and in some special cases up to 1:100. If working on other scales the light distribution of a model light will give only a rudimentary idea of the light distribution in the real-life situation, so that what can be assessed or simulated is merely the mood a certain light would create but not the exact lighting situation. At a scale of 1:50 light simulation models have to be detailed to a very high degree in order to achieve satisfactory results, i.e. which are not too rough to be of any use. This means that a lot of effort goes into the construction of the model and it should thus be considered whether in this case other simulation methods might not be more efficient.

The big advantage of computer simulation, for example, is that once an object has been designed it can simply be reproduced as many times over as desired. Here a highly detailed lamp would have a positive effect on the simulation and not too much time would be lost in the construction of the model.

COMPUTER VISUALISATION VERSUS ANALOGUE SIMULATION - A COMPARISON ON THE BASIS OF THE GUTBRODHAUS BUILDING

Objectives  Since the emergence of computer simulation of architecture people keep asking me why I still preferred to use the “obsolete” method of analogue simulation in an age when computer simulation was in every way superior. My answer was simple: I get my job done quicker using the analogue method and I like the result better.

After a while, however, I decided that the time had come to prove whether this statement was still valid. So I started the following study with a small group of highly motivated students:

We visualised a real building using traditional endoscope simulation and computer simulation. I have to point out that my students had had little or no experience with either endoscope or computer simulation. So I can state with some confidence that we had the same conditions for both tests. During the project we recorded how many hours the students had worked on the tests so that a final judgement on the overall effort would be possible.

Procedure  Once the group had conducted comprehensive research work and got together all the necessary planning material it decided on the most suitable locations for the out-take stills of the simulation, then it produced real photos onto which the simulation images were to be photo-montaged later.

1. The group then started an analogue simulation which involved the following steps
   - construction of a model
   - production of daylight stills
   - and, finally, stills taken at nighttime,

2. In part two of the study we conducted the digital simulation involving roughly the same steps.

3. Part three of the study involved incorporating the simulation out-takes into the real photos/takes as well as drawing the necessary comparisons and attempting an assessment.
Analogue light simulation
See figure 3

Construction of the model
The model was built as a simple back-drop model, i.e. the rooms were constructed immediately behind the windows of the model in order to create a real feeling of space when looking into the window during simulation.

Materials used for the model were cardboard, "plexiglas"/perspex, styrodur, wooden planks and round metal bars.

The shop windows were made from paper cuttings pasted on boards.

Simulation
There is no need for me to describe the simulation of the daylight stills as you know the necessary procedure. The night-time stills were made using a technique which I developed myself and which I had explained at the first EAEA Conference.

Digital simulation
See figure 4

Construction of the model
We started the construction of the digital model using a Pentium PC 166/64 MB Ram Win 95 and the CAD programme Allplan. However we soon discovered that we would encounter a lot of problems trying to transfer of data into the simulation software. So we decided to continue with ACAD 13 on a Sun-workstation sparc 10. Here too, we constructed only those parts of the building which would be relevant for the simulation.

Simulation
For the simulation we had a Pentium PC 133 Mhz 32 MB Ram with Windows NT and 3D studio-max visualisation software.

Simulation results analogue/digital Figure 5 and 6.

Taking a close look at both building simulations I would tend to say at the moment that if you use the analogue method you obtain visualisations which have more atmosphere. However, there are two important points to make. Firstly, the possibilities of analogue model simulation have been exhausted - we cannot expect any further developments. Miniature or fingercameras are going to be used in and facilitate part of the endoscope simulation. However, the model certainly remains the limit analogue simulation. The options of visualizing objects which are not part of the model are very limited.

Secondly, digital simulation is at the very beginning of its development. I emphasize the "beginning" because in the coming years there will be a lot of progress regarding manageability and performance of the visualisation programmes. The best example for this is the software 3D studio max. which we used for this simulation. If you consider that 3D studio max is not a high-end visualization software the results are amazing, the more so because the photos have been made by students who had never worked with this software before.
Photo-montage  In order to photo-montage the simulation out-take into the real photo we used the digital technique. As a platform we had a mac power pc with 80 MB Ram and a slide scanner. We used photo-shop 3.05 in order to work on the stills.

We found out that certainly from this stage onwards using digital techniques has definite advantages as there are so many different possibilities how the images can be manipulated so that differences of perspective between real photo and simulation can be corrected. Working with digital simulation fewer corrections of perspective are necessary because it is easier to determine the exact recording position for the camera.

Simulating a building without its environment substantially accelerates visualization. While on the one hand this simulation saves time, analogue simulation images are of poorer quality when they are being processed.

In order to speed up the process of photo-montaging the images digitally onto the real photos it became necessary to reduce resolution down to 500 DPI. Compared to a 24 x 36 mm slide made with a pocket camera this resolution appears low indeed and this means that in the last run analogue and digital stills are of similar brilliancy.

Findings  The photo-montage shows the surrounding environs with integrated endoscope simulation (See figure 7).

Real situation Gutbrodhaus at night-time.

Analogue and digital simulation photo-montaged onto the real image/picture.

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How much effort is required in order to produce these simulations? Digital simulation is ca. 30 % faster than analogue simulation. However, the table needs to be explained in more detail.
1. We produced the analogue simulation before the digital simulation - this means that we were able to use the experience gained in the process of analogue simulation.

2. The simulation times demonstrate that the digital method is faster by a factor of two compared to analogue method, for the following reasons.

   The complicated set-up for the night-time pictures of analogue simulation means that two people conduct the simulation, who, taken together, have to wait twice as long during long-time exposure (i.e. ca. 6-10 minutes).

   The process of developing the slides means that the work has to be interrupted for some time if simulation stills are to be assessed before new simulations can be made.

   Given a certain scale, the results of digital simulation can be rendered without loss of time and any corrections can be undertaken immediately. Moreover only one person is necessary in order to conduct a simulation.

   Of course this is not a representative study. It was made with only one group of students working on only a single project. This is why it does not allow general conclusions. But it shows up which stages of the different simulation methods are particularly time-consuming.

   I do not think, however, that the future will belong to the one or to the other technique exclusively. Each technique should be used when it can be used most effectively.
PRESENTATION ON THE NEW DELFT ENDOSCOPE LABORATORY
THE NEW DELFT ENDOSCOPE LABORATORY

Jan van der Does

**INTRODUCTION**  During the 1st EAEA conference, held in Tampere in 1993, endoscopic video simulations from a study entitled "The Art of Representation", in which endoscopic video images were compared with drawings and computer images, had been assembled with rented equipment. The reason was that the review report following an inspection of the Faculty's endoscope showed that it no longer met the standards required for research purposes; in addition, the mechanical and electrical parts of the 25-year-old equipment had worn badly. Inquiries were made of several European faculties, whereby valuable information about a state-of-the-art endoscope was received from Tampere and Vienna. A schedule of requirements was then drawn up for the endoscope renovation, which was to be carried out in cooperation with the head of the Faculty's educational and research services. Mechanical and electrical specifications for control systems, lighting, recording equipment, and such things as a table and type of background were worked out in close collaboration with specialists from the professional community. Subsequently, a tight schedule was drawn up for the renovation.

The technical staff of the University's Central Workshop developed the endoscope which was assembled and installed by our own staff.

The light grid ceiling was designed and produced by G. Bulten of Burst Video, Veenendaal.

**THE ENDOSCOPE STUDIO**  The table on which to place models measures 2 x 4 square metres. Behind it is a smooth, grey 'backcloth horizon' which is dimmable in sections to emulate the light pattern of the sun behind clouds. Eight frames over the table represent a light dome with a maximum luminous intensity of 17,000 lux, 3,200° K; here too lighting is regulated with dimmer switches. Spotlights are used for artificial sunlight. The endoscope hangs over the table and is mounted on wheels, which allows horizontal movement along the X-Y plane; for movement in the Z direction (0 - 60 cm) a height adjuster is fitted at right angles to this plane. Speed is regulated by sliding pedals. Camera movements are secured.

The endoscope can be used on models to four scales: 1:50, 1:100, 1:200 and 1:500.

To help orientation when the endoscope is moving, a colour camera registers top views of models and the route along which the endoscope head moves. Recorded images are carried to a monitor on the operating panel.
The endoscope studio is equipped with a video printer and a Super HVS recorder/player, the images of which can be viewed on a separate monitor. The video studio provides for a combined use of the endoscope camera and two colour cameras. Pictures can be previewed with the aid of a monitor in the endoscope studio. There is an intercom for communication.

**USE OF THE ENDOSCOPE**  The endoscope is used by staff and students in media courses in the third and fourth years of study and for research purposes.

**TECHNICAL DETAILS**

Endoscope camera; Panasonic colour, 3 CCD 1/2", C mount, Pal Colour System CCIR, type GP-US 502°

Endoscopes; Wolf, with tilting mirror, horizontal angle - 21°. Wolf endoscope, horizontal angle 35°. Overall view camera; Panasonic colour 1/3", type WV-CP-410, screen size 44 cm (vertical) x 58 cm (horizontal).

Analogue camera rig; range of movement: X direction: 2 m, Y direction: 4 m, Z direction: 55 cm.

Angle of view: rotation of angle of view, 120° round the Z axis.

Media 100: digital editing of analogue video tapes.
IMAGING
IMAGINATION
WORKSHOP
IMAGING IMAGINATION

Exploring the Impact of Dynamic Visualisation Techniques in the Design of the Public Realm

Workshop as part of the third Conference of the European Architectural Endoscopy Association
THE DEVELOPMENT OF THE IMAGING IMAGINATION WORKSHOP

The conference workshop in Delft was a follow-up to workshop sessions during the two previous EAEA conferences. In Finland, in 1993, the conference participants took part in a design exercise, making active use of the Tampere University endoscope facilities. In Austria, in 1995, conference participants were invited to contribute to the workshop ‘the (in)visible city’. In this case a model had been prepared, scale 1:500, of a part of an ambitious urban masterplan for the old airfield of Aspern, near Vienna in Austria (designed by the Viennese architect Rüdiger Lainer). The scale model subsequently travelled to the institutes that had indicated they were willing to contribute to the workshop. On the basis of this model each institute prepared a design presentation which was shown at the conference, chaired by Bob Martens at the University of Vienna (for more information: see the Proceedings of the second EAEA conference).

The (in)visible city workshop formed the inspiration for the conference workshop prepared by the Delft Media group for the third EAEA conference. Our contribution to the Vienna workshop had proved useful as a case study object in the Media group’s design visualisation research and subsequently formed the basis of an educational experiment: ‘Learning from the (in)visible city’ (for more information: see the paper ‘Modelling for eye level composition’ in this publication).

The theme - Imaging Imagination - was inspired by the term imaging, introduced by John Zeisel as a characteristic ingredient of design in his influential book ‘Inquiry by Design’. Zeisel argued that imaging is an essential design activity, as the designer has to steadily create design images throughout the different phases of design. These images communicate the intentions of the design (as far as they are known at that point) to the critical designer and his/her team, but also to others involved in the design process, such as the client(s) and different other actors influencing design decision-making.

The organisers of the 1997 workshop were curious to see how Endoscopic imaging techniques might be able to stimulate the imagination in the design process. Again: this may concern the stimulation of the designer as well as the involvement of the other disciplines involved. We hoped a workshop situation might provoke insights into this essential aspect of creative design. Another point of interest was how different optical endoscopic approaches might compare to emerging computer visualisation techniques. The workshop was envisaged as a ‘marketplace’ for methods and ideas, where colleagues would meet and openly discuss the impact of
existing techniques and the potentials of new ones. The object of the workshop was to include - and confront - both optical and digital Endoscopy techniques.

The method adopted for the workshop at Delft was comparable to the set-up in Vienna. Again a design task would be set beforehand and would be forwarded to the participants, who would then prepare a contribution prior to the conference. This time the model would, however, not travel from one institute to the other, but a relatively simple model set would be sent to each participant separately. The Media group decided not to choose for a more or less 'interior' scale for the design visualisation task, but opted for the scale of the urban ensemble, a design context for which we believe Endoscopy is most often - and most effectively used.

The idea was to keep the design task relatively simple, with a clearly defined set of constraints, in the hope that this would facilitate the comparison and evaluation of the contributions, on the level of the quality of design proposals as well as concerning the specific technical solutions.

A design task was chosen which is a variation on a Form Studies exercise at the Delft Faculty of Architecture in the educational Block number 3: 'The City'. The site is an imaginary situation on the edge of a Dutch city (see chapter 'The workshop task').

The choice was made for a scale model 1 : 200 in addition to a computer model. To suggest a sufficient sense of 'place' and a basic level of 'realness' in the model of the surroundings, a texture mapping technique was adopted which had been developed by the Delft Media group for the (in)visible city models. This entails the 'sampling' of images and subsequently applying these as a kind of urban 'wallpaper' onto the elementary geometry of the building blocks. This technique only leads to something approaching a correct spatial image, as there is no reliable perception of 'depth' in the simulated eye level views. However, this approach works relatively quickly and the Media researchers in Delft were interested to find out how experts from other institutes would respond to this technique.

The facade 'textures' were taken from real buildings in the recent, southernmost, housing development of Delft called the "Tanthof". On a bicycle trip through the area, images were collected using a digital photo camera. From these images a selection was made which were 'straightened' using 2D photostyler software in the computer. The flattened elevations were then applied as texture mappings in the computer model and used as 1 : 200 elevations for the scale models.
THE WORKSHOP TASK  Each of the institutes that had shown interest in the workshop was sent a set of material, consisting of a model set for optical or digital visualisation. A number of institutes received both.

In addition, each received a written text with plans, amounting to the 'rules' for the workshop exercise, plus a questionnaire meant to gather data about the technical aspects of the presentations and specific experiences or suggestions.

The following workshop information was sent to all the potential participants:

Dear Workshop participants, we are very pleased that your institute is willing to contribute to the Imaging Imagination workshop as part of the third EAEA conference.

At this moment a total of 14 institutes have indicated that they will be preparing material for the workshop. Of these 5 will be preparing Optical Endoscopy proposals and 5 will be using Computer Visualisation techniques, while 4 institutes plan to use both techniques.

The Workshop 'Imaging Imagination' forms a part of the third EAEA Conference to be held in Delft on August 27, 28 and 29 1997. Participants are invited to prepare contributions to the Workshop by creating design images which will be presented and compared during the conference and evaluated in the Proceedings, which will be published after the conference.

The contributions are to be prepared by the participants at their institutes prior to the conference. The workshop results will be presented and evaluated at the conference on the 28th of August. Material should be brought to the conference for exhibition and presentation. Participants who are not able to present their contributions at the conference should forward material to the conference organisation beforehand.

Design Media  Participants can employ different design media, the first being a combination of scale model and Optical Endoscope. For this purpose a standard model set will be forwarded to those participants who indicate that they will be using optical Endoscopes. The scale of the model components is 1 : 200. The design can be worked out on a standard cardboard base measuring 50 x 50 cm. This should be brought to the conference, where the different design models can be compared and viewed in the Endoscope of the TU Delft.

In addition, it is possible to prepare design views by using Computer aided methods for design visualisation. An AutoCAD/3D-studio computer model of the design surroundings will be forwarded on floppy disc to those participants wishing to use CAAD.

Institutes taking part may choose to present plans using either one of these visualisation techniques, or both. The design task is considered as a vehicle for a comparative study of design visualisation approaches using optical or digital visualisation techniques. During the conference the qualities of both techniques will be compared and discussed.

The merits of different design solutions and how these are reflected in the visualisations will also be the subject of discussion and evaluation.

The main objective of this workshop focusing on the perception of the public realm, is provide a friendly confrontation of different working methods and technical approaches concerning dynamic design visualisation.

Design and Visualisation  Task The task for the Workshop can be compared to a limited design competition set by an imaginary Dutch town council for a site at the edge of an equally imaginary Dutch city. The overall measurements of the site are 100 x 100 metres with two incisions on opposite corners (another way of considering the area is as two overlapping squares, each measuring 65 x 65 metres). (see figure 1)

This level, open space is bounded on three sides by housing blocks of varying height (blocks of 3, 4 and 6 stories). The fourth side has been left open and offers a view over an extensive, typically Dutch polder landscape. A minor road runs across the site, dividing it into two unequal parts.
At the beginning of this fictitious design competition, the surrounding buildings have been determined, but the site is an unattractive open plot of land with no form of articulation whatsoever. Participants are asked to work out a 'scenario' for an attractive public environment, with a clear relationship to the surrounding buildings, but with specific qualities (in the words of the influential Dutch architect Aldo van Eyck: "a sense of place and occasion").

Although a certain openness is to be maintained, the designers are asked to introduce one or more 'primary' elements in the form of compact buildings: pavilions that might house communal facilities. Such built forms should be placed and shaped strategically, so that the hitherto empty site will acquire a new level of spatial articulation and differentiation.

In addition 'secondary' elements may be introduced, such as for instance differences in ground levels, surface treatment and paving, (semi) transparent screens or rows of streetlights and of course trees...

The aim is to create a spatial composition which should offer interesting, varied spatial experiences against the backdrop of the existing buildings, particularly when viewed at a pedestrian level.

It should be clear that the design and visualisation task is primarily concerned with the open public space and not with the surrounding buildings. However, if it is considered necessary to change aspects of the buildings which could influence the spatial experience, it possible to introduce alterations into the design context. This might involve changing the 'design' of the end elevations of the blocks, or possibly the extension of one or more blocks by adding extra building volume. For Optical Endoscopy participants it is advised that this should be done in such a way that the underground will remain removable and can therefore be inserted into the Endoscope model in Delft for viewing during the conference.

The road should not be considered as a great problem for the development of the plan. It should be imagined as a not particularly busy street with occasional car and bicycle traffic. It is possible to pay attention to the way in which the crossing of pedestrians should be worked out and to ways in which car drivers might be made aware that they are approaching a public square and will be cautioned. The basic profile of the road may be articulated further. Apart from this road it is not necessary to create special facilities for cars. The site is intended to be car-free, only to be used by pedestrians - and perhaps bicycles. The surrounding houses can be reached via other streets, so no roads need to cross the public space which is to be designed.

The new building pavilions which are to be introduced can contain any kind of (public) facilities which the designer(s) consider necessary. In principle it is not the intention to create more buildings for housing.

The new functions need not be specified. What is expected primarily is an indication of the placing, shape, scale, structure and possibly a suggestion of the kind of architectural expression which might be expected in the new buildings. The architectural plans and interiors do not need to be worked out in any way (this would be the subject of a theoretical next design round, this phase is primarily intended to lead to an indicative
The site is flat, but differences in ground levels may be introduced. In principle, there are no limitations to changes above the basic ground level. Changes in ground level downwards are limited to a maximum of 60 cm, due to the underground waterlevel which lies at this depth under the existing surface (this corresponds with the thickness of 3 mm of the Optical Endoscopy cardboard groundplate). This underground waterlevel corresponds with the water in a small canal which forms the boundary of the site on the side of the typical open polder landscape. In the design this drainage ditch should in principle not be bridged, however it is possible to introduce some form of terrace against or even over this canal boundary. It is also possible to introduce water into the rest of the plan area.

Besides primary architectural elements and variations in ground levels any number of secondary spatial elements, such as different types of paving or grass, boundaries and screens, streetlights, masts or signs, ‘green’ elements such as trees and other items which can convey a sense of scale may be introduced as compositional ‘layers’ of the design. One of the aims of this workshop is get insight into the different materials and techniques used by the participants in modelling and visualising their proposals. Besides more sophisticated modelling solutions, approaches which make use of more informal, experimental modelling techniques are welcome.

**Presentation**

The emphasis in the design presentations should lie on the visual experience at ground level. Participants are encouraged to investigate and present the qualities of their proposals using dynamic means of design visualisation. This can mean either a ‘serial vision’ approach using a series of static images or a flowing motion sequence approach using either Optical Endoscopy or Computer Animation techniques. Each participant will be asked to prepare a compact set of images: six ‘stills’, which are to be taken from previously specified spots, looking in a given direction (see the scheme). These sets of design images will form the basis of the exhibition and presentations during the conference and will be used for the comparison and evaluation of the different approaches and technical applications. The quality of the designs and the ways in which these are visualised will also be considered and discussed.

During the conference a limited amount of time (approximately 5 minutes per plan) will be available for additional video/slide/Cad presentations.

The presentations should be primarily aimed at creating insights into the qualities of the design proposals for the benefit of the ‘client’ (firstly, the fictitious town council committee, but also for other possible ‘actors’ in
the design process, such as citizens concerned about the impact of the proposals on their neighbourhood). For this reason participants are requested to prepare images simulating visual impressions at street level.

The essential piece of workshop 'output' per contribution will be the six 'stills' as indicated in the scheme. You are required to prepare these as photographic prints 10 X 15 cm. These six photographs should handed over to the conference organisation at the beginning of the conference. This set of photographs will remain with the Delft Media group and will be used for the workshop exhibition and for the proceedings. Please note on the back of each photograph the name of your institute and the number of the ‘take’ (number 1 to 6 corresponding to the numbers in the scheme).

The camera situations numbered 1 to 6 are of course indicative. If for some reason it is impossible to create a reasonable view from the predetermined spot, because for instance there is a building or some other object situated there, please choose a similar location in the vicinity which will offer a useful view. Please indicate different camera standpoints on the scheme which is included. Besides the eyelevel 'stills', it is advisable to include a plan or an overview of your design.

Apart from the photographic images, participants are stimulated to create dynamic images of their proposals as perceived in motion, documented on Video or computer files.

We invite Optical Endoscopy participants to bring their 50 x 50 cardboard inset to the conference so that these scale model proposals can also be exhibited and viewed in the Endoscope of the Delft Architecture Faculty during the conference.

**Procedure** The results should be brought to the conference and the basic set of six design images handed over at the beginning of the conference for exhibition. In addition the participants will be asked to complete a questionnaire, which will be used to evaluate the different design strategies and working methods and their impact.

Institutes participating may prepare one or more proposals. Besides members of staff, students may be involved in preparing design images. If your institute is presenting more than one plan, please indicate this clearly by using a letter code or motto per plan variant which should appear on all documents which are to be handed over to the Delft Media group. Please indicate on the questionnaire (which will be sent to you shortly) the names of the persons who contributed to each proposal, specifying those involved in the design and those responsible for modelling and visualisation, plus the status of each (academic staff, student, professional).

**Material to be presented to the conference organisation on the first day of the conference:**
- The six Endoscopic images (15 x 10 cm) from the previously described viewpoints, either as photographs or Computer images.
- The design models themselves, either as 1 : 200 scale models on the cardboard base or as computer files.
- Filled in questionnaire (the form will be sent with the next conference mailing, second half of June).

Besides the six still images of the pre-defined viewpoints, you can present dynamic visualisations on videotape. Digital documents (images, VRML models, AVI or QuickTime files) can be handed over on floppy disks or ZIP drives, formatted for MS-DOS / Windows computers.

We look forward to your contributions and to seeing you at the conference!

The Delft Media group.
THE WORKSHOP CONTRIBUTIONS  Eventually, the input to the conference workshop amounted to fifteen different entries, of which eight were prepared using optical visualisation techniques and seven using computers.

At the beginning of the conference, the participants handed over their material: the 'stills' which had been requested for the workshop exhibition, videotapes and computer files.

Using the still images taken from the predetermined positions in the model, a data 'wall' of images was made, which could be viewed during the afternoon of the workshop session during the conference.

During the project presentations, additional images on slides, video or computer format could be presented and some of the design models brought to the conference were viewed in motion using the recently renovated Delft Faculty of Architecture endoscope.

On the following pages, each of these contributions is presented in the form of a project 'file'. In principle the set-up for each project presented in this overview is the same:

- Basic information, including the name of the Institute and the names of researchers and/or designers participating in the project and the specifications of the apparatus used for the design visualisations. In addition, specific remarks from the workshop questionnaire are summed up.

- A vertical band of small images on the left hand side, corresponding to the positions in the given path (see plan of the site) from which these images have been taken. In principle the top photograph is an overview (0) followed by six images taken from viewpoints numbered 1,2,3,4,5 and 6 (see the example for the organisation of the images in the side line of this page). In some cases the photographs do not correspond exactly to this set-up, in which case a compromise has been made. Some participants brought more stills than specified (for instance showing various extra viewpoints, design alternatives or a simulated night situation). These are to be found in a similar band on the right hand side.

- Selected images are shown in a larger format. This may concern one or more pictures from the basic set of seven, or may consist of some extra information, such as a drawing, a detail or one or more prints from a video presentation.

- Each of the presentations is accompanied by a short description of the project (drawn up by the Delft Media group).

In addition, a videotape has been prepared of the conference presentations and also the workshop projects can be viewed using a special web-site: http://www.bk.tudelft.nl/GTM/Media/eaea/1mim/index.html.
TOKYO INSTITUTE OF TECHNOLOGY, JAPAN

Design & Visualisation:

Ryuzo Ohno (rohno@nc.titech.ac.jp)
Masashi Soeda (msoeda@nc.titech.ac.jp)
Takuya Imai, Rieko Tsujiuchi

Visualisation:

Ryuzo Ohno, Masashi Soeda
Ryoichi Yanai, Yoshiharu Matsuda, Hirofumi Aoki

Institute:

Department of Architecture and Civil Engineering
Tokyo Institute of Technology, Dept. of Human-Environment Systems
4259 Nagatsuta, Midori-ku, Yokohama, 226 Japan
Phone: + 81 45 924 5613
Fax: + 81 45 922 3840

Used techniques:

Endoscope, Olympus OM-1

Questionnaire Remarks:

The design and visualisation group of the Department of Human-Environment Systems is satisfied with the context model and the use of texture maps as far as this scale of design task is concerned. They emphasise the use of movement in visual presentations because of the subtle changes in view that occur. The six given viewpoints for the workshop presentation are not sufficient, as they do not show these gradually changing views.
PROJECT  A sophisticated environmental design.
The environmental simulation project of this subdued, yet powerful
design proposal appears to spring from the poetic, spiritual design
approach customary in traditional Japanese garden composition, yet
absorbing a present day (and even futuristic) choice of materials and
atmosphere.
While the overall impression of the design is one of controlled ele­
gance, incorporating circular and geometric shapes, the emphasis lies
on the dynamic, ‘scenographic’ experience of the composition.
The model, mainly made of white elements with green accents, shows
two major parts: a crescent shaped ‘theatre’ on the landscape side and
a more subdued formal ‘garden’ on the side of the buildings, incorpo­
rating suggestive, high tech transparent plastic rods distantly reminis­
cent of bamboo bushes. The two major parts of the spatial composition
are linked by an adventurous, meandering path, with an emphasis on
the middle of the route.
The potential of the plan comes to life clearly when perceived from an
eye level viewpoint, either in serial vision (for instance in a series of
photographs, as prepared for the conference), or in flowing motion
(using the moving endoscope as was demonstrated during the work­
shop sessions in Delft).
Besides paying attention to the daytime experience, the designers con­
ceived a true metamorphosis of the design elements in the plan, which
will light up in the evening, creating a contrasting (but complementary)
night-time experience.
Design & Visualisation: Arpad Pfeilsticker ¹
Frue Cheng ²

Institute: ¹ Universität Stuttgart, Architektur und Stadtplanung, Simulationslabor am Städtebaulichen Institut, Keplerstrasse 11, D- 70174 Stuttgart, Germany. Phone: +49-711-121 3374 Fax: +49-711-121 3225.
² National Taipei Institute of Technology, Department of Industrial Design, No1, Section 3, Chung-Hsiao-E.RD, Taipei, Taiwan, R.O.C. Phone: (008862)7712171-2822 Fax: (008862)7317259.

Used techniques: Full moving endoscope-system 2,5 x 4,0 m; Stortz 0°/ Stortz 90° / Photo Perspectar 90° endoscopes; Kobold DLF 400 SES Daylight system; Videosystem: U-matic low band / S-VHS / VHS

Questionnaire Remarks: No information available.
**Optical Endoscopy**

**PROJECT** An evocative example of a ‘film set’ approach, particularly in creating a night-time atmosphere. By manipulating a relatively simple, almost ‘sketchy’ scale model, surprisingly convincing images were created. The model incorporated sufficient detail (for instance printed structures on the ground) to acquire a sense of scale when viewed with the optical endoscope.

Special elements such as an adventurous climbing rock were instrumental in creating an effect of excitement and activity. In the video production of the plan, this atmosphere was underscored by an effective use of music and background sounds. Also, the use of human figures and urban design elements such as street lights (in both the daylight and the night-time simulation) were instrumental in conveying the message of the design. The perfection of the video production, incorporating varied video footage and suggestive use of background noises, such as footsteps, drew extensive response during the discussion (including mild criticism that the footsteps were perhaps too hurried).

A particularly impressive aspect of this production is the extensive use of miniaturised night lighting. For this project, an integral lighting plan and special types of light fixtures were developed (for more information see: Frue Cheng’s paper ‘Visual Simulation Techniques on Environmental Cognition Systems’, included in these Proceedings).

The project shows the effect of a creative fusion of a professional scenographic approach and technical innovations in modelmaking and miniature lighting technology, and is a good illustration of the specific opportunities for night-time environmental simulation using Endoscopy.
NAGOYA INSTITUTE OF TECHNOLOGY, JAPAN

Design: Masato Shimize, Eiji Koyanagi, Koshi Sakuragi, Takuya Saito,
Visualisation: Naoji Matsumoto (matsumoto@archi.ace.nitech.ac.jp)
Shigeyuki Seta (s-seta@alpha-web.or.jp)
Toshiki Kono, Eiji Koyanagi, Koshi Sakuragi, Fumiaki Aono, Yosuke Sada
Takuya Saito, Naoki Fujiwara

Institute: Nagoya Institute of Technology, Matsumoto Laboratory
(http://archi.ace.nitech.ac.jp/matu2/index.html) and Tobishima Corporation.

Used techniques: Endoscope f=5.5, 3CCD, SVHS, background: chroma-key, mechanical / electrical camera movements, more direct spotlights.

Questionnaire Remarks: The design and visualisation group of the Matsumoto Laboratory mentions the great importance of 'eye-level views' during all kinds of design tasks. The 'birds eye view' is less often used, but instead a dynamic view is used to get a better insight during the design. Such 'views in motion' are made by moving the eye along the sides of the model, by real-time endoscopic movements and by video recording and play back. The dynamic visualisation tells the designer and the client more about the atmosphere of the site than static images do.
PROJECT  A dynamic, elegant - and potentially very feasible - planning proposal, coupled with a convincing design visualisation.
The team from Nagoya's Matsumoto lab. succeeded in creating a complex, yet balanced plan with different facets. The strategy followed is to offer an interesting, varied public space with two strategically placed, well articulated pavilions (a smaller pavilion close to the housing and a larger one facing the open landscape).
In the model these two buildings have been worked out effectively, suggesting a visually convincing level of detail. Further aspects of the plan included a pyramid shaped gate, integrating water and accentuating the main diagonal axis. In the central part there is an area with special paving textures, creating an in-between realm where the axis crosses the road, overlooking geometrically ordered flowerbeds and a walled bridge towards the main pavilion, which has been raised by introducing different ground levels (see the plan with specific explanations).
The design sensibility demonstrated in this plan could perhaps be considered typically 'Japanese' as in this plan there are also undertones of traditional Japanese garden design, using contemporary forms and materials. However, the impressions created suggest that this composition would certainly not be out of place in the typically Dutch locality of the workshop site. The flowing visual impressions of the different places and routes through this sympathetic plan were created using the head mounted, highly interactive optical Endoscopy facilities of the Nagoya laboratory.

Overview of the plan:
1-6 = places where we took a picture.
a = This main pavilion has the image of one wing of a windmill, and the function of this pavilion is meeting facilities in the region.
b = The mound in the plaza gives the level change to the flat site.
c = Flowerbed
d = Water springs up from the 'mountain' and becomes a 'river'. The flow from the river is poured into the 'sea'.
e = The pyramid type gate invites and pours water, it is in symmetry with the main pavilion and becomes a landmark.
f = The secondary pavilion has the image of the wing of the windmill just like the main pavilion. It improves the unified feeling of the space, the function of it is a toilet.
g = The change in the texture connects the two squares, divided into parts by the road. It has the image of the polder which extends from the water.
h = The walls provide for an approach space. People feel the flow of the water and the gravity by the slope, and approach the entrance.
TECHNICAL UNIVERSITY DRESDEN, GERMANY

Design & Visualisation: Ronald Franke (franke-r@Rcs1.urz.tu-dresden.de)

Institute: Modellsimulationslabor, Technische Universität Dresden, Institut für Gebäudelehre und Entwerfen, Mommsenstrasse 13, D-01602 Dresden.
Phone: +49-351-463-5083, 463-2210, 463-4796
Fax: +49-463-2395

Used techniques: A miniature video camera (17 mm diameter x 48mm); S-VHS recorder; computer controlled moving system 2x3x1 m (x,y,z) with speed control; the route through the model is furthermore programmable by a computer and navigation is possible with a joystick.

Questionnaire Remarks: No information available.
PROJECT  A good example of the way in which Endoscopy can be used to evaluate the opportunities of different, intermediate design proposals during the development process and how in this way the making of choices concerning architectural form can be facilitated.

Other than the optical design experiments of the Vienna group, who refined one fundamental design concept, the group from Dresden initially generated a number of quite distinct options for the site. These design concepts were compared and documented in a systematic way, allowing for comparison and design decisionmaking.

Subsequently, a basic strategy was determined and this was developed and articulated further in a number of steps. The basic design evolved from a more or less ‘immortal’ model composition to a specific, integral design solution, incorporating clearly articulated statements concerning proportion, shape and colour of the different elements.

The different design variants and the evolvement of the chosen concept have been documented on a project video tape, presented during the conference workshop sessions, with the video soundtrack generating some response from the audience.

This project is particularly interesting as it allows us to trace the different design steps, from the early, conceptual choices to the shaping and materialisation of the facades. It also demonstrates the impact of the characteristic elements of the final design, such as the see-through offered by a ‘gate’ building which links the different urban spaces within the overall plan.
MOSCOW ARCHITECTURAL INSTITUTE, RUSSIA

Design & Visualisation: Michael Matalasov
E. Matalasov, N. Kolenteyeva
Dmitri Berdinsky

(bvl@icp.ac.ru or pager@vessotel.com first line of email message must be: vif41799)

Institute: MARCHI, Moscow Architectural Institute (State Academy), Lab of Video Systems, Prof. Michael Matalasov, 11 Rozdestvenka str. 103754 Moscow K-31, Russia.

Used techniques: Endoscope, CCD type, camera G-100, VHS· tape editing, hand / mechanical guided camera movements, painted background, more direct spotlights.

Questionnaire Remarks: The group mentions the model with texture maps as one of the best and most ‘compact’ ways to provide a designer with information of a building site.

As a starting point for their design, they made small tests to find the optimal materials to be used in the design. They prepared a set of elements which were moved and combined in the design process.

Both dynamic visualisation and single perspective images have their own task in a presentation. The viewpoints and the routes for the endoscope have to be set after the design is made, in order to present the whole design adequately. Therefore the six previously set viewpoints can have a strange influence on the development of design.

The MARCHI group stresses the importance of such EAEA workshops and encourages this kind of combined research effort.
PROJECT In the entries from Moscow, the route suggested for the workshop became a major theme for the development of the plan. As can clearly be seen in the plan, the design is conceived as a path through an adventurous garden landscape. This park comes across as a green, open oasis in the urbanised surroundings, a kind of 'antidote' for the relatively dense housing in the area.

Much attention has been paid to the 'furnishing' of the model. The use of coloured textures for street and paving patterns, different types of vegetation and human figures as functional scale objects contribute to bringing a specific (Dutch or Russian?) atmosphere across to the audience.

On the basis of the same plan the team from the Moscow Architectural Institute prepared two presentations, one using optical means and also a computer aided visualisation (see the other Moscow entry in the digital category). It is interesting to compare the results from these two approaches.

The optical presentation made extensive use of video techniques. A notable aspect of this video production is the way in which an attempt was made to create a 'Delft' atmosphere using video fragments from a presentation by Jan van der Does in Vienna in 1995. This led to surprising effects such as the (relatively small!) tower of the station of Delft appearing as a landmark the size of a major church tower in the background of this suburban location.
SLOVAK TECHNICAL UNIVERSITY OF BRATISLAVA, SLOVAKIA

Design: Peter Kardos, Radoslav Vlkovic, Júlia Hanuliaková, Alexandra Lakotová
Visualisation: Peter Kardos, Radoslav Vlkovic, Júlia Hanuliaková

Institute: Faculty of Architecture, Slovak Technical University of Bratislava, Nam.Slobody 19SK-812 45 Bratislava 1, Slovakia

Used techniques: Endoscope, Focal length 32mm, CCD: 512x582 pixels PAL 625, VHS, photography: OM SC 35, mechanical / electrical hand guided movements, painted background, diffuse light with 3200K colour temperature, digital image editing (post production techniques) with Aldus PhotoStyler.

Questionnaire Remarks: According to the design and visualisation group of Peter Kardos, the imaginary model represents a typical 'Dutch town image' as far as the technology of the housing blocks and the extensiveness of the Dutch housing environment are concerned. The realistic information of the photo-textures on the facades enhances the relevance of architectural form, identity and the urban proportions. The shadows of buildings on their facades are imaginative.

The group mentions the high importance of the 'eye-level view' during design tasks concerned with details in the model. The more general design decisions, such as placement and height of masses can be made in 'birds eye view'. Proportions of spaces can be designed best when both views are taken into account.

The designers had an initial image in mind about what the design should look like, but this image differed a lot with the final result. The reason they mention for this difference is: 'endoscopy, with its verification, enables deeper elaboration of the design idea in a positive sense'. They used the endoscope as a true design instrument rather than merely as a presentation tool. During the design process, they used hand sketches and model sketches within the given context scale model. Different modelling concepts were made in order to verify spatial dimensions and compositional relations. Finally, Kardos stresses the use of binocular images and the development of stereo-endoscopy (see his conference contribution).
A vigorous and dedicated approach to the implementation of optical Endoscopy in creative design is evident in this visualisation project contributed by the Bratislava Technical University.

This proficient presentation illustrates a number of the recurring themes of dynamic design visualisation in an interesting way...

Firstly there is the matter of the model, which has to be made in such a way that it will come across well when viewed with an endoscope. This implies a 'film-set' approach to modelmaking, putting emphasis on the parts shown in endoscope motion and should suggest the correct scale. The finely tuned Bratislava design model brings across a very imaginable, lively outgoing and shopping environment by using effective facade modelling and covered walkways. Another, often indispensable, aspect is the introduction of secondary information which 'furnishes' the space plus model figures which accentuate the human scale. In this model the use of simple cut-out figures proved very effective. The more 'real' the information in the model, the higher our demands on lighting and use of 'background'. A 'sky' used as a backdrop can easily become too obtrusive, as some of the computer presentations demonstrate. This visualisation made use of an aerial background with painted clouds and subtle lighting. Camera standpoint and travelling speed are another aspect to take into consideration. This presentation made use of different types of motion, such as walking and travelling by car (underscored by showing the view through a 'windscreen').

Lastly, this project emphasised the importance of paying attention to 'output'. The same images photographed from a TV screen, using SC 35 photos and using digital prints, conveyed quite different impressions of the same viewpoints. All in all a successful and truly 'didactic' contribution!
ROSTOV STATE ARCHITECTURAL INSTITUTE, RUSSIA

Design: Evelina Vereshchagina, Marina Gorskikn, Angelica Gorobets, Natalya Frolova

Visualisation: George Yesaulov, Evelina Vereshchagina, Marina Kiriyenko

Institute: Rostov State Architectural Institute, 39 Budennovskiy pr.344082
Rostov on Don, Russia.

Used techniques: Electronica 822 video, Kodak Gold-200 film, Mamiya 1000 Camera,
more direct spotlights, dark background. In the process of printing a yellow filter was used in order to get the most natural colours.
During photoshooting the model was lit up by halogen lamps 'Foton-500'.

Questionnaire Remarks: The group of the Rostov State Architectural Institute is satisfied with the context model as it was provided for the workshop. They do not think the model needs more details, because the main task is to create a set of design images (the purpose is 'imaging imagination'). At a certain moment during their work, when they tried to give special attention to the composition of the space and the forms, they would have preferred a less (photo-)realistic model in order to get a more fundamental image of the design. The group is more or less familiar with Dutch city extensions and recognises 'the buildings with a cosy human scale due to their low floor level'. The six static viewpoints do not represent the design fully, because it is impossible to look around to the surrounding.
The Rostov group's detailed description of their design ideas has been used as the basis for the project text.
Optical Endoscopy

PROJECT  A lively, dynamic plan with a strong visual impact.
The team from Rostov State Architectural Institute developed the potentials of the undifferentiated site towards a positive new environment, rich in experience: with a sense of place and occasion. The authors of the project saw it as their task to create a unified composition in the space of the square, preserving its open character while at the same time introducing the appropriate human scale.
The formal approach to the design involves the use of curved, overlapping areas and distinct elements situated strategically within the open space. The composition consists of three primary forms: a hemisphere, a cube and a cut-off pyramid. These volumes can house communal facilities.
A covered gallery runs across the site, beginning at the hemispherical pavilion. This covered walk allows for open views through the site at a pedestrian level. This covered route through the plan is a flowing line which runs across the two unequal parts of the square, contributing to an effect of one 'united compositional space'. According to the designers, the fourth - open - side of the square should remain unobstructed, so there are no buildings at this side. To avoid the impression of an unfinished composition, a semitransparent spatial structure has been situated here, allowing one to look out towards the extensive polder landscape. Flower beds, lawns and water basins are used to contribute towards creating a 'typically Dutch' atmosphere.
The plan visualisation makes use of suggestive modelling techniques. The dark background, in combination to the colourful elements of the model, contributes to an inviting, festive impression.
Design &
Visualisation: Oliver Pestal and Bob Martens

Institute:
Department for Spatial Simulation (Full-Scale Lab), Technische Universitaet Wien, Karlsplatz 13/2561, A-1040 Wien, Austria.
Tel: +43-1-58801-3382 or 3383.
Fax: +43-1-5041147.
http://info.tuwien.ac.at/raumsim/

Used techniques:
Endoscope 3CCD, focal length: 80°, hand movements, painted background, more direct spotlights and diffuse light, specific color temp. 3400° K. Archicad 5.0, 3D-Studio, phong shaded, with textures and materials, background as a gradient, more spotlights. Vrml export.

Questionnaire Remarks:
Pestal and Martens find the facade images on the building blocks an easy way to get all textural information on the walls. It creates useful pictures of the existing 'characters'. No extra details are required in the geometric form of the surrounding buildings.
To evaluate the effects of different materials and in order to explore the characteristics of the design draft, they made small tests of different modelling concepts. To make the design look fit into its surroundings, the model was refined, in steps, introducing a higher level of detail in the facades and the surface.
Through dynamic visualisation the design is explained better, as one can only experience a model fully by including the factor time.
PROJECT

The optical endoscope supported design proposal by the Vienna Full Scale Lab group is notable for the way in which the instrument was used to develop and refine the design from the initial stages onwards. An interesting point is that in the earliest phases of the process, the designers found that the model of the surroundings which had been provided, led to a visual information 'overload'. In this stage they would have preferred a simple volumetric model showing only the floor-levels, to indicate a basic suggestion of the buildings' scale (for a documentation of the development process: see the workshop paper 'Possibilities of Endoscope Implementation Regarding Development of Complex Spatial Structures', on the Imaging Imagination Web-site).

The main characteristics of the plan are the strategic positioning of two distinguishing buildings (a complex tower pavilion and an equally articulated, lower volume).

Using the endoscope these determining elements and their position were worked out step by step, from very rough, basic shapes to more precise, sculptural elements. An example of an 'in situ', iterative design process taking place directly in a scale model.

Besides being photographed using an endoscope pipe in Vienna, the final model was also viewed using the Delft Faculty of Architecture endoscope during the conference workshop sessions.

In addition, the final design was documented convincingly using computer aided techniques, highlighting the contemporary (somewhat 'Gehry-ish') impression of this design proposal.
Questionnaire Remarks:
The photo-realistic information in the workshop model is mentioned as being effective in both the initial and the very final phases of the design process. During the rest of the design process the photo textures are not seen as an actual help.

The general urban setting of the site is mentioned as being a bit arbitrary and uneventful. A real 'Dutch town image' could be more like extensions in Rotterdam by the Mecanoo office or Amsterdamse School style buildings.

For a good presentation of the design some birds-eye views are necessary, in order to access the general setting of the town planning scheme; small as it is in this case.
PROJECT  A balanced, professional urban plan. The design proposal from the Vienna Full Scale Lab group, making use of digital means, introduces a clear spatial structure into the given site as well as formulating specific (communal) functions. In the words of the designers they “lay down specific urban-constructional criteria and design determining impact factors” (see the workshop paper with the ambitious title: ‘The Effects of Visualising Imagination in Virtual Reality Regarding the Imagination of Reality in Actual Reality’, which can be found on the Imaging Imagination Web-site).

The design strategy in this plan is to weave a pattern of orthogonal paths and pavements, thus creating three main areas for articulated, bordered urban spaces. The most apparent intervention is to position three blocks, containing shops, a bank and a post office, parallel with the road with a linear pavement in front of them. These elements serve as a boundary, creating an urban square on the housing side (including two buildings for neighbourhood functions, incorporating water) and two distinct spaces on the side facing the open landscape (an open space with a pond and a café pavilion with a terrace, bordered by another space with trees; as it were ‘pulling’ the open landscape into the site).

This somewhat rational, elegant plan is finely detailed, particularly in the buildings, even offering a glimpse of the interiors. Unfortunately it was not possible to use the facade textures of the workshop context model. This leads to a visual discrepancy between the hard orange blocks of the ‘existing’, surrounding buildings and the refined additions. It would have been interesting to see how the two kinds of model would have worked in combination.
DELFT UNIVERSITY OF TECHNOLOGY,
THE NETHERLANDS

Design &
Visualisation:
Paul de Ruiter (p.deruiter-2@bk.tudelft.nl)
Ernst Janssen Groesbeek (e.janssengroesbeek@bk.tudelft.nl)
Amin Amin (a.amin@bk.tudelft.nl)

Institute:
Delft University of Technology · Faculty of Architecture
Department of Building Technology, office 5.50, Prof. Sevil Sariyildiz
Chair "Technical Design and Computer Science"
Berlageweg 1, 2628 CR Delft, The Netherlands
Phone: + 31 15 278 44 85
Fax: + 31 15 278 41 27

Used techniques:
Computer software: AutoCAD and 3D-Studio MAX 1.2.
Render type: phong-shaded, raytraced shadows, textures materials /
facades, atmosphere (fog) and background.
Light set-up: more spotlights.

Questionnaire Remarks:
The model with texture maps is mentioned as a good visual and mate­
rial reference for the design process. More 3D geometry in the build­
ings is not needed; enough information is given to form a basic
impression of the site.
It was difficult to explain the whole design with only six viewpoints.
More freedom to choose different adequate reference points is neces­
sary.
The group, involved with knowledge covering a broad variety of
Information and Communication Technologies, mentions the impor­
tance of this kind of workshop and the organisation of lectures and
courses in this field. A new development supported by them is the set­
up of Virtual Collaborative Design Studios, in which groups of students
from different institutes make a design by using the Internet, CAAD
and Virtual Reality.
PROJECT  The contribution from the Delft Technical Design and Computer Science group (Building Technology) is notable for its high level of visual detailing.

This is particularly remarkable as the plan and its visualisation were conceived in a typical 'competition' setting, starting only three days before the conference. To cope with this short time span, the tasks were split up amongst the team members, which apparently did not have a negative effect on the result. The presented project is the outcome of a truly collaborative, computer aided architectural design process. The inconsistencies of the original digital model, such as false perspective in balconies and cars as part of the facade textures were corrected at the offset.

The basis for the plan is a geometric ground pattern, which leads to the introduction of 45 angles into the design context. Two characteristic elements of the proposal are a new high rise building (employing texture mapping techniques using a specially developed facade pattern) and landscaping extending underneath the 'existing' road. The visual detail goes as far as pavement tiles and street lights which contribute to a sense of scale. While the buildings have 'real' shadows, use is made of a familiar kind of computer sky (also appearing in the entry from Seoul).

The presentation made use of sophisticated computer animation, at first following a car and then taking off for an aerial view of the plan. This unexpected camera motion led to animated audience response during the workshop presentation.
INSTITUTE SINT-LUCAS, BRUSSELS, BELGIUM

Design: Tom Provoost
Johan Verleye
Johan Verbeke (wenkarch@innet.be)

Visualisation: Tom Provoost

Institute:
Institute for Higher Education in the Sciences and the arts,
Department of Architecture Sint-Lucas, campus Brussels,
Paleizenstraat 65-67, B-1030 Brussels, Belgium. Tel +32 2 242 0000
Fax +32 2 245 1404 or http://www.club.innet.be/~pub00730/

Used techniques:
Computer software: 3D-Studio R3/R4 and STAR ARCHI.
Render type: phong-shaded
Light set-up: one spotlight

Questionnaire Remarks:
This group mentioned a problem with the scale of the model, which
was sent digitally to their institute. It is correct, the units of the scale
were missed up while they were converted from AutoCAD to 3D-
Studio MAX, and good scale was not brought back into the model. A
good opportunity to check if the workshop participants reacted in
their design via their natural sense for scale, based on the height of
the buildings and the texture maps, or if they relied on the units and
numbers in the CAD model.

This group (like most participants) found the use of the context
model with texture mappings quite good ('quick and easy for a nice
effect') although the textures are 'not always needed or necessary'.
Additional questions mentioned for such an EAEA workshop are:
What about the use of 'pen and paper - techniques' during the
design... Who did not use pen and paper? What about the initial
phases of the design process? How much time did people spend on
their design and how long did they work behind the computer or
endoscope?
PROJECT    An interesting 'experimental' use of computer assisted - idea phase - design visualisation.
The Sint-Lucas group are professionally interested in possible ways of implementing digital media in the 'upstream' (i.e. early, conceptual) phases of design. They used the workshop task as a vehicle for exploring the potentials of computer media in such stages of design. As such the material presented at the workshop sessions is not intended to be considered as a rounded off final product, but rather as a collection of images from a work 'in progress'.
The work presented consisted of intermediate results from two phases: the translation of the very first reactions to the task and a second step where a process of selection and 'sharpening' of the initial ideas is made visible.
The Belgian group found that the resemblance with a typical Dutch Townscape in the model convincing. In fact this was exactly what they felt was wrong, finding the set-up too strictly planned. In their response they tried to upset this excessive 'orderliness'.
The plan basically consists of two parts: a terrace with water (on the side of the houses) and a 'theatre' with two monumental towers functioning as landmarks (more or less at the point where the road crosses the site, towards the open landscape). The road in the initial set-up had been erased, the whole underground of the area being replaced with a carpet of (very) green grass. The hard colours of the different design elements and the black sky emphasise the conceptual quality of the design imagery, but mean that the images are as yet somewhat less effective in communicating the potential qualities of the plan to others...
MOSCOW ARCHITECTURAL INSTITUTE, RUSSIA

Design & Visualisation: Michael Matalasov, E. Matalasov, N. Kolenteyeva, Dmitri Berdinsky

Institute: MARCHI, Moscow Architectural Institute (State Academy), Lab of Video Systems, Prof. Michael Matalasov, 11 Rozdestvenka str. 103754 Moscow K-31, Russia.


Questionnaire Remarks: See the description of the same group's endoscopy application.
PROJECT A professional, alternative presentation of the design prepared by the group from the Moscow Architectural Institute. The basic plan, worked out in the form of a scale model, makes use of a series of curved paths through an exuberant, cultivated park landscape (see also the Moscow entry in the Optical Endoscopy category). It can be noted that, although the design qualities of the proposal, used in both presentations, are of course fundamentally the same, the visual effects of both techniques are quite different. Where the optical presentation comes across as slightly romantic, almost cosy (probably because of the 'tactility' of the model used and the strategic use of 'people') the computer model exudes a more designerly, 'precise' kind of atmosphere. This may partly be due to the absence of human figures, as compared to the optical views from the scale model. A notable aspect of this presentation is the surprising way in which trees and bushes have been created by mapping textures onto curved geometric shapes. The subtle use of colour, particularly for the blue of the sky, contributes to the overall impression of a thoroughly skilful project presentation.
Questionnaire Remarks: The group divides computer models into two types: models for representation and models for actual design. The models for representation of a building site, such as the workshop model, do not need more 3D geometric details. Instead, texture maps can be used to provide information of the site. Models which represent a new design need more details in their geometry. Especially for this workshop design task, in which the interference with the surrounding buildings is not too big, the model is adequate.

Dynamic visualisation is mentioned as a more useful presentation technique than static images because people like to watch movies and through motions more information can be transferred.
PROJECT  A novel, experimental visualisation project, attempting to extend the opportunities of existing digital modelling techniques. This original, mildly provocative contribution is the result of an ongoing series of studies by the Bialystok group aimed at using (and sometimes even misusing) existing techniques as design 'media' which may surprise and stimulate, offering the designer unforeseen shapes and solutions. The attitude is to shift the creative boundaries of contemporary design tools.

In this conceptual design visualisation another kind of 'world' seems to have been fused into the, originally somewhat dull, Dutch context. The title of the production is 'Squares and Spheres', the basis of the proposal being the introduction of primary shapes and elements onto the 'set'. These have then been manipulated and have further acquired suggestive, texture mapped patterns and images. Of particular interest is the way in which elements have been transformed so that they take on a new role within the plan as a whole. An example of this approach is the use of a scanned compositional study, which is applied as a surface texture to the underground of the plan. The overall effect is one of an adventurous, somewhat theatrical plan with distinct undertones of science fiction (and perhaps even psychedelia?). This surrealistic feel is emphasised by the use of colour; the whole composition being submerged in a fluid 'purple haze'.

The impressive film sequence and high quality stills give a good insight into the concept and method of this project. Above all the inquisitive, experimental attitude and boundless enthusiasm of the Bialystok researchers/designers is portrayed in this sympathetically unfamiliar production.
Yeun Sook Lee (YUN2556@chollian.dacom.co.kr)
Hyun Won Jung

Design: Yeun Sook Lee
Hyun Won Jung

Visualisation: Hyun Won Jung

Institute: Department Of Housing and Interior Design,
Yonsei University, Seoul, Korea 120-749

Used techniques: Computer software: AutoCAD and 3D-Studio R4.
Render type: phong-shaded, textures materials / facades, background.
Light set-up: more omni-directional lights

Questionnaire Remarks: Yeun Sook Lee and Hyun Won Jung found the facade images on the building blocks a very efficient way to convey the neighbourhood characteristics, which is a fundamental information for the development of the design idea. This type of model is valid since the visual perception and appreciation depends on the contextual characteristics. Still they argue there are more details needed in the geometric form of the surrounding buildings (e.g. in the balconies and windows) because it could influence the design interventions in the process of developing the design concepts. There was no need to hide the texture map information (to make the facades more abstract) during the design process, because the design was meant to exist in a realistic context.

In order to get a better insight, they rendered some camera animations during the design process. Pedestrian and bird-eye views were used almost simultaneously, using the different 'view-ports' of the CAAD program.
PROJECT An adventurous - yet highly realistic - urban landscape design presentation.

The group from Seoul were stimulated by the computer model of the surroundings, which uses facade images applied via texture mapping techniques. This not only proved instrumental in conveying the characteristics of the neighbourhood (even giving a suggestion of climate and atmosphere) but also prompted a method of referring colours for the design to the context model. The group sampled some of the colours from the surrounding buildings and used them for the materials in their design. In this way they attempted to integrate the design elements into their surroundings.

Other techniques used in this presentation are the enhancement of colour and the adjustment of clouds in the background. In the professionally animated simulation of the design, this does mean that these background clouds do not move in sequence with the camera movement, creating a slightly disorienting effect. Nonetheless the film highlights the importance of dynamic visualisation, as - in comparison to the stills - the spatial set-up of this design is perceived much better in motion. Further technical aspects worth noting are the use of two types of 'digital trees' (one type is 'geometry based' and has realistic branches with green square facets as leaves, while the other type uses less computer geometry, employing two faces, texture mapped with two dimensional tree images).

The Korean contribution was conceived as a presentation of a varied new urban landscape design to residents from the area. This effective presentation could certainly be expected to lead to enthusiasm amongst such inhabitant groups.
Design & Visualisation: Martijn Stellingwerff (M.C.Stellingwerff@bk.tudelft.nl)

Institute: Sector Media, Faculty of Architecture, Delft University of Technology,
Berlageweg 1, 2628 CR, Delft, The Netherlands
Phone: +31 (0)15/2781393
Fax: +31 (0)15/2784822
http://www.bk.tudelft.nl/GTM/Media/index.html

Used techniques: Modelling: 3D-Studio MAX 1.2
Interaction: 3D-Studio MAX - VRML exporter plug in + text edit program

Presentation: VRML-browser

Image production: screencaptures from the VRML-browser, + digital collage techniques with photo-edit program.
Render type: realtime VRML shading, no shadows, textures materials / facades + transparent Gif-images.
Light set-up: more spotlights.

Questionnaire Remarks: "Well ... the questionnaire was set-up by myself, so I did not participate in answering it. I have tried to draw some general conclusions from the answers and comments in the questionnaires at the end of this overview of participants' contributions."
PROJECT  An ‘evocative’ contribution from the midst of the Media research group from Delft. The Imaging Imagination workshop was used to develop this pilot study, directed towards the further evolvement of possibly stimulating ‘virtual reality’ applications in urban design. Like the Bialystok contribution, this project is primarily driven by an inquisitive, designerly research approach, aimed at a fundamental regeneration of emerging (and existing) design media, particularly using digitised instruments.

The theme is to create an interactive, ‘real-time’ environment meant to stimulate inspiration in the designer who should be able to activate elements of the composition, which can then be manipulated and can ‘evoke’ images.

The designer is free to move through the environment and investigate the spatial organisation of interactive elements. The objects give colour and create structure within the model space. When they are ‘clicked’ on they may take on a new form and the viewer’s image changes.

As such this project is not to be viewed as a final proposal for a concrete, urban plan, nor as yet as a finished digital design support product. In the present stage it can be considered as a playful and not yet fully working model, however with serious design media research undertones.

What kind of imaging might inspire which kind of designer - and how - remains an object of discussion - and indeed for further study. Further research will be carried out in the coming time...
SOME GENERAL REMARKS CONCERNING THE WORKSHOP QUESTIONNAIRE

We first would like to thank the workshop participants for filling in the attached questionnaire. The given answers provide useful information about the way context models for architectural and urban design tasks could improve and give insight into how these kind of models influence design.

Some general opinions and answers from the questionnaire are described here. Other, more specific, answers and remarks have been included in the project file per participant. Although this was a limited group of participants (with 11 filled-in questionnaire forms), we would like to draw some cautious conclusions.

In general the texture mapped models were received positively. This can also be seen in the various designs, which attempt to fit in and react to the surroundings. During certain decisive moments in the design process, some participants would have preferred a less detailed model, with only the abstract forms of the building blocks (without facade textures) in order to focus on the matter of the form of masses and proportion of spaces. The facade textures give a lot of information even though the projection is totally flat. More 3D geometric details could be provided in the balconies and the gardens, because these elements are most distorted when projected on a flat facade ‘face’.

The question about which view, ‘eye level view’ or ‘birds-eye view’ is most appropriate for visual checking during 11 different design tasks, gave a lot of insight and a confirmation about the use of endoscopy and certain graphic user interfaces of computers. Most ‘primary urban design decisions’ like the ‘placement of masses’ and ‘finding an appropriate urban scale’ are done in birds-eye view. The more detailed decisions (visual checks) and decisions about height are made in eye-level view (e.g., details on the ground, choice of texture and material, light adjustments, camera placements, finding the appropriate human scale and proportions of spaces).

A critical evaluation of the project images has shown that the chosen ‘eye levels’ are not always reliable. In some cases a viewpoint for a simulated walk has been used, which is considerably higher than a ‘realistic’ pedestrian observation level.

The comparison, after taking the average of the answers in all questionnaires and for all design tasks, shows some preference of the use of eye level views (60%) over use of ‘birds-eye views’ (40%). Remarkable was the consistency of this outcome among 8 participants (all between 54 and 64% for eye level use). Only two participants seem truly dedicated to perspective eye level views with their score of only 25 and 10% for the use of birds eye view.

Very important, though, is the simultaneous combination of both views. In most endoscopy laboratories this combination is almost natural, as the designer is standing next to the scale model and looking through the endoscope pipe or looking at a video monitor. When the views are separated through enhanced technology (such as happens when electronic camera navigation tools are introduced or in most ‘full immersion’ Virtual Reality applications) the
need emerges for the insertion of a second view-frame in which an overview is provided. In a video or a previously rendered computer animation of a route through a model, the same need for an overview can occur. If a small overview image is not offered, one can easily get disorientated.

During the first and second EAEA conference, Petri Siitonen came up with an interesting comparison between endoscopic- and computer visualisation techniques. The computer was winning terrain, but endoscopy 'won'. Again we can say much in favour of computer visualisation and simulation technology, and during this third conference Arpad Pfeilsticker proposed to rename the EAEA as Architectural Simulation Association (in order to clearly include non-European participants and the use of computers).

Computers may be the future, but still these questionnaires of the workshop brought up 'dynamic visualisation' as an aspect in which endoscopy seems to offer a much more 'natural' interface than most computer programs do. All optical Endoscopists emphasised the use of a moving camera in order to find out certain aspects of the model, while only one of the computer users mentioned the use of rendered camera animation during the design process. When using certain 'virtual reality' programs, 'dynamic visualisation' is possible using ordinary desktop computers. Moreover, processor speed is still accelerating and render algorithms have become more efficient. Nevertheless it seems important to learn from endoscopy how a graphic user interface can be designed in order to combine dynamic eye level views with dynamic birds eye views in computer applications. Only when confronted with the reality of scale models and the material world, can we know what concepts like 'real time', 'intuitive', 'stereoscopy' and 'interaction' might mean, and that is still different from computational simulation of these aspects.

Finally we can mention the almost unanimous use of sketches and small tests before the real modelling work started. This is shown clearly in the video of Michael Matalasov and in the digital animation of the group from Bialystok.
WORKSHOP PRESENTATIONS AND DISCUSSION

The workshop projects were presented on the 28th of August, during an integral afternoon session, chaired by Jack Breen in the Faculty of Architecture's visualisation laboratory. Prior to these presentations two senior members of the EAEA, Antero Markelin from Stuttgart and Wolfgang Thomas from Essen - both pioneers of Endoscopy - were asked to follow the sessions critically and report their findings during the workshop discussion after the presentations.

During the first part of the meeting, all contributions were presented separately, with a brief round for questions and remarks per project. The presentations were made using a broad selection of media, amongst others using slides, video productions and computer animations. In addition, some of the models (from the Tokyo and Vienna groups) were viewed using the dynamic, optical endoscope of the Delft faculty. The dynamic visualisations have been collected together on a video compilation tape featuring the conference presentations. During the break between the two parts of the project presentations, the facilities were viewed and there was room for informal discussion.

After all the projects had been presented, the meeting convened for a group discussion. Antero Markelin kicked off the review. After the remarks made fresh after the project representations, an attempt should be made to "see the whole" and draw conclusions. Markelin stressed that he did not see his role as one of a jury member. The workshop was not a design competition, the primary interest is that of Endoscopy, the results should be considered under this aspect. Not too much emphasis should be placed on technical limitations ("we are all familiar with the 'earthquakes', the kind of problems anyone working with Endoscopy knows, and also the imperfection of models with roads going up and so on, this is secondary"). What was most interesting was how the plans (ranging from relatively simple explorations to brave, complex undertakings) were shown, given the scheme for movement specified beforehand. In the presentations nearly no-one ("only Matalasov?") followed this path. This shows that "ideas need their own roads - to show them".

"We have seen many interesting and fascinating works where the idea and the technique fit together - in very different ways!". Some plans were realistic (and could be built tomorrow) while some were less concerned with this aspect. From the presentations one can learn about the ideas behind the projects. In the design process the ideas come first, then comes the 'moviemaker' to awaken the audience's interest. Markelin confessed that he had previously been sceptical about the workshop, but today had seen 'good Endoscopy': evidence of "a direction we should work on"...

Wolfgang Thomas confessed that he was enthusiastic ("begeistert") about the workshop. Even the way in which all the presentations had fallen into place as in a 'gesamtkunstwerk' had contributed to his excitement. The solutions that had been shown were very, very diverse. The 'focus' had nearly always been different. There were examples which had concentrated on finding the 'good solution', where the presentation was less important, and there were those where the presentation itself had been considered the task, the problem. As far as the discussion - what is better CAD or Endoscopy? - is concerned, Thomas felt optimistic by the way both techniques were being used. One type of technique or the other
doesn't matter; it is a matter of producing the right image: the level of validity in relation to the design being presented. Possibly there are situations where using Cad is better. Cad makes it easier to do things which are normally not possible and Cad is tempting, even seductive (“verführerisch”). A number of participants have sought solutions beyond architecture - looking further...

Another good aspect of the workshop, according to Thomas, was that next to the more ‘scientific’ paper presentations, it offered an opportunity to bring the conference participants, from very different cultural backgrounds, together on the level of Imaging (“Bilder zu machen”), getting to know each other and sharing in each other's enthusiasm: a miniature ‘global village’...

The Russian delegates continued the discussion on the topic of digital and optical means. It was confirmed that both offer good opportunities. Concerning the level of detailing, Markelin remarked that this depends entirely on what one wants to bring across, if you want to show the effect of a window, you will have to make the window. Concerning the texture-mapped context model, the Dresden group had been impressed how well this worked: “a good and cheap technique”. Amin Amin, from the Delft Building Technology group stated that his group had been challenged by the model to find texture maps that would fit in. The general impression was that the context model proved to be sufficient for this task (although some would like to see more detail in balconies etc.), but that the new design propositions added to this background could be considerably more detailed.

Stimulated by the Stuttgart night-time contribution, a discussion arose about other kinds of conditions which might be simulated, such as night and day but also summer and winter. The ‘blue-ness’ of a sky (and the use of clouds and/or fog) was a recurring theme (is it always sunny in an endoscope?). This aspect, in combination with lighting is still a critical aspect, particularly in Cad presentations.

Architects seldom think in terms of lighting. Learning from the lighting experience of (old) movies could be very useful. At this point it could be that lighting in an Endoscope model still has the edge over the computer model...

There is a need to differentiate between realism and simulation. The acceptance of a simulation is often greater if the audience is aware of the fact that it is only a limited simulation and that there is a model involved. Ohno remarked that all of us choose which part of the information we simulate. There is always a reduction, even though we may include non-visual information, such as acoustic input. Also, real video sequences can contribute to the involvement of the viewer. There are developments towards new applications, such as the possibility of creating stereoscopic pictures and digital instruments are developing fast. However, simulations need not always aim for a ‘high’ level of realism. As Patricia Alkhoven has noted it can even be advantageous to consciously choose a level abstraction at a certain point. Despite the natural ambition towards perfection, we have to be aware that we are after all simulating a design (which is not yet ‘real’) and be honest about this...

The reason we come together at such meetings is to discuss and compare experiences and perhaps even ‘borrow’ from each other in order to use the instruments at our disposal creatively...

Markelin closes the discussion, thanking all those responsible for organising the event.
CONCLUSIONS

The conference offered a large variety of themes which may be of importance in furthering applications for environmental simulation - and particularly the development of Endoscopy.

As a part of the overall arrangement, the workshop Imaging Imagination attempted to bring experts from different institutes together within the framework of a creative exercise, which might stimulate comparison of different results and lead to an exchange of ideas. In this perspective it seems justified to consider the workshop a successful experience. Although the number of participants was limited, the task led to contributions of impressive quality (both on the level of the design solutions as on the level of technical implementation and even innovation) and considerable diversity.

Although it is impossible to generalise - and at the risk of simplification - one might nonetheless be able to recognise the following 'streams' running through the collective undertaking:

- a 'scenographic' approach (emphasising the changing visual qualities of the design as perceived from different viewpoints and experienced through motion);
- an 'atmospheric approach' (making conscious use of selected stimuli such as differences in lighting conditions and the use of background sounds to convey a sense of presence);
- an 'experimental approach' (using the instrumentation in an inquisitive search towards finding the 'correct' form for the design, or in an attempt to shift the existing boundaries of design media).

These categories are naturally not 'inclusive' in the sense that one of these will comprehensively sum up a specific project. Indeed, it is probable that a number of workshop participants will recognise aspects of their design and simulation process not only in one, but in two, or perhaps even all three of these rudimentary categories.

Essentially, what Endoscopy does is create images from a design model, from an imaginary eyeline. This is an effective way of presenting an - already finished - design to others involved. However it also has the potential of being used creatively in the design process. This workshop was intended to explore the uses of Endoscopy as a design instrument. The method was to offer a context model in the hope that the participants would continue working on their designs in the model, using perspective views. There appears to be considerable evidence that those who contributed to the workshop used the model in such a way. This obviously does not mean exclusive use of the eye level option in design, but a combination of working in an overview mode
(mostly used in primary design decisionmaking) and also in eye level perspective views (mostly for checking and refining the concept). Although the workshop participants were of course a select group, familiar with the opportunities of Endoscopy, it seems justified to assume that such an approach might prove to be of use in other design tasks on the level of the composition of urban ensembles.

The chosen design context was fictitious, even though it had been ‘assembled’ using elements from real, ‘typically Dutch’ urban landscapes (which may have led to a feeling of déja-vu amongst some participants during the final day’s group excursion). The method of ‘sampling’ facade textures and applying these to simple building blocks as a kind of ‘urban wallpaper’ has proved effective within the context of this limited workshop, although some participants would have liked to have seen some more articulation. It was certainly an effective way of getting the models to institutes around the world and appears to have activated the imagination in a number of culturally diverse groups of design visualisation experts...

The decision to include both optical and digital endoscope techniques has worked out well. Roughly the same number of proposals was received using these two types of techniques. Both of these approaches are worthwhile propositions, it is perhaps not a question of ‘or’ but one of ‘and’. An optical approach may be better in some cases and a computer approach in others. Much depends on the personal preferences of the designer. Working with the computer is still very different from working with a scale model. The use of different tools can possibly stimulate different design solutions and as yet it still appears to lead to different kinds of images and use of ‘camera’ motion. Computers are steadily developing and gradually becoming more ‘sensitive’, both in their user interface and in their visual expression potentials. At the same time certain ‘traditional’ techniques are relying more and more on computation.

The general impression at the conference has been that optical Endoscopy is very much ‘alive and kicking’. It has once again become clear during this meeting, that international Endoscopy groups are not conservative in their approach, but look towards new and innovative applications. New opportunities may lie ahead for the combined use of digital and optical techniques!

The Media group have thoroughly enjoyed preparing and documenting the conference and the Imaging Imagination adventure and wish to thank all those who have put their time into preparing images which will hopefully continue to stimulate the imagination!
COLOPHON

CONFERENCE
International Relations: Lilian v.d. Meer
Administration: Carla van Rossen

Technical Support: Hans Krüse
Hans Schouten
Rob Maas
Maarten van Wageningen
Ane Melein
Ton v. Aart
Rinus van Vliet
Ruben Feuerberg
Yvo van den Bosch (CED)
Marcel Bergsma (CED)
MCM video
Nico v.d. Meer (AVC)

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