Reflection Paper

Graduation Project: Computational intelligence applied to Art Center design

Project Title: Computational Architecture: Focusing on perception and functionality aspects of urban intervention

Given location: Lange Voorhout 102, 2514IJ, Den Haag, Netherlands

The design is focused on the urban research and how to implement the methods learned throughout the process into this field. From the results of this study I would be able to understand the capabilities of the computational methods, the advantages and disadvantages in comparison to the traditional way of designing and analyzing in the urban and building scales.

Computational methods used:

a- Neural fuzzy trees  
b- Perception analysis  
c- Genetic algorithms (Optimization)

Neural fuzzy trees were used in order to quantify the present situation of the site and at the end it will be used to check the result of the designed intervention. This method proves to be very helpful because by making use of this method the design can be quantified, which makes it easier to compare the proposed design with the existing situation. This method proves to be very good in dealing with the complexity of the task and by the way it is structured makes it easier to explain what we mean by each term ex. proportion, safety etc.

After having checked the present situation of the site a proposal for an intervention was made. Deeper analysis had to be done on different aspects of the urban scale and these further studies were translated as extensions of the nodes in the previous neural fuzzy model of the site.

Out of the research developed in the urban scale, it was taken the decision of making deeper research into the water transportation system (canals) and the entrance of the site.

The proposed intervention for the entrance part was done in two parts:

1- Analyzing the entrance and input the data into a neural fuzzy model  
2- Proposing a design as a solution to overcome the problems that were identified in the analysis
The proposed design in this stage of the project was developed in the traditional way. This meant that the design was not able to be put further more into the optimization process afterwards. By designing it parametrically I could have been able to input certain goals for that part of the design and I could have got at the end of the optimization process the best design which could justify my goals. On the other hand at that moment I was not able to build it fully parametrically and by the advice of the instructor it was thought that the best way to go was by doing it in the traditional way.

The next step in the design process was the decision of what type of building was suitable to be designed at the given spot in the site. After making the analysis in the urban scale (ex. Soil analysis, silhouette analysis etc.) rethinking of the socio-economic aspects and the situation of the site in the urban area it was found suitable to propose a tower in the given spot.

In order to reach a good design of the building which would satisfy the required goals coming from the analysis, the building was put into an optimization process where three goals were taking place.

1- High perception of the building
2- Good proportions of the building
3- Height of the building

-Perception was important so that it could become a landmark in the site (there were put 5 different spots in the site to check how much perception was the building getting compared to the other buildings in the site). *trees were not input in the model because it was taking too long to do one iteration by lotus, and at certain time the pc used was crashing

- Proportions of the building were important for the silhouette and the build environment that surrounds the building (the width/height proportion, length/height proportion and plan proportion were taken in consideration).

-Height of the building was important for the silhouette (the height value was given in order to bring an in between height which is missing in the silhouette).

All the given goals were also related to the program requirements given at the beginning of the project, which eventually was given as an input in the algorithm.

At the end of the optimization process I had a pareto front from which I could choose the design that I liked the most, and in this case I chose the one that was satisfying better all my goals. From this stage of the design process on the design would be developed in the traditional way. The methods could have been used throughout the remaining process but because of the time constraint I continued in the traditional way.

While going more into the details of the project I realized that I have some missing goals in the optimization process ex. Plazas at the upper levels of the building, positioning of the elevators in the
building, configuration of the functions and the relations among themselves and with the environment, material properties (transparency, texture etc.). All these are aspects that could have changed the results of the optimization process.

In this scenario what could have been done is to go back and redefine the whole algorithm of the tower and include the other goals. While the plazas, elevators and configurations of the functions would be possible to be input in the process the material properties would have been impossible to be input because the perception model does not include these properties.

With the plazas, elevators and configuration of the functions there were two aspects that made it impossible in my case to input these aspects in the algorithm and re-optimize it to get the results.

1- Time constraint
2- If I would have input these aspects I would have reached at least 7 goals, which would already pass the limit number of goals, which is 4-5.

Time in the situation where the design had passed already the first half of the graduation year is a big constraint, knowing that the optimization process takes quiet long to come to a result. In my scenario, with 3 goals and 800 generations including 50 populations size each, it took 3 days to get a pareto front. With the additions of the new goals I had to raise the population size to 200 and the number of generations to >10 000. This process would need a long time to reach the required results and as such it would create a gap in the design process because at the mean time it was impossible to develop further the design because everything depends on the results of the process. Also, the time left to develop the design was so small that it restricted the process to continue with the already chosen result for the optimization process.

Not including many other goals in the optimization which related to the functionality of the building difficulties rose while solving the plans of the building as a result of the small size in length and width of the floor area and also in difficulties in solving the structural system which would suit better the design.

After this stage of the design there were used non-computational methods in developing further the design.

-Sketches
-Sections
-3D models (understanding and design of the spaces)
-Physical models (comparing the lighting quality of space and as a part of the fabrication part of the studies)
-Renders (materialization, lighting experimentation in the space and space visualization)
By making use of these methods it was possible to judge the spaces created in every aspect of it, in order to design a better experience for the users. At the same time by using these methods it was possible to check and keep the coherence of the overall design from the urban scale to the details of the building, which brought as a result the overall coherence of the design within the environment.

To conclude, I think this design is unique for the given spot, in which are brought together the research in various fields and scales, aspects like spatial quality of space and what is more important, everything has been coherent from the urban scale to the detailing of the building. The coherence includes not only the proposal in itself but also the context, considering not only the build environment but also socio-political and economical aspect of the surrounding environment.

Being new in the field of Computational Architecture had its difficulties throughout the process of understanding and application of the methods learned. As everything, the application of these methods has its advantages and disadvantages, but what is sure is the fact that it broadened my view towards the field of architecture and I gained a new perspective on how computational methods can be applied in this field and I feel confident to use these methods in the right way throughout my future career.

I could have learned a bit more on computer programming but that is definitely not the crucial point, because the computational thinking is the most important aspect in this realm, and I think I have achieved this personal goal throughout this program.