The Evolving Room

The System

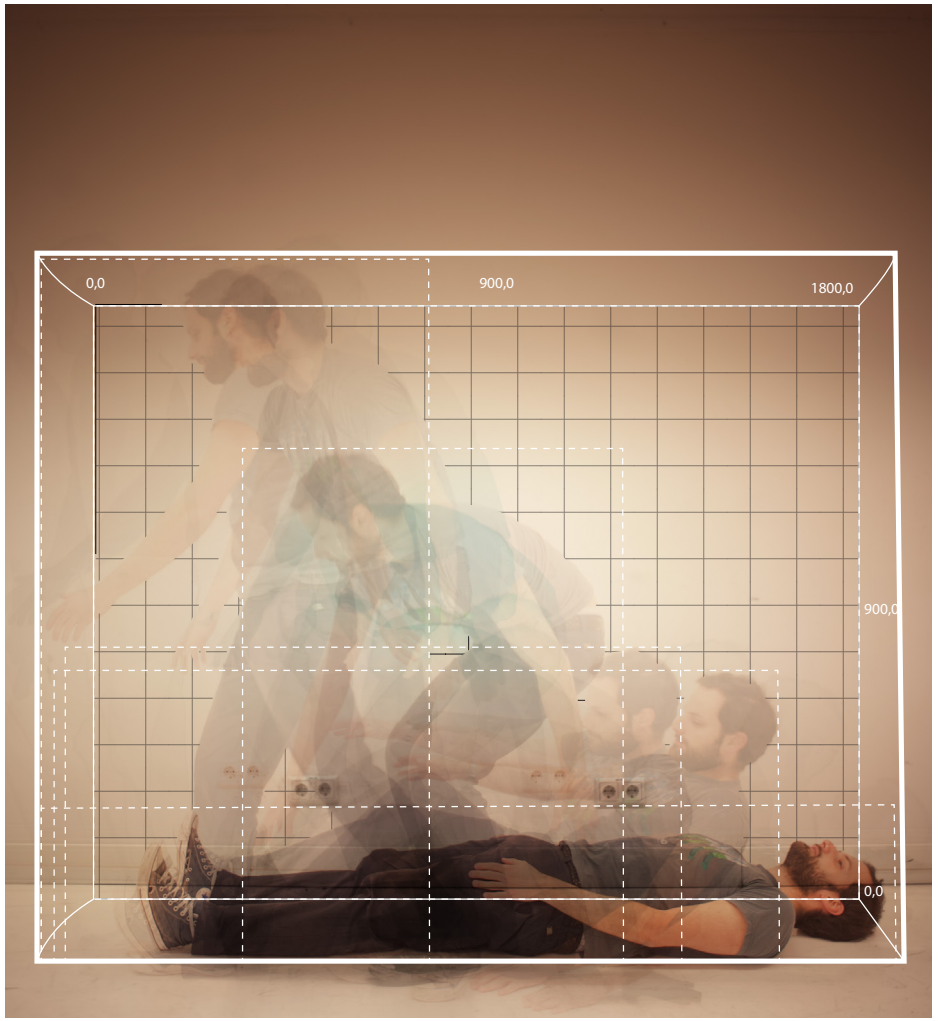
Imagining a living environment which learns over time from human behaviour and eventually learns how to predict it.

1.0
Calculating Space usage

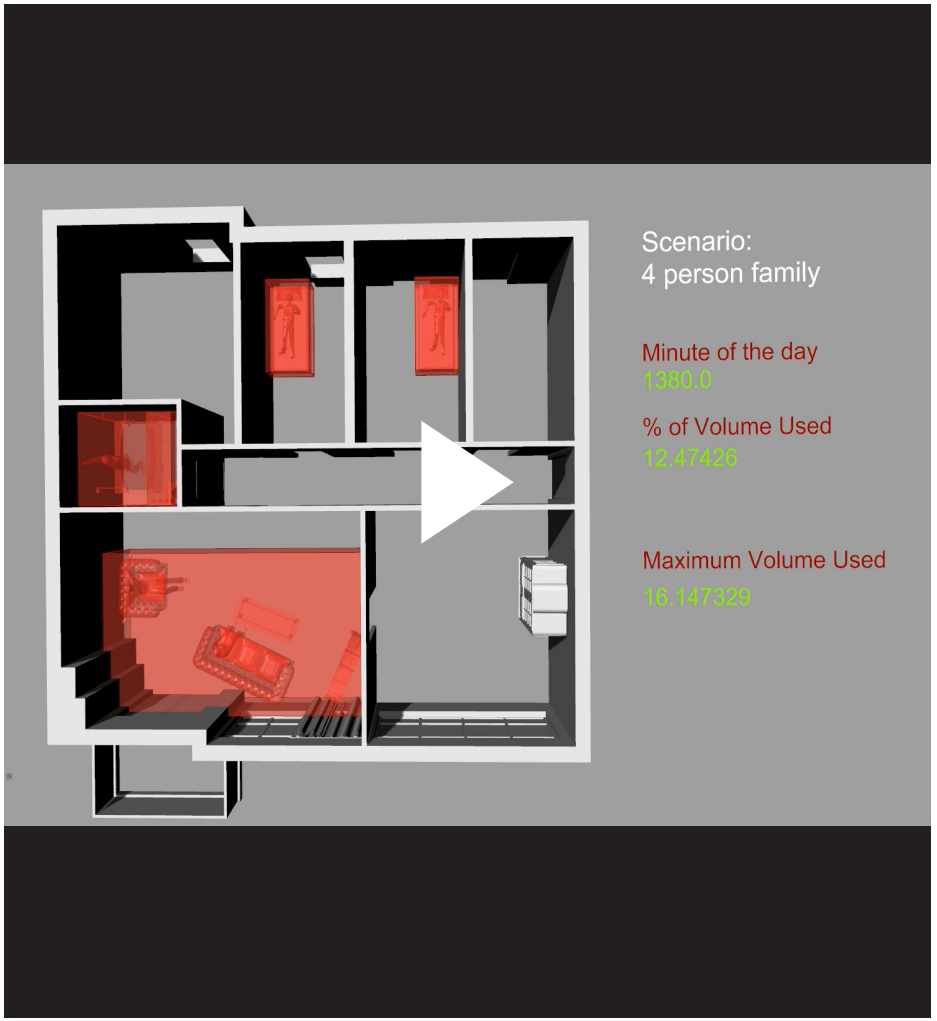
1. Space Usage Calculator 1.0
2. Space Usage Calculator 2.0

1.1 Space usage calculator 1.0

calculating the maximum Volume used in 24 hour cycle



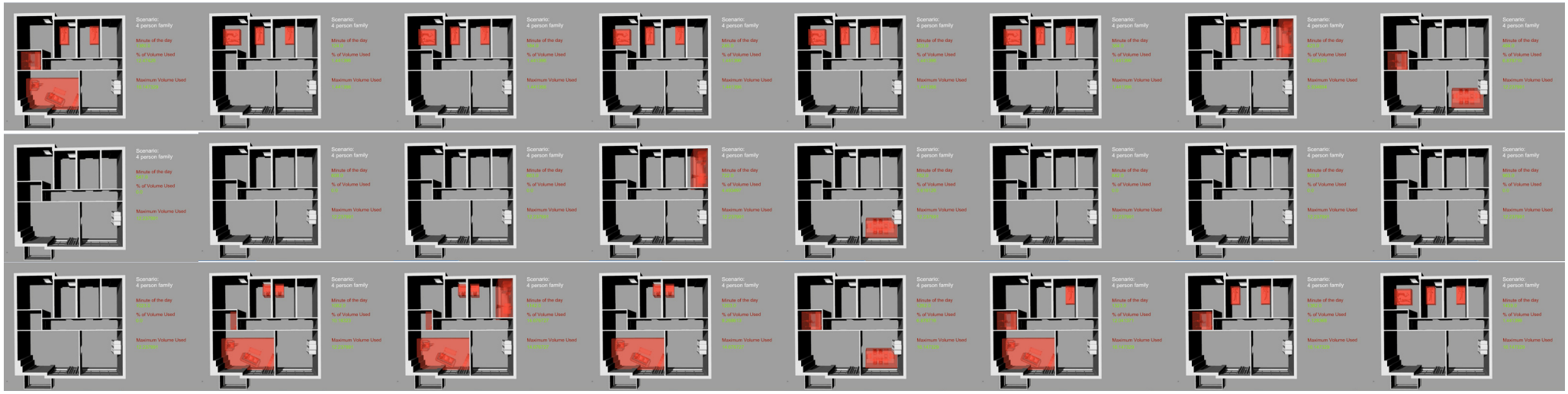
volume usage per activity >> for script



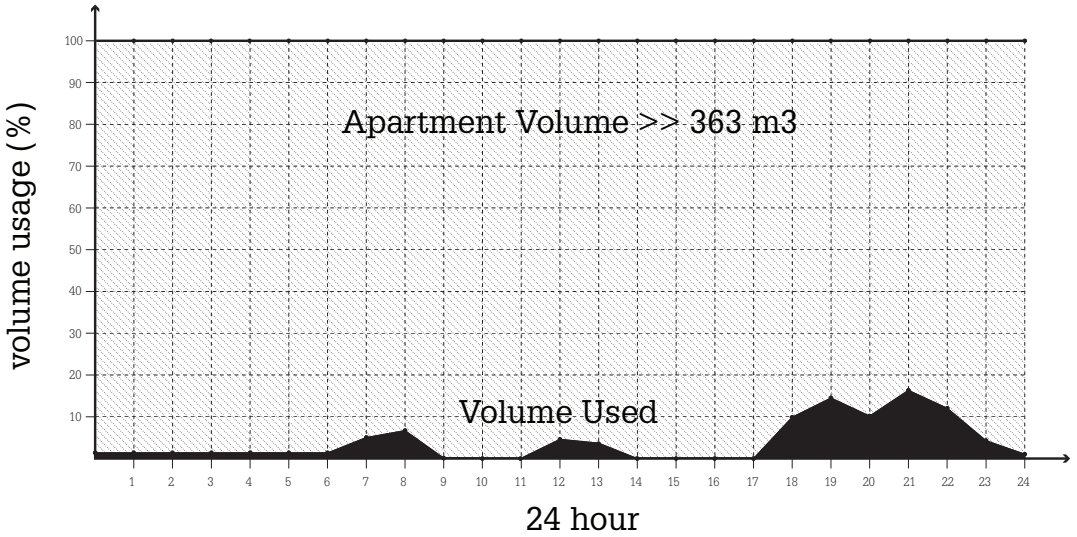
script simulation >> 24 hours
4 person apartment

1.2 Space usage calculator 1.0

24 hour calculation



Volume usage vs time

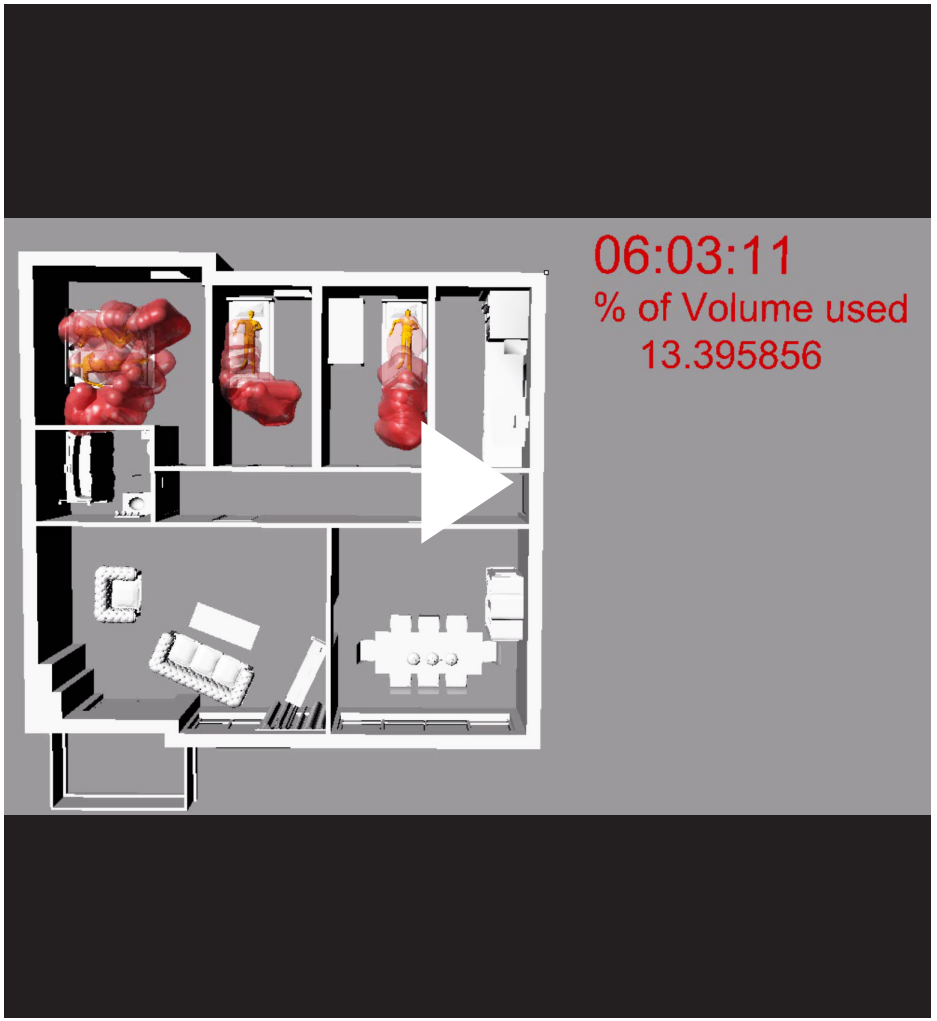


Urgency 1.0

maximum space usage at any minute of the day is 16.15%.

1.3 Space usage calculator 2.0
More refined volumetric study

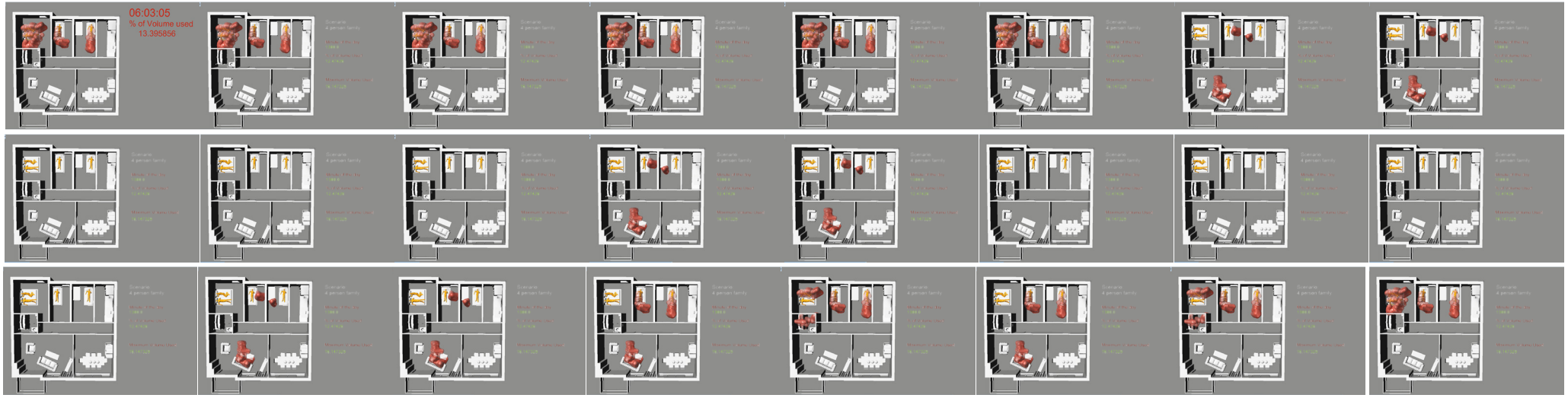
volume usage per activity >> for script



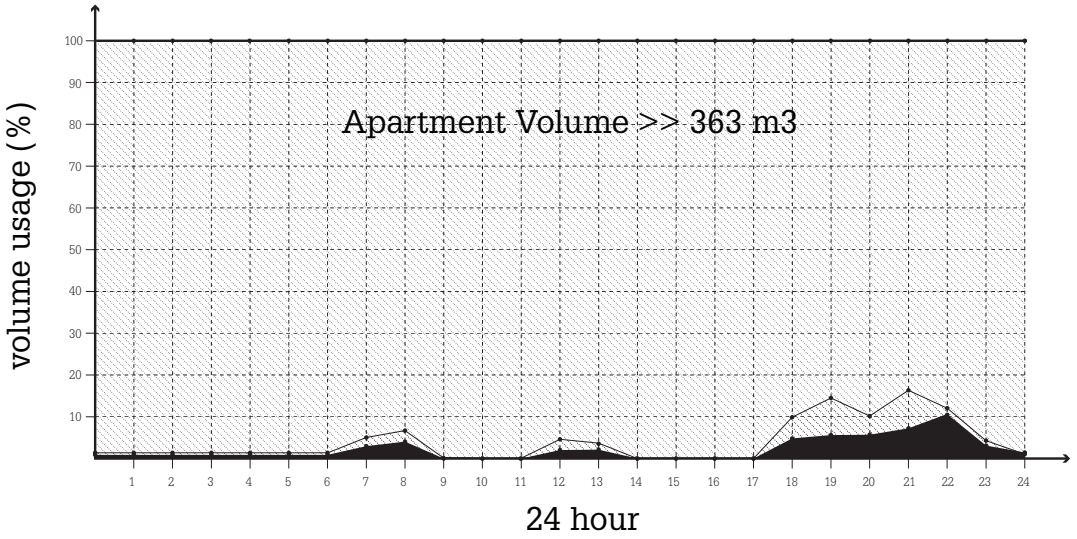
script simulation >> 24 hours
4 person apartment

1.4 Space usage calculator 1.0

24 hour calculation



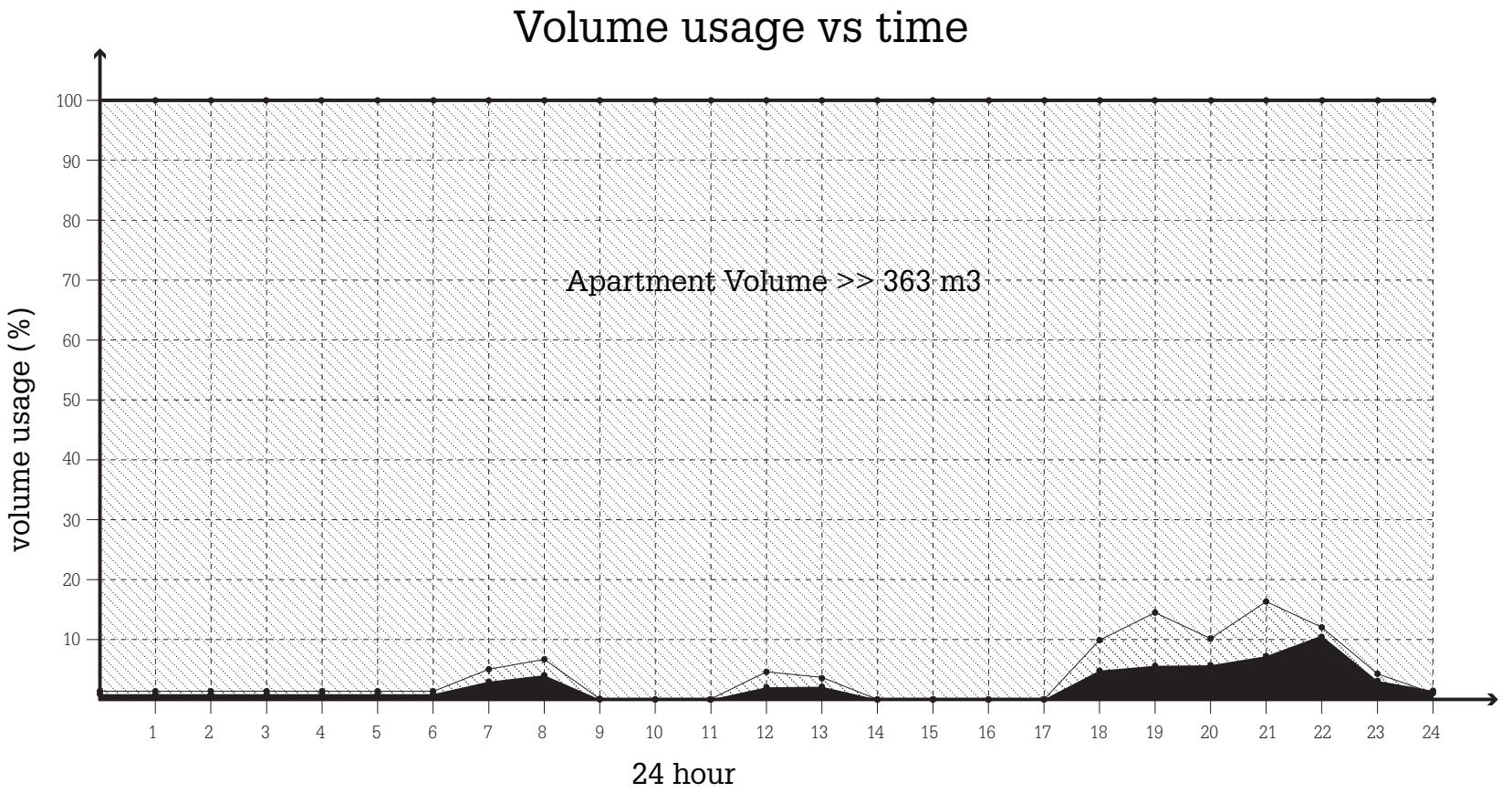
Volume usage vs time



Urgency 2.0

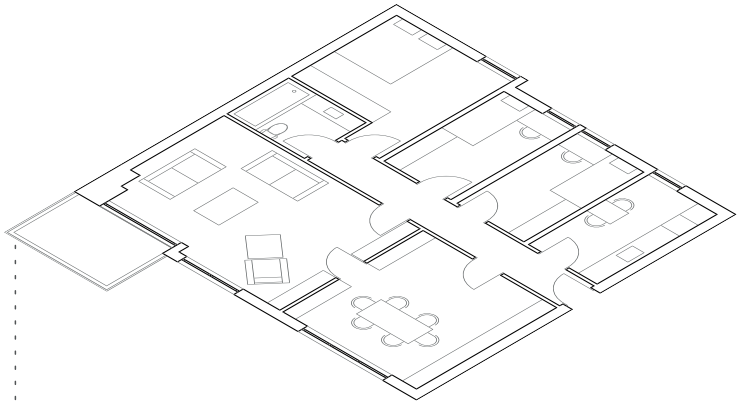
refined calculation presents a maximum space usage at any minute of the day of 10.46%.

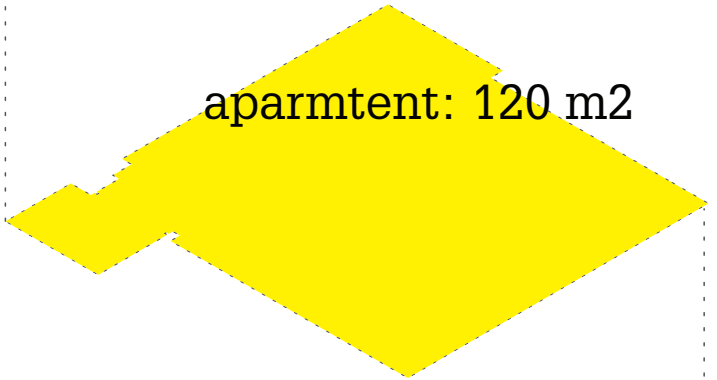
1.5 The urgency

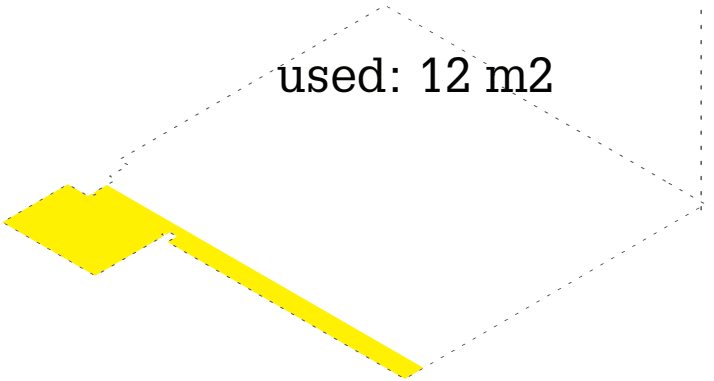


There is a large discrepancy between the space provided to us and the volume we actually use

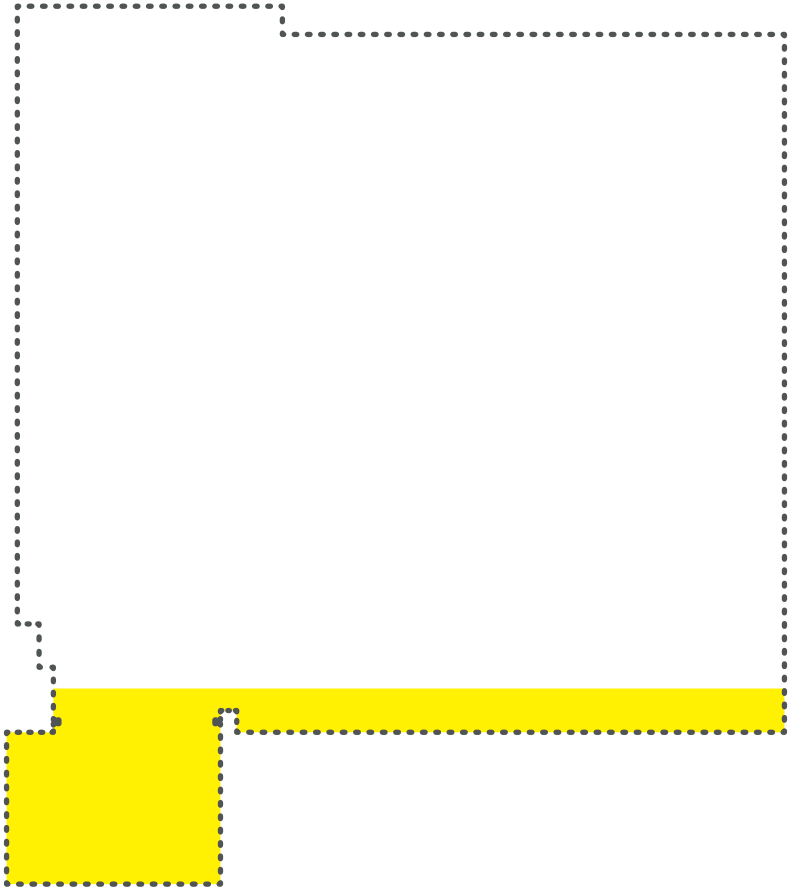
4 person apartment







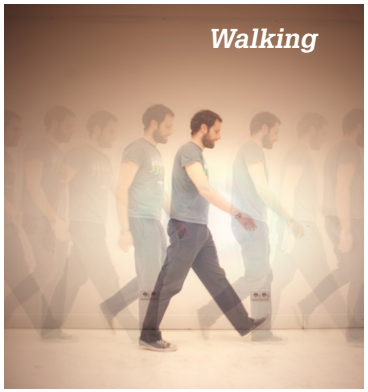
Can we live with zero wasted space?

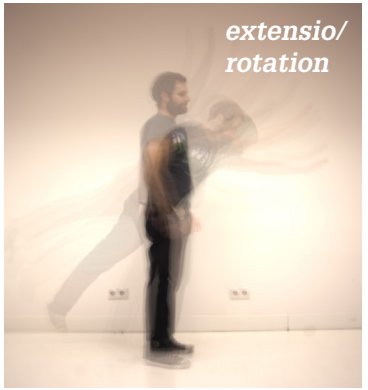


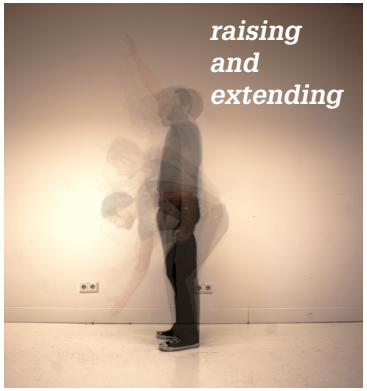
2.0
identifying the body

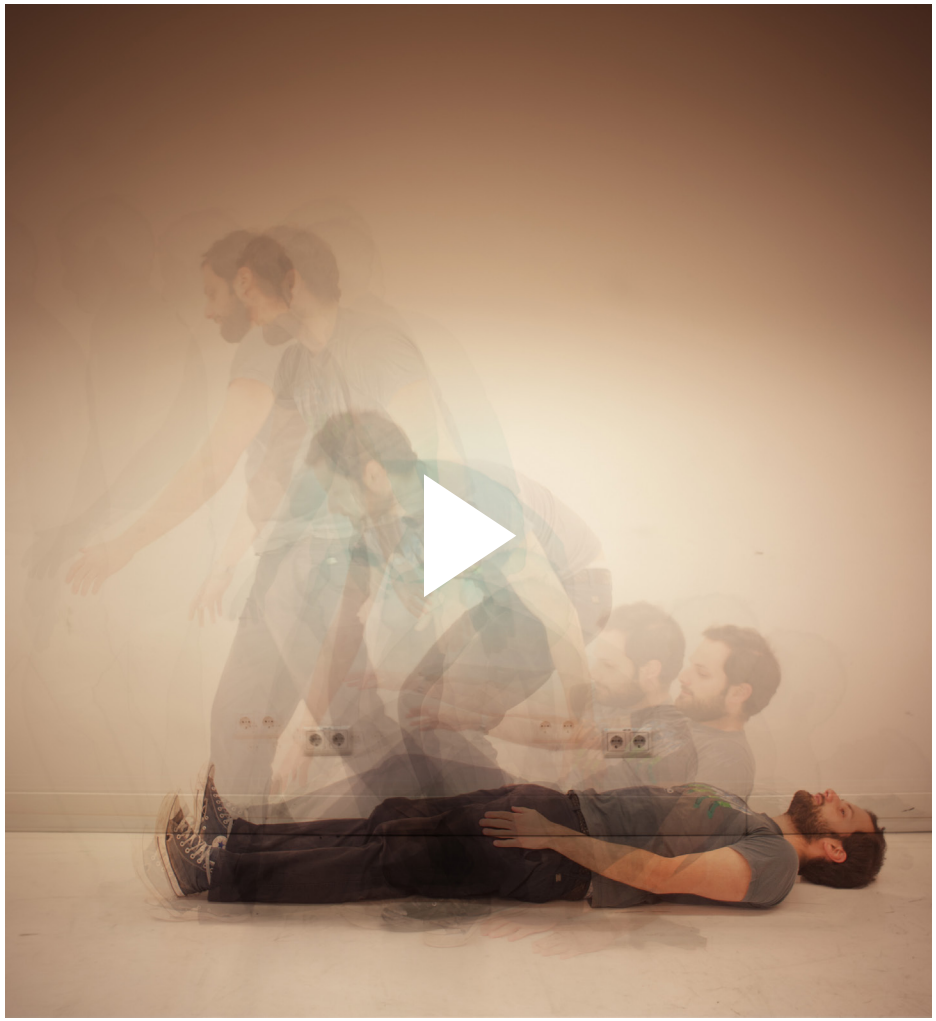
defining our space beginning from our body

2.1 Human



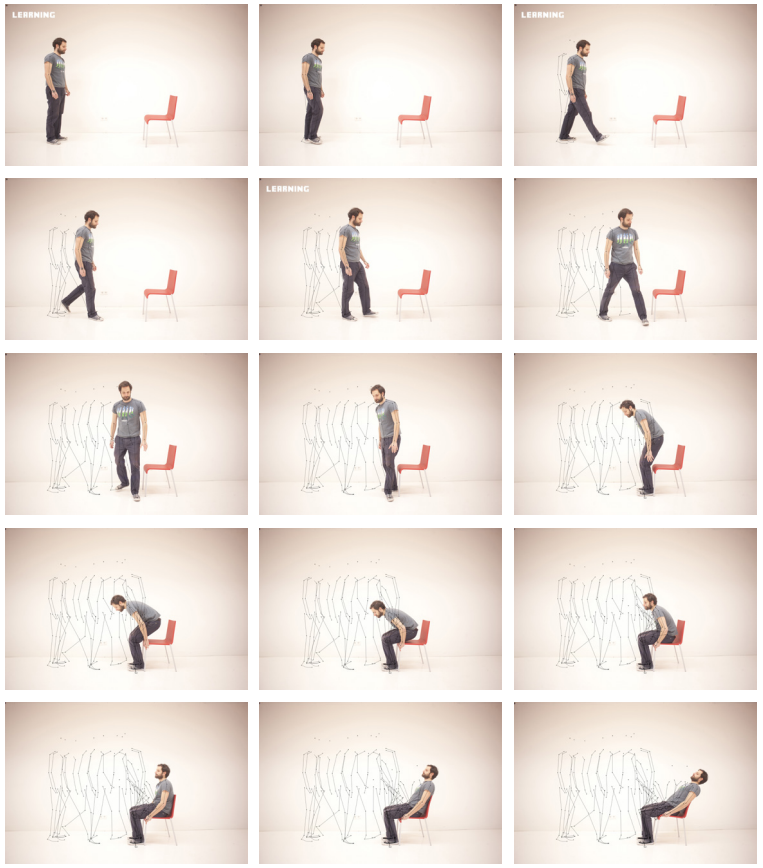


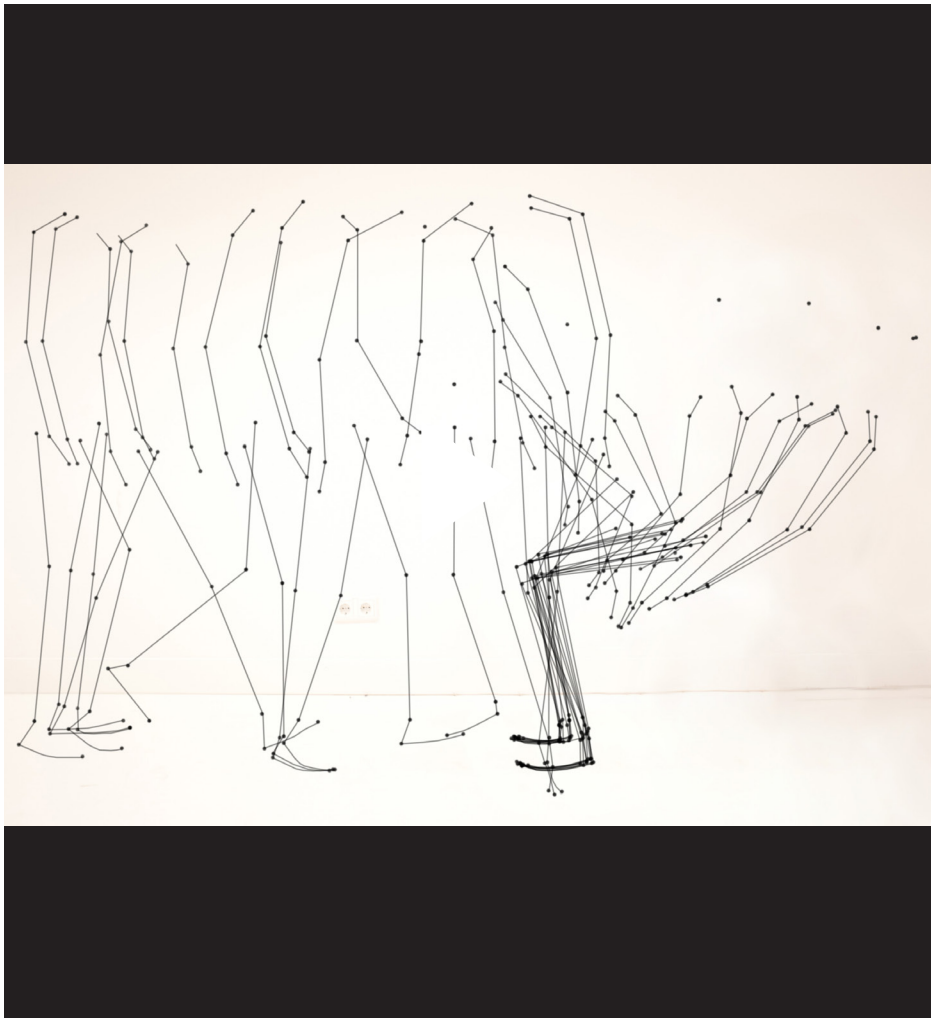




can we develop a way to define our space, while starting from human occupancy?

2.2 Human
movement as data points





Muybridge exploration_

method allows us to trace and generate data points of human movement

Kinect motion detector

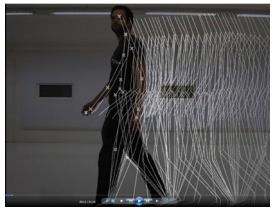
using motion tracking towards a new understanding of space occupancy

2.4 Human
tracking and recording posture

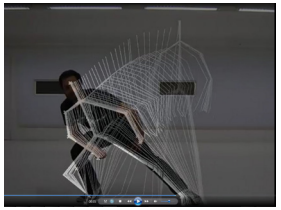
squatting

jumping up

jumping to the side



walking forward. slow



stretching to the side from upright

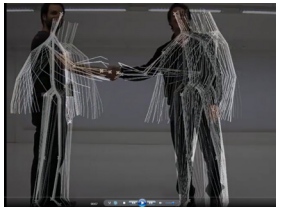
leaning sideways from upright

stepping up. fast. leaning forward

sitting. resting forward. elbow on knees

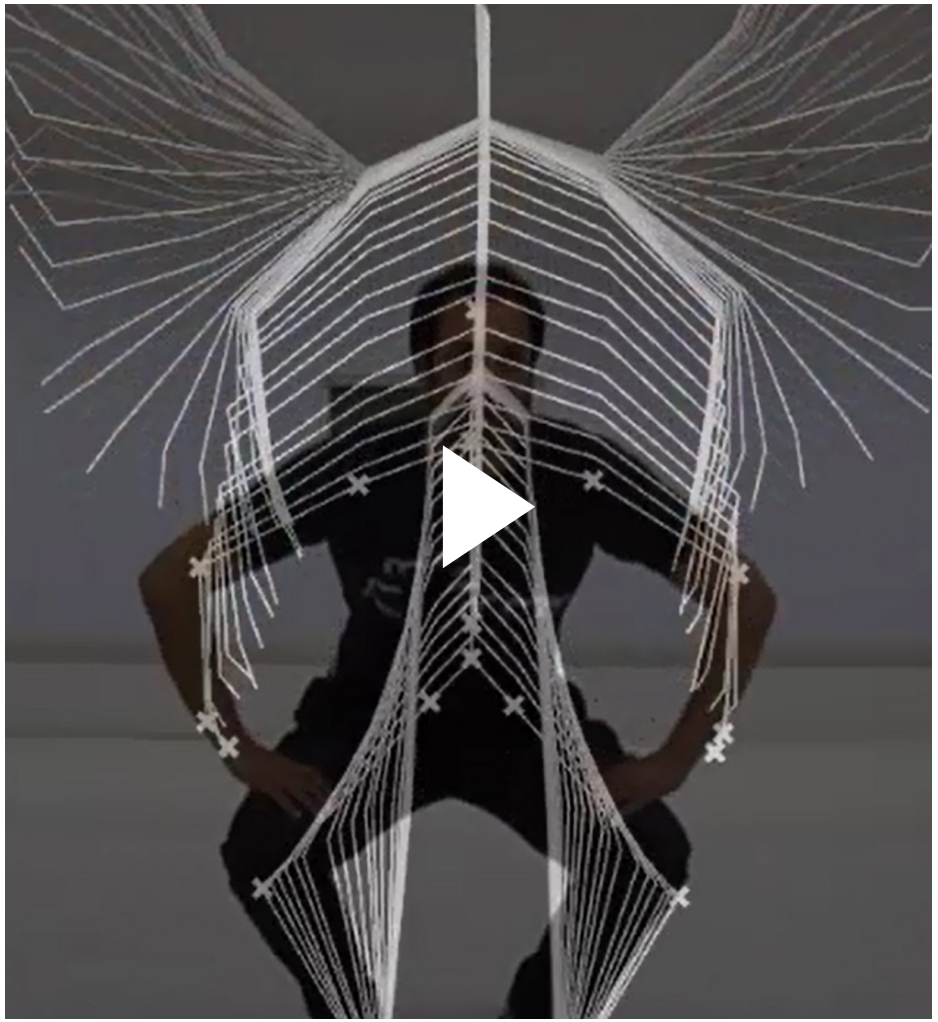
sitting from upright. slow

resting back



hand shake. slow. same depth from tracker

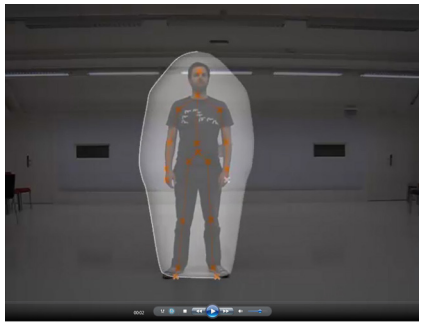
leaning/ standing. 2 people. same depth from tracker



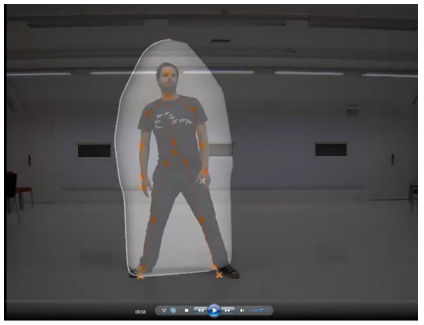
Kinect sensor allows us to track [quite precisely] human posture as a skeleton of data points.

It further allows a recording of this data.

2.5 Human
defining space of occupancy [the Halo]



standing. front. hands down



moving to the side. front

standing. side. right hand up

standing. front. right hand up

kneeling. front. both knees

standing. front. left leg raised

beginning to define a 3-dimensional space of occupancy around the skeleton. Every posture thus has a space associated to it.

2.6 Human
can we add comfort?

standing
hand at+ 1.20m
halo scaling: 1.1

standing
hand at + 1.60m
halo scaling: 1.5

standing
hand at + 1.80m
halo scaling: 1.9

kneeling
hand at+ 0.40m
halo scaling: 1

kneeling
hand at + 1.20m
halo scaling: 1.2

kneeling
hand at + 1.50m
halo scaling: 1.7

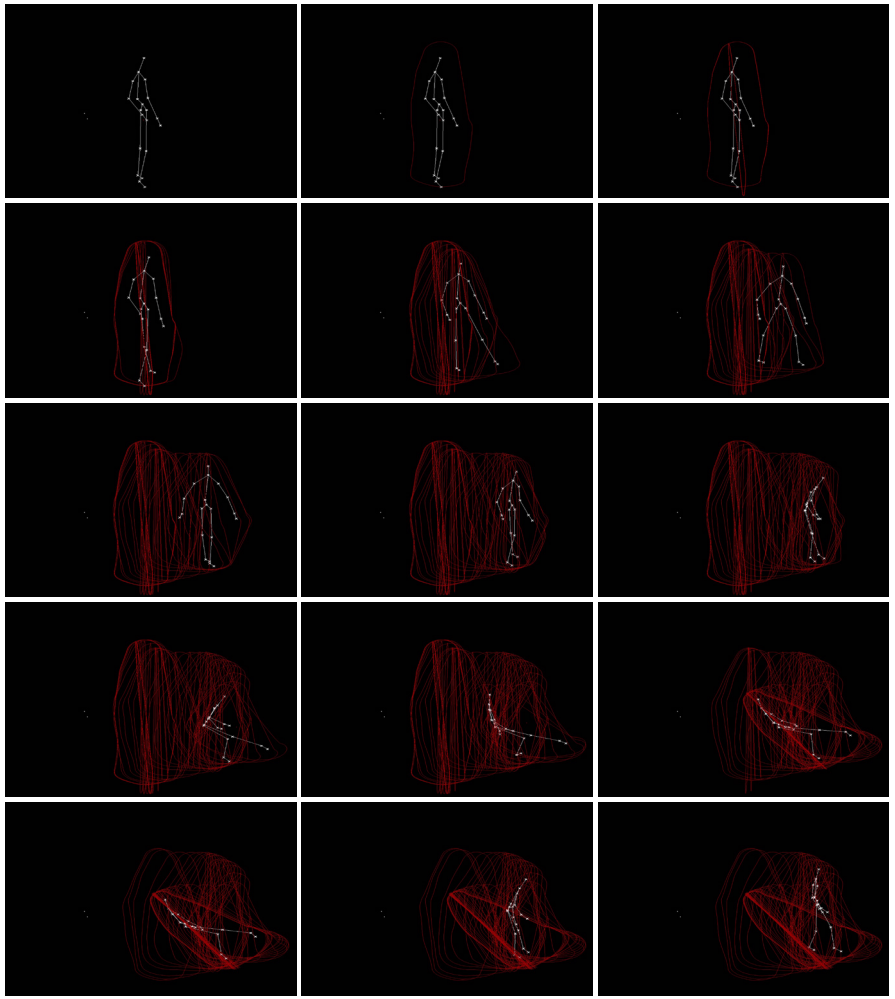
right hand up
hand at+ 1.05m
halo scaling: 1

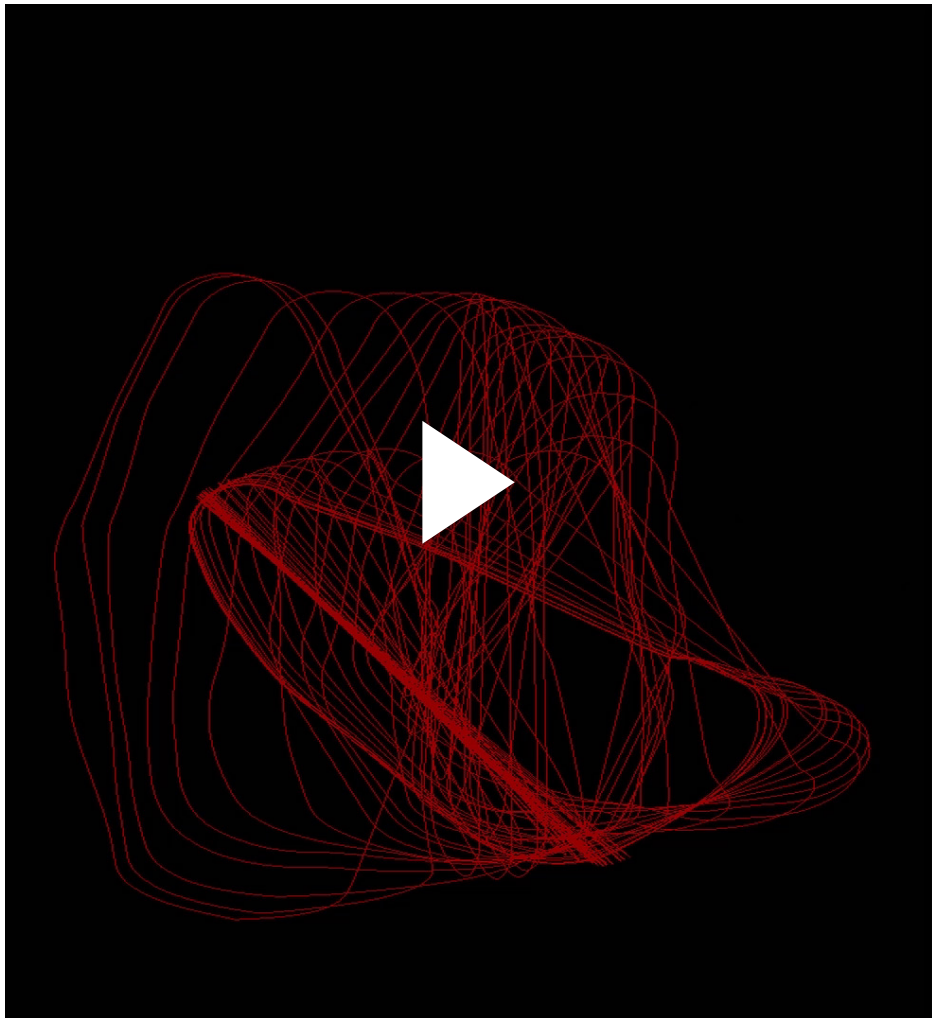
right hand up
hand at+ 1.50m
halo scaling: 1.35

right hand up
hand at+ 1.80m
halo scaling: 1.9

beginning to define a 3-dimensional space of occupancy around the skeleton. Every posture thus has a space associated to it.

2.7 Human
information filtered from tests





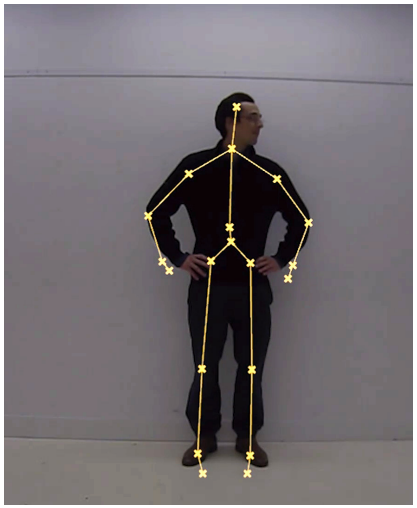
2 strands of information

_skeletal data
_curves defined by occupancy [halo]

3.0
A Mapping Device

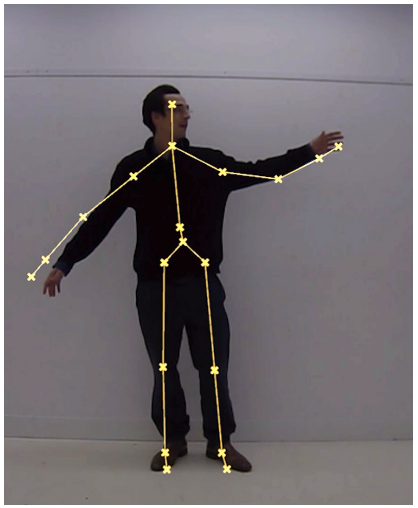
tracking and logging human movement

3.1 Device
generating curves from human movement



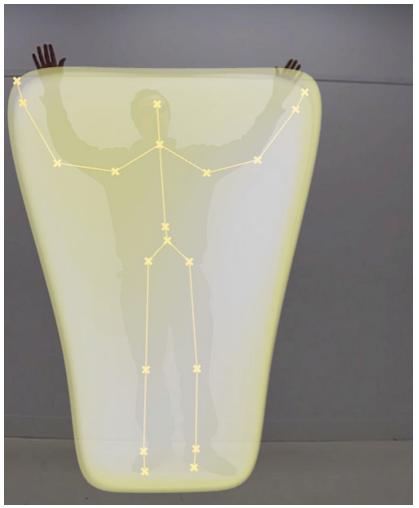
>> subject
Adrian

**tracks up to 2 people at a time*



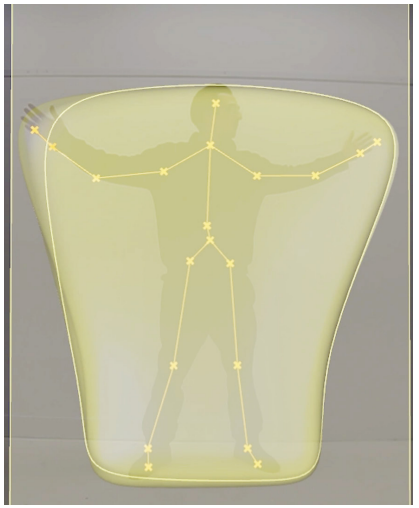
>> skeleton
tracking and defining skeleton

**skeleton defined as 20 points [for each joint] and 20 bones [each limb]*



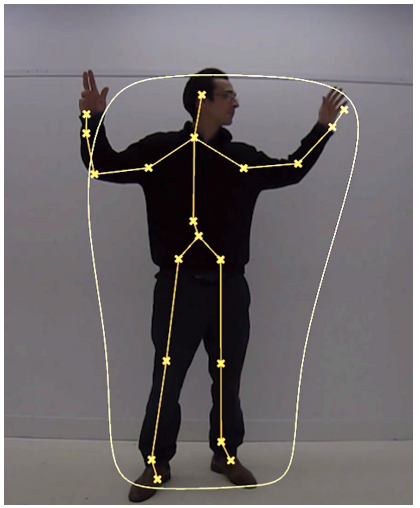
>> halo
3-dimensional space defined around skeleton

**based in distance from skelton_could be altered*



>> Plane surface
surface aligned to the spine of the skeleton

**based in distance from skelton_could be altered*

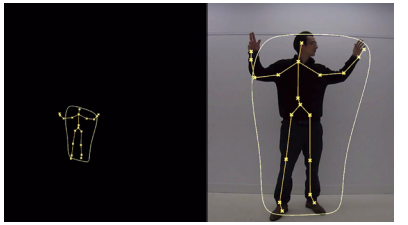


>> halo/ plane intersection
curve generated by the intersection point to between the halo and the plane surface

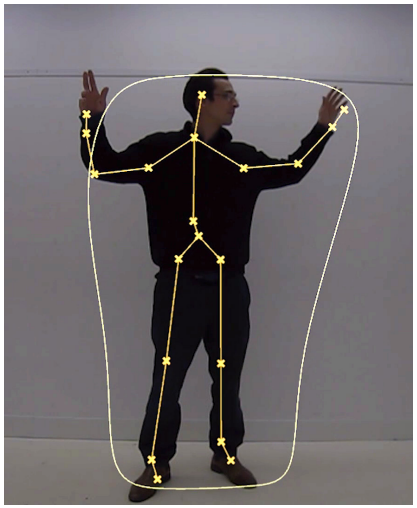
**same operation could be carried out different directions and thus generating multiple curves*

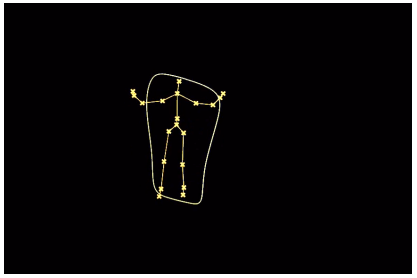
3.2 Device

logging curves from human movement
1 person

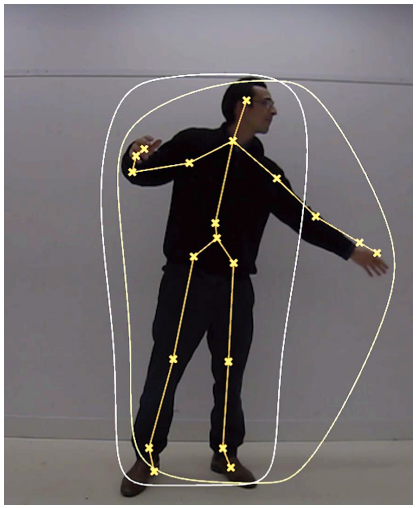


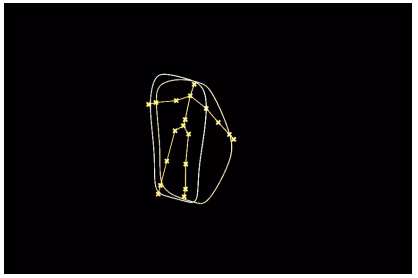
click for animation



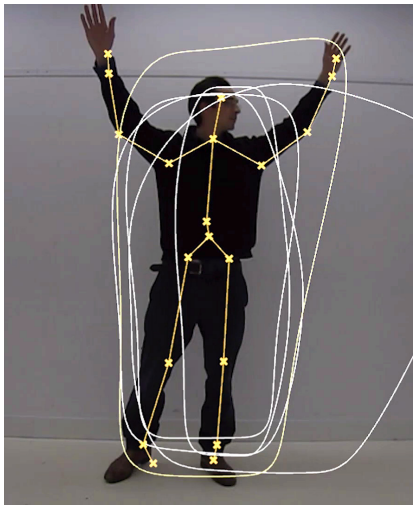


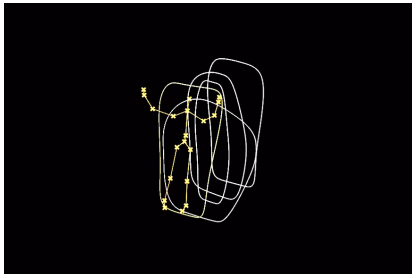
>> curves
curves logged after 2 seconds



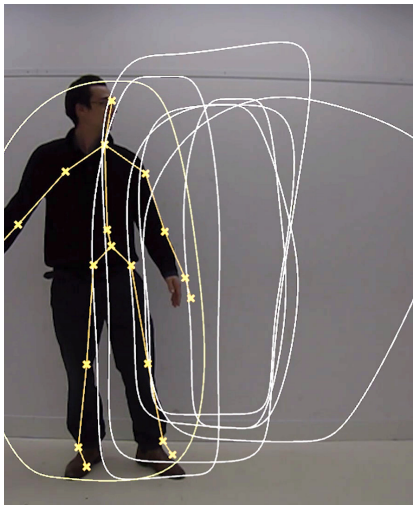


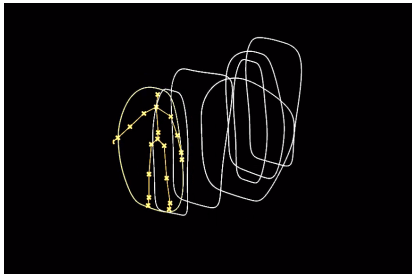
>> curves
curves logged after 4 seconds



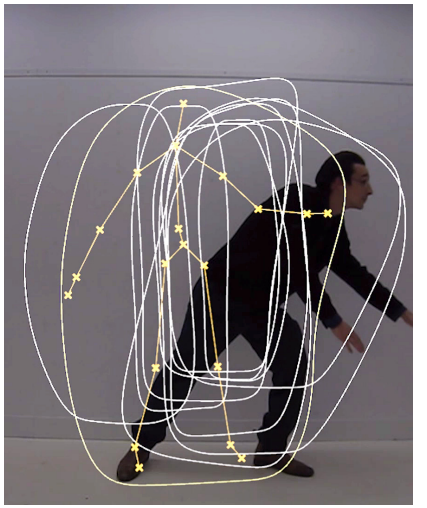


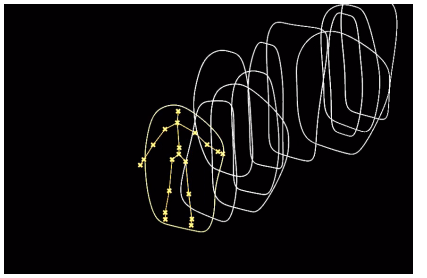
>> curves
curves logged after 10 seconds





>> curves
curves logged after 14 seconds

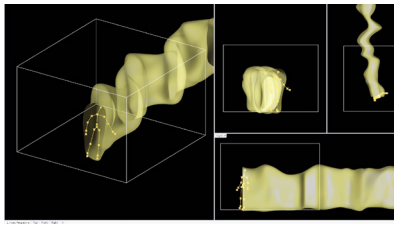




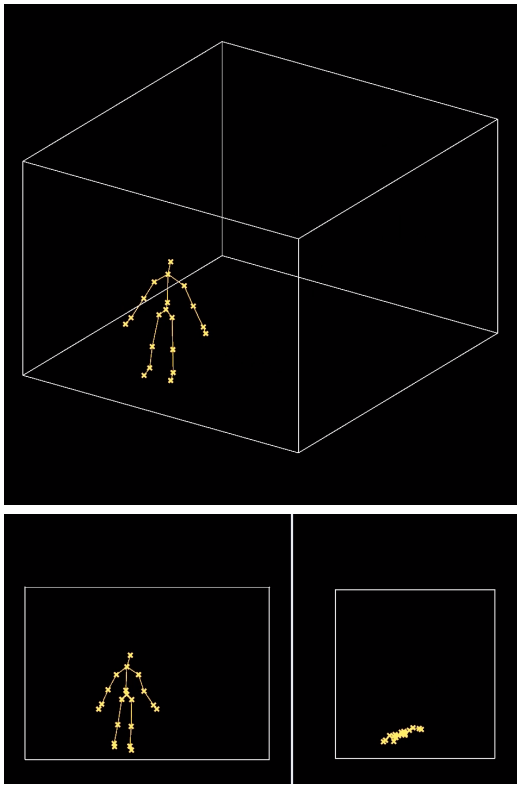
>> curves
curves logged after 22 seconds

3.3 Device

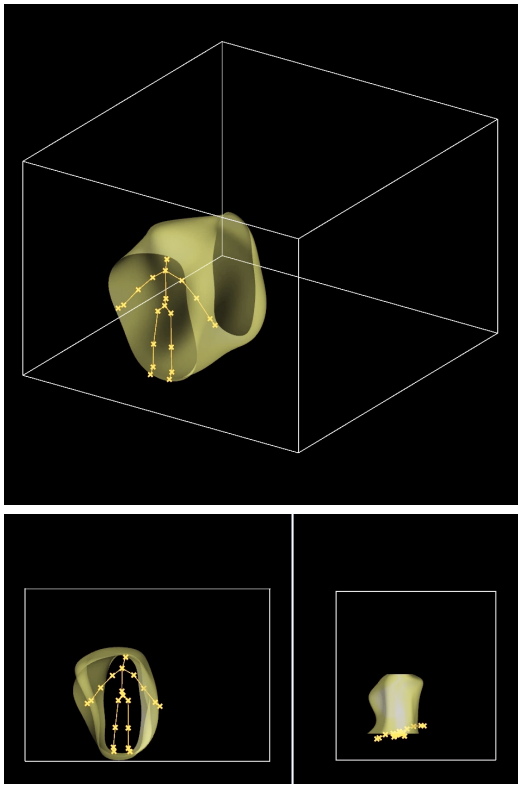
generating the worm of space usage
1 Person



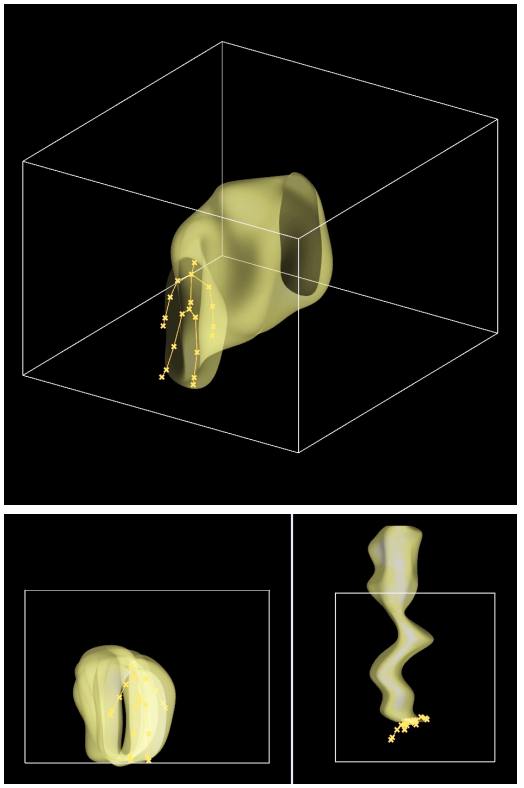
click for animation



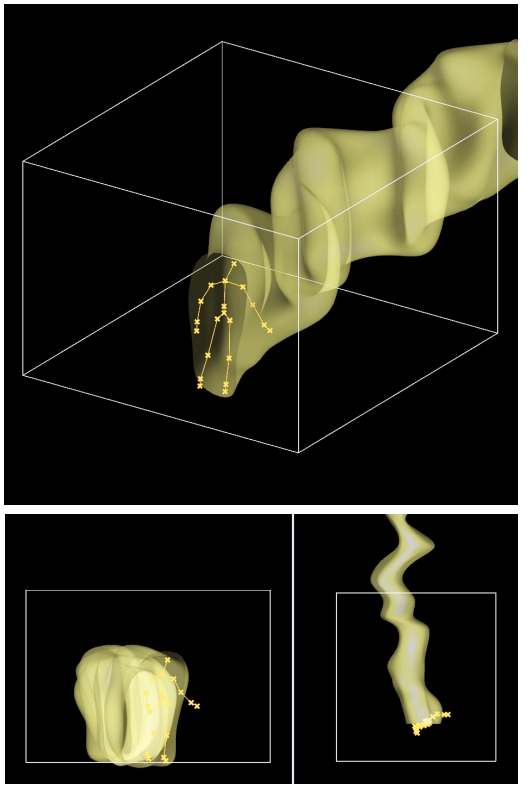
>> worm
space logged after 0
seconds



>> worm
space logged after 4
seconds



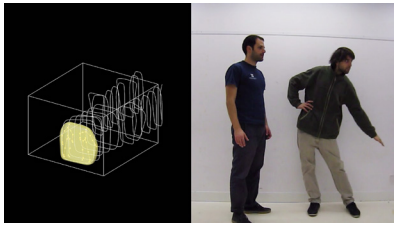
>> worm
space logged after 10
seconds



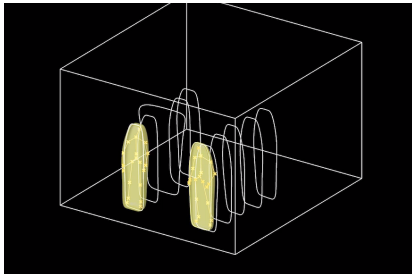
>> worm
space logged after 18
seconds

3.4 Device

logging curves from human movement
2 people



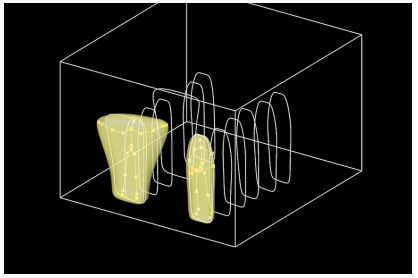
click for animation



>> curves
curves logged after 8 seconds

**seperate halos logged*

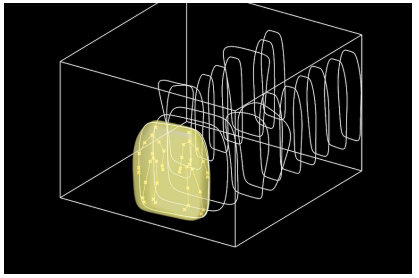
> separate curves



>> curves
curves logged after 10 seconds

**seperate halos logged*

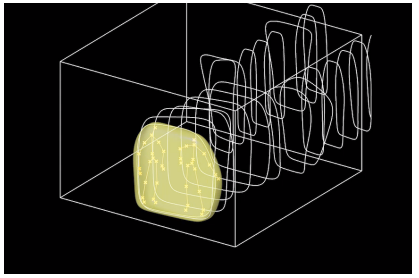
>separate curves



>> curves
curves logged after 20 seconds

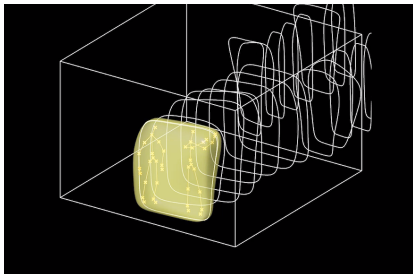
**halos join [when subjects come close]*

> curve combines to one



>> curves
curves logged after 24 seconds

**halos remain joined*
> curves remain as one

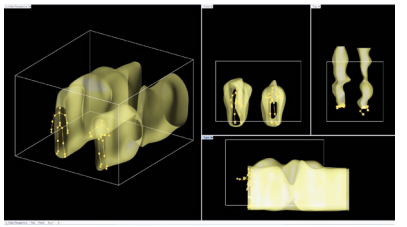


>> curves
curves logged after 30 seconds

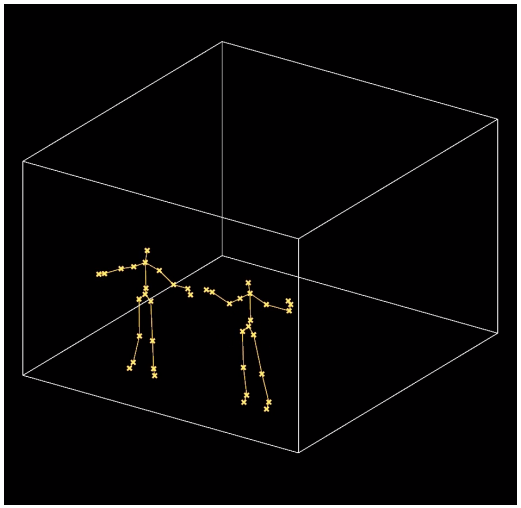
**halos remain joined*
> curves remain as one

3.5 Device

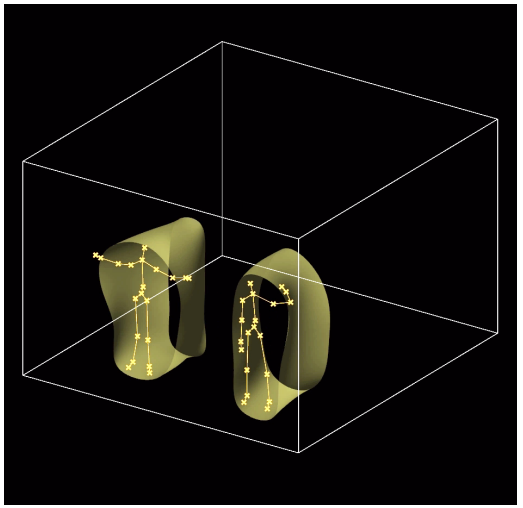
generating the worm of space usage
2 People



click for animation

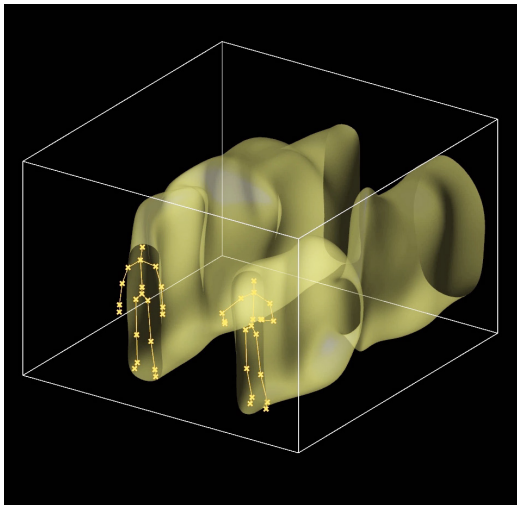


>> worm
space logged after 0 seconds



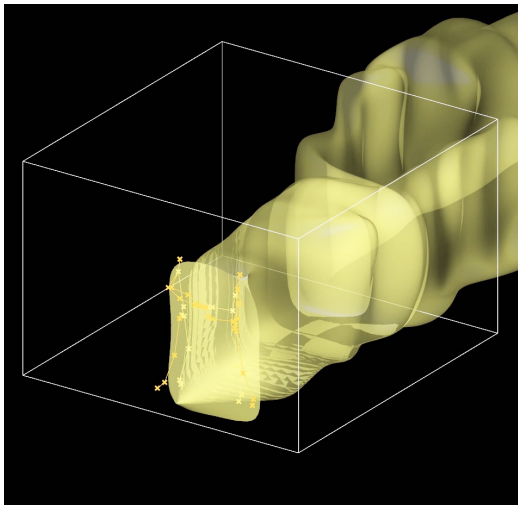
>> worm
space logged after 4 seconds

**separate space worms*



>> worm
space logged after 10 seconds

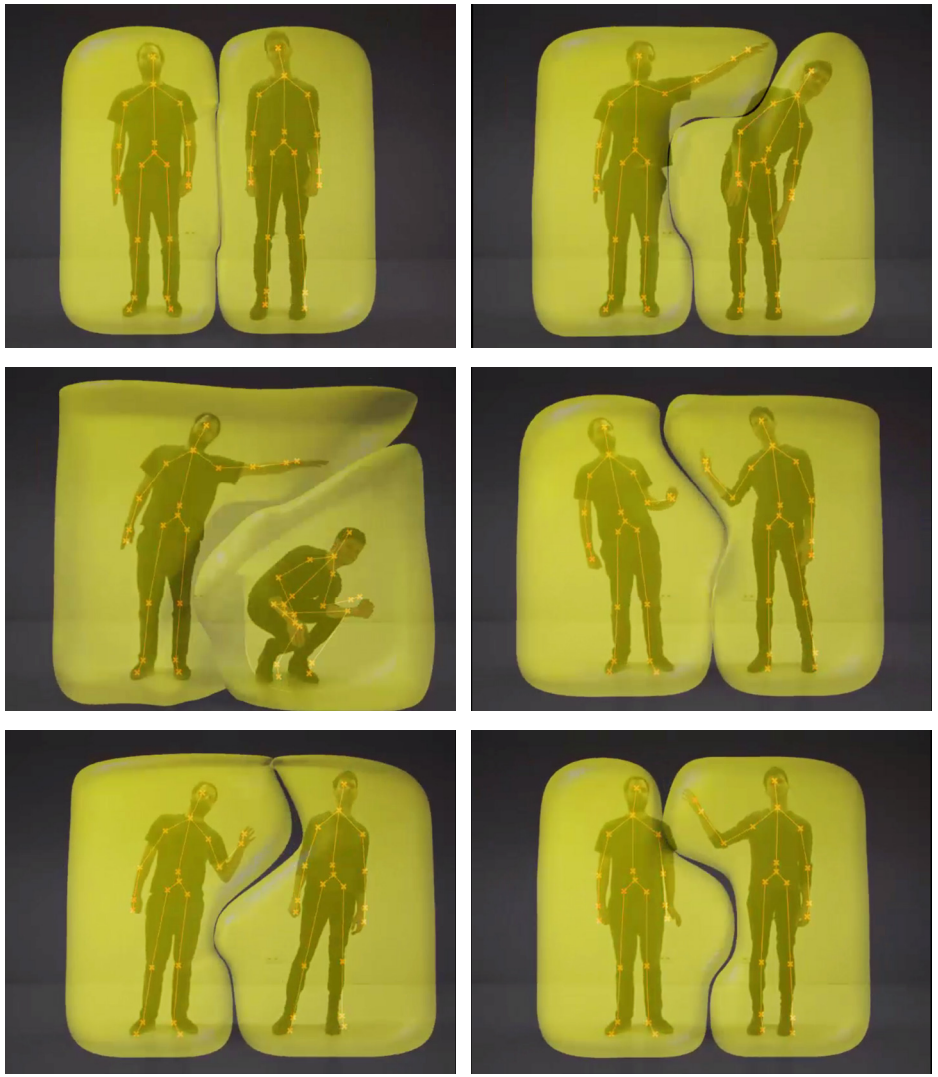
**separate space worms*
> subjects at a distance



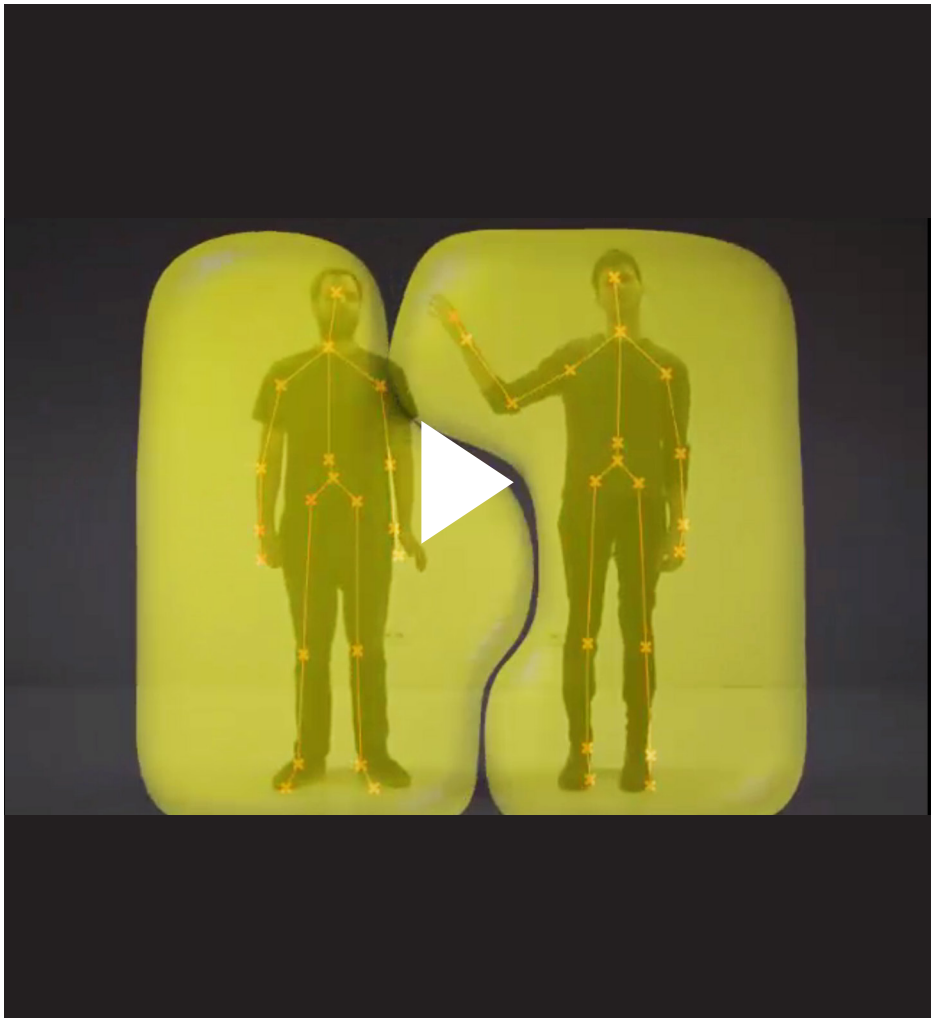
>> worm
space logged after 18 seconds

**combine space worm*
> subjects within a distance from eachother

3.6 Device
exploring 2 person interaction



repelling

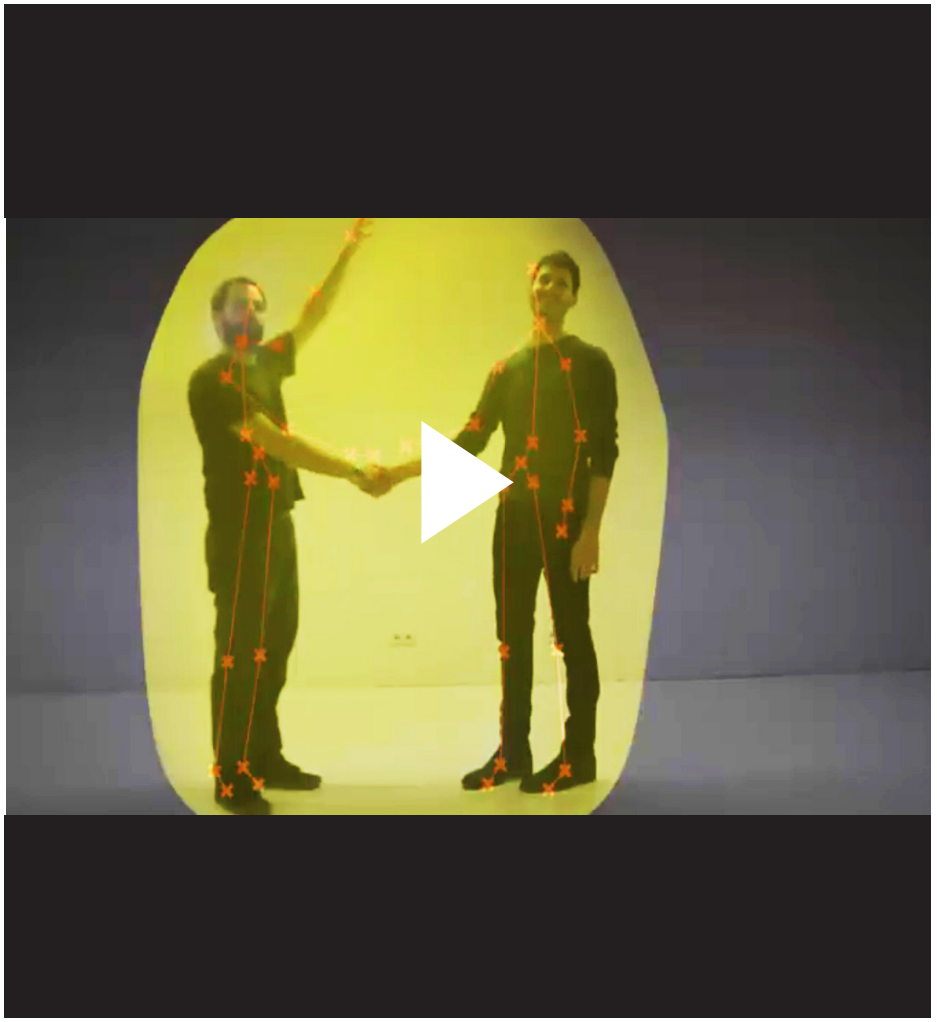


spatial negotiation

> halos remain separate
> negotiate for space by repelling eachother

3.7 Device
exploring 2 person interaction

merging

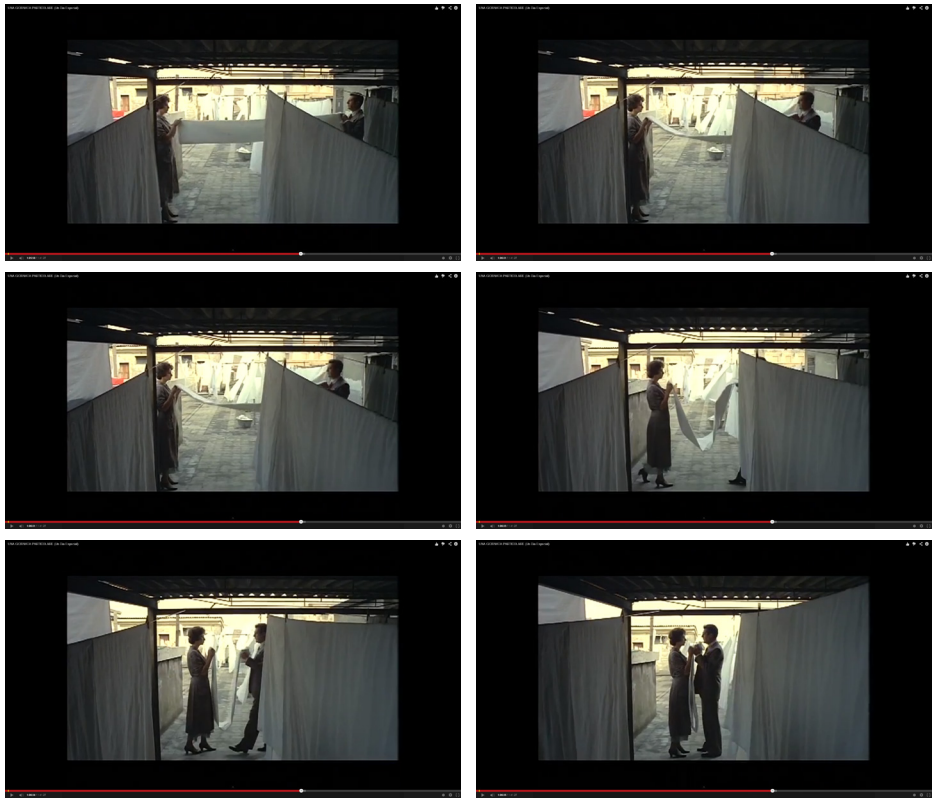


spatial merging

> halos merging in interaction
> within a certain distance from eachother

further exploring 2 person interaction through case study
Movie >> Una Giornata Particolare

3.8 Device
exploring 2 person interaction



first merging

spatial merging

> halos merging in interaction
> within a certain distance from eachother

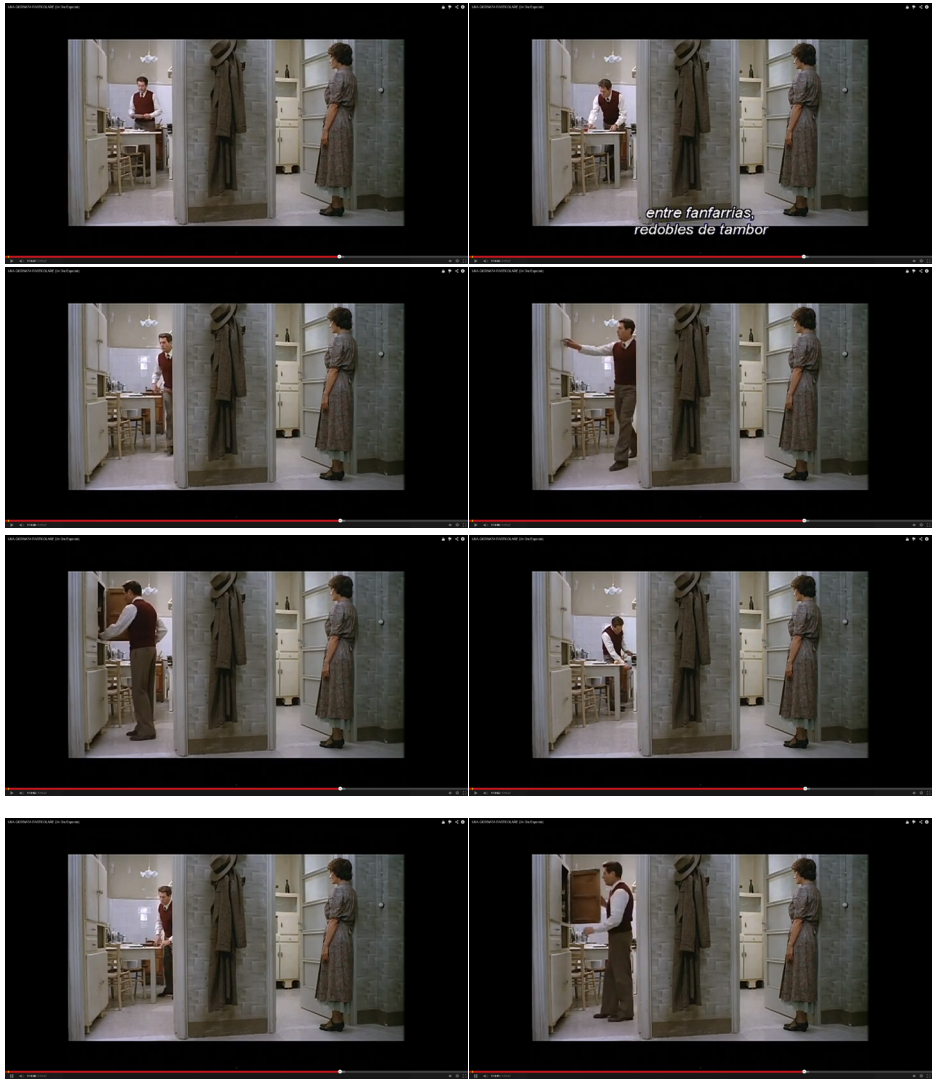
3.9 Device
exploring 2 person interaction

repelling

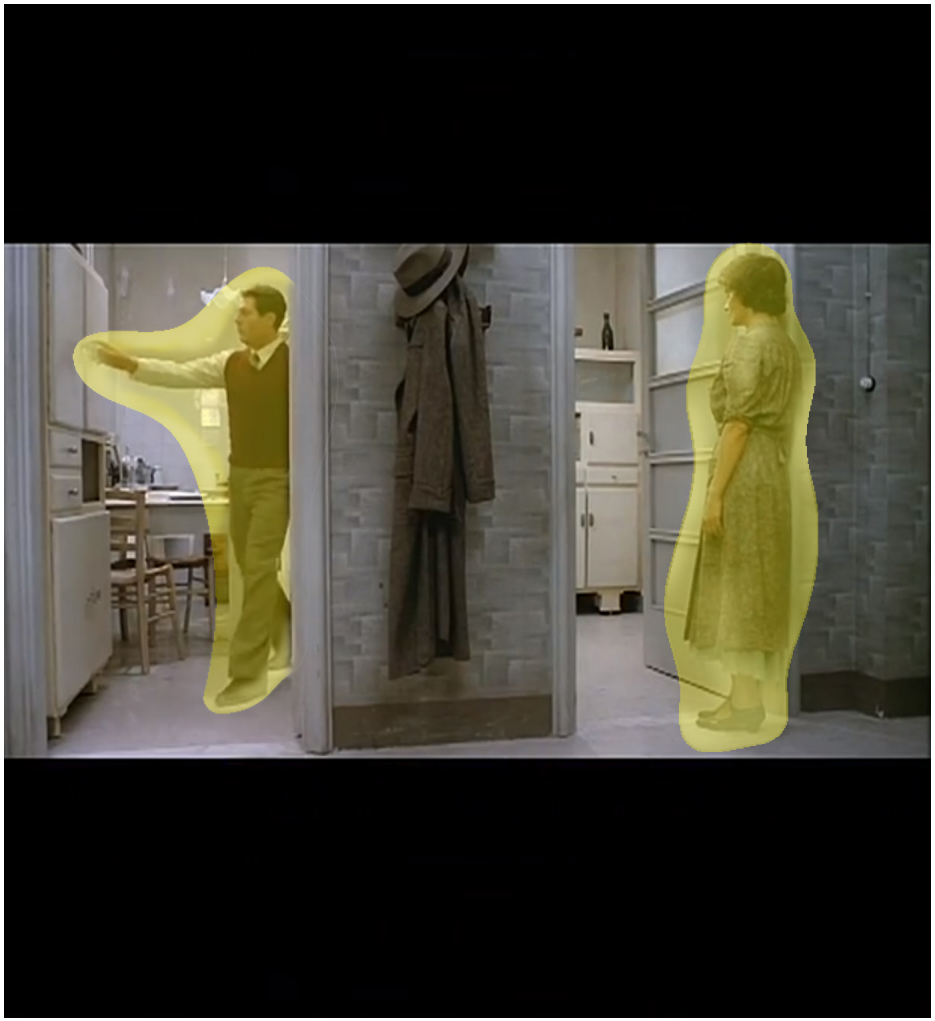
spatial repelling

> halos repelling in interaction

3.10 Device
exploring 2 person interaction



co-exitence



spatial co-existence

> halos not merging

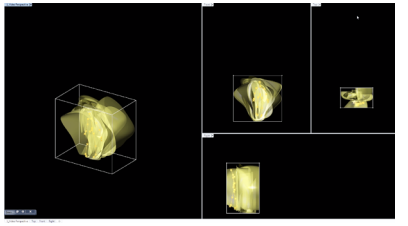
3.11 Device
exploring 2 person interaction

complete merging

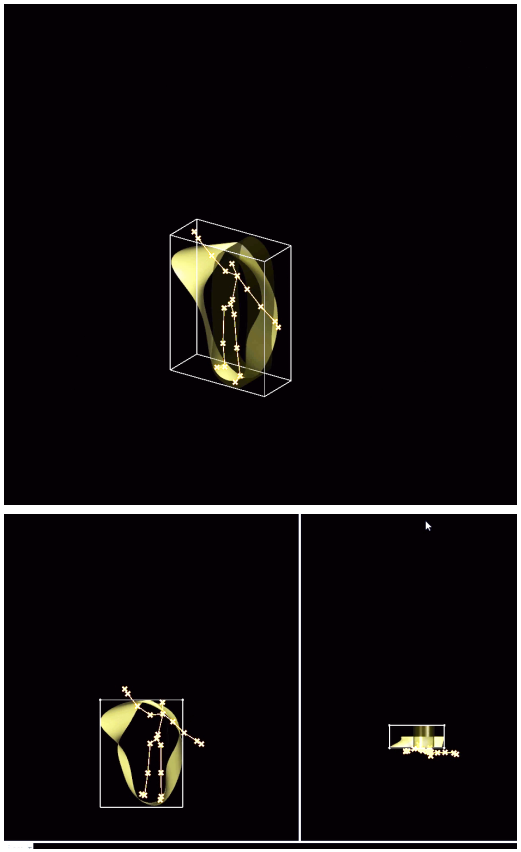
spatial merging

> halos becoming one

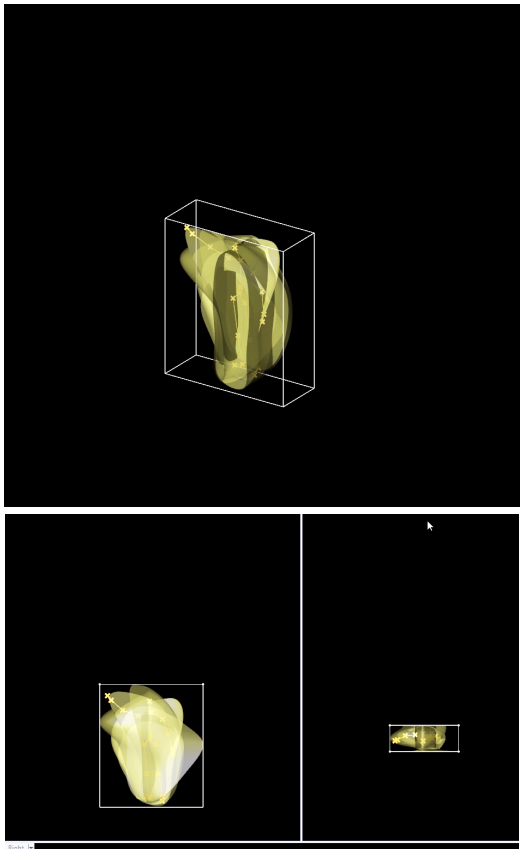
3.12 Device
information from mapping device



click for animation

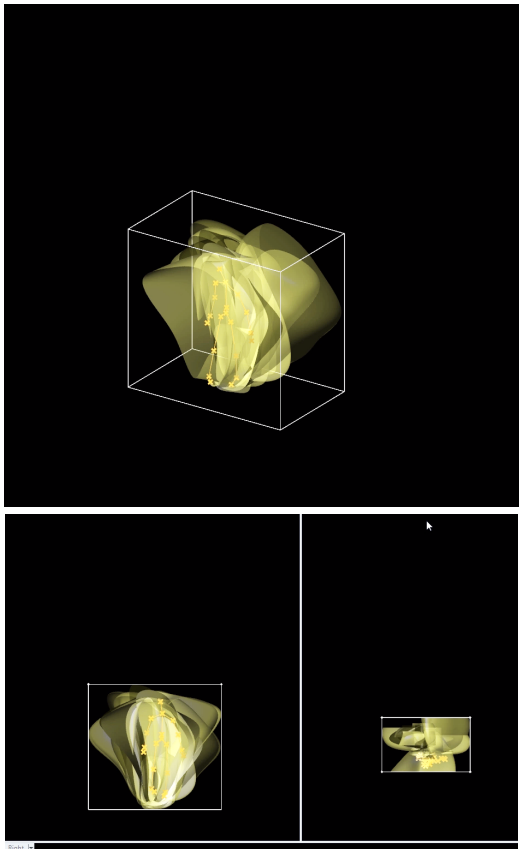


>>
space used logged after 0 seconds



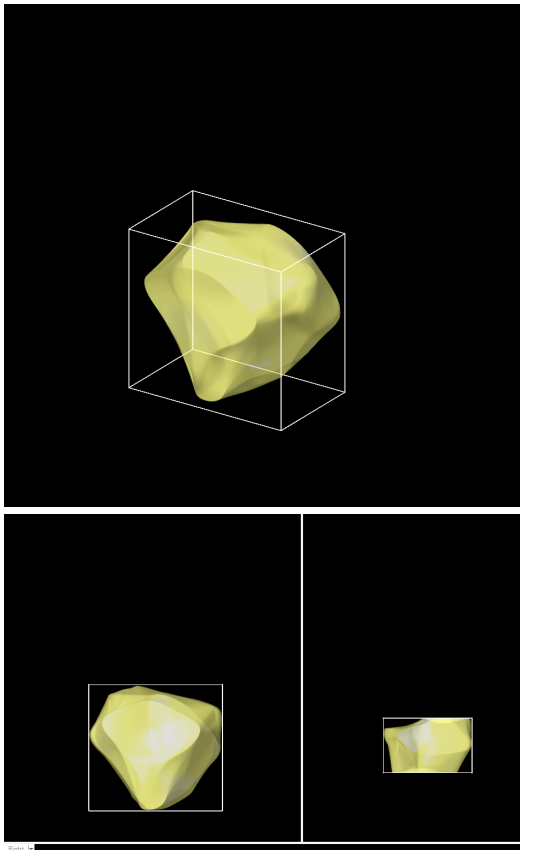
>>
space logged after 4 seconds

**activities logged where they happen*



>>
space logged after 9 seconds

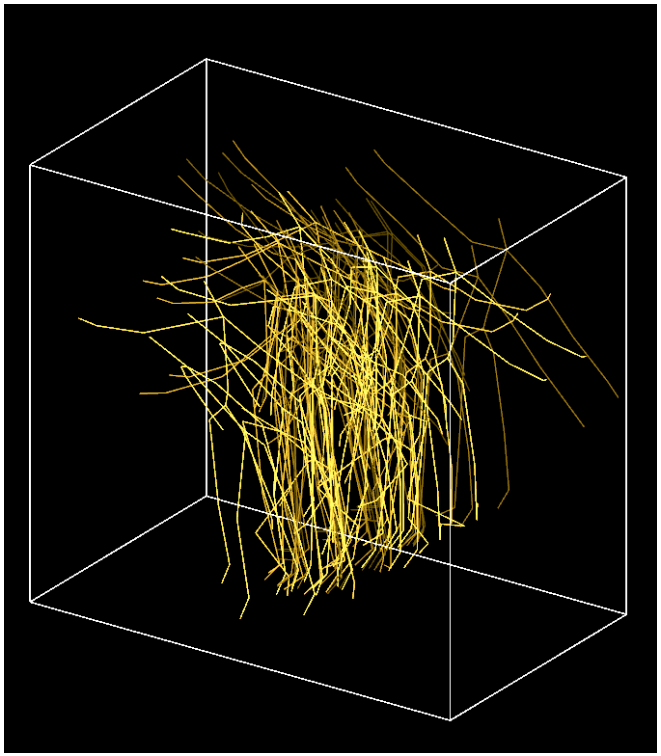
**overlapping activities*



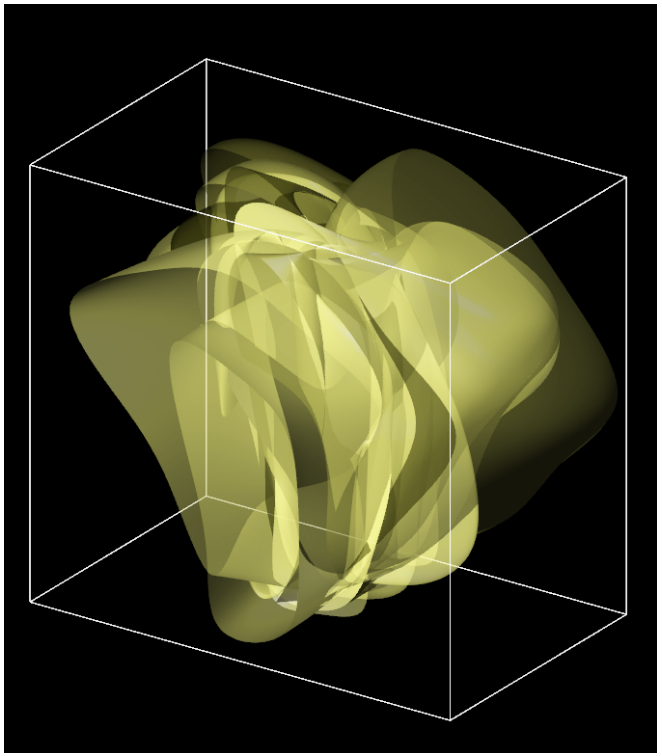
>> **worm**
space logged after 30 seconds

**merging them indicates the space that was used in 30 seconds*

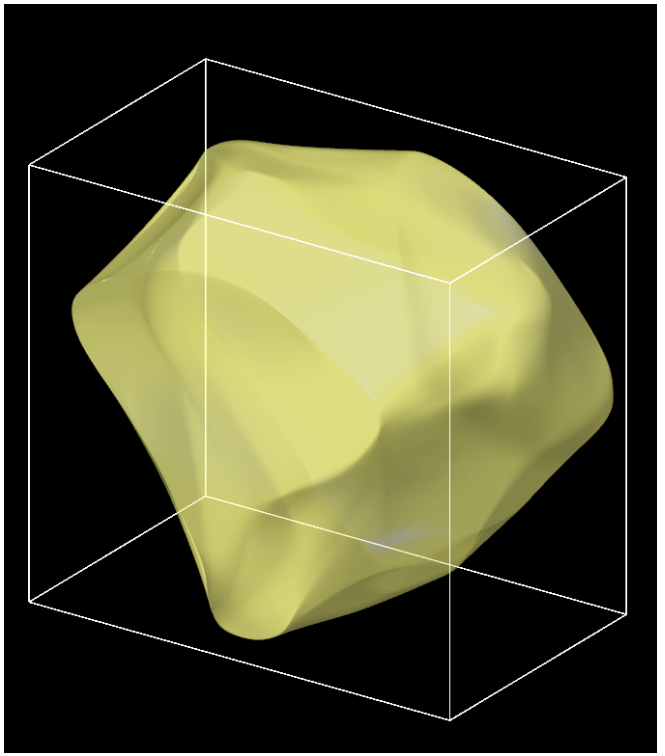
3.13 Device
What do we take from the mapping?



>> Skeleton logg
catalogue of all the postures of the human during the time of mapping

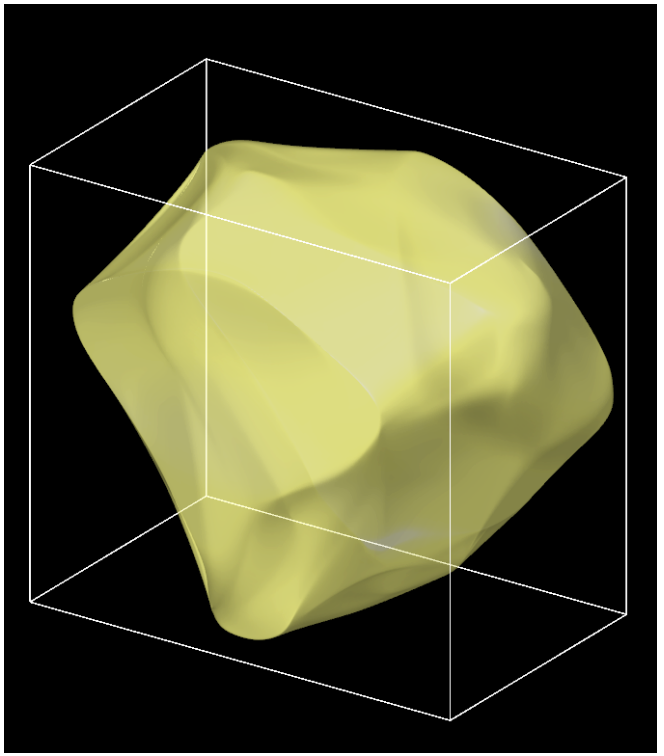


>> space logg
a catalogue of all the spaces that were required for the different activities of the human



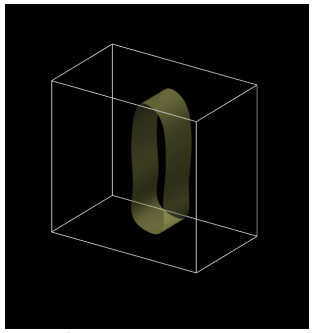
>> volume logg
a complete calculation of the volume used during the time of mapping

This is the diagram of zero wasted space.
Can we achieve this?

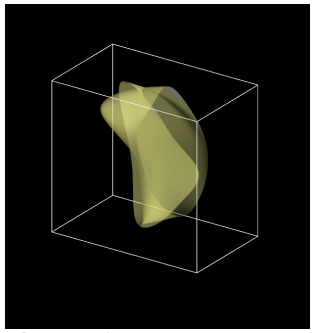


3.14 Device

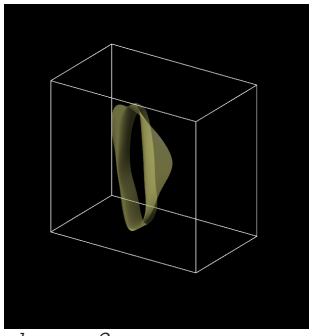
breaking down the volume [understand the conditions of each activity]



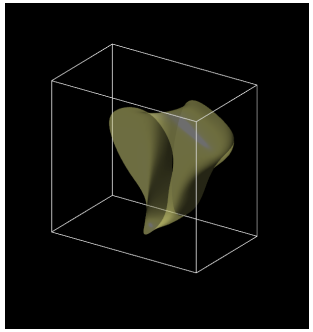
standing



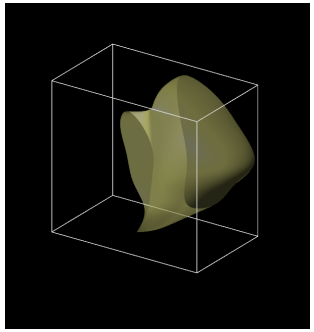
shower 1



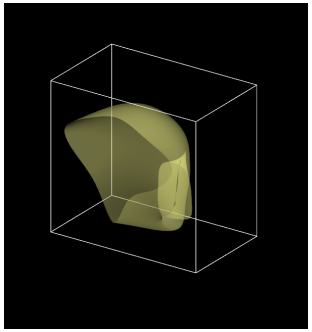
shower 2



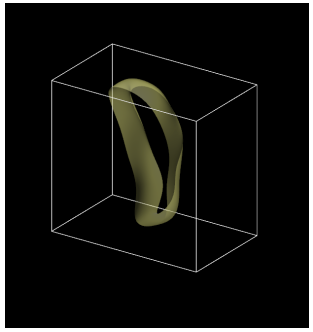
sitting 1



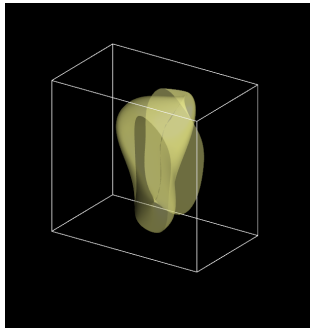
sitting 2



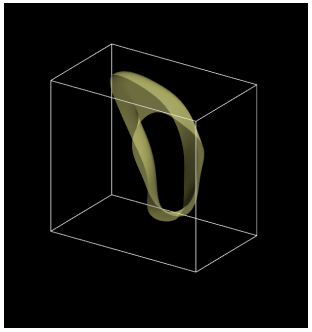
sitting 3



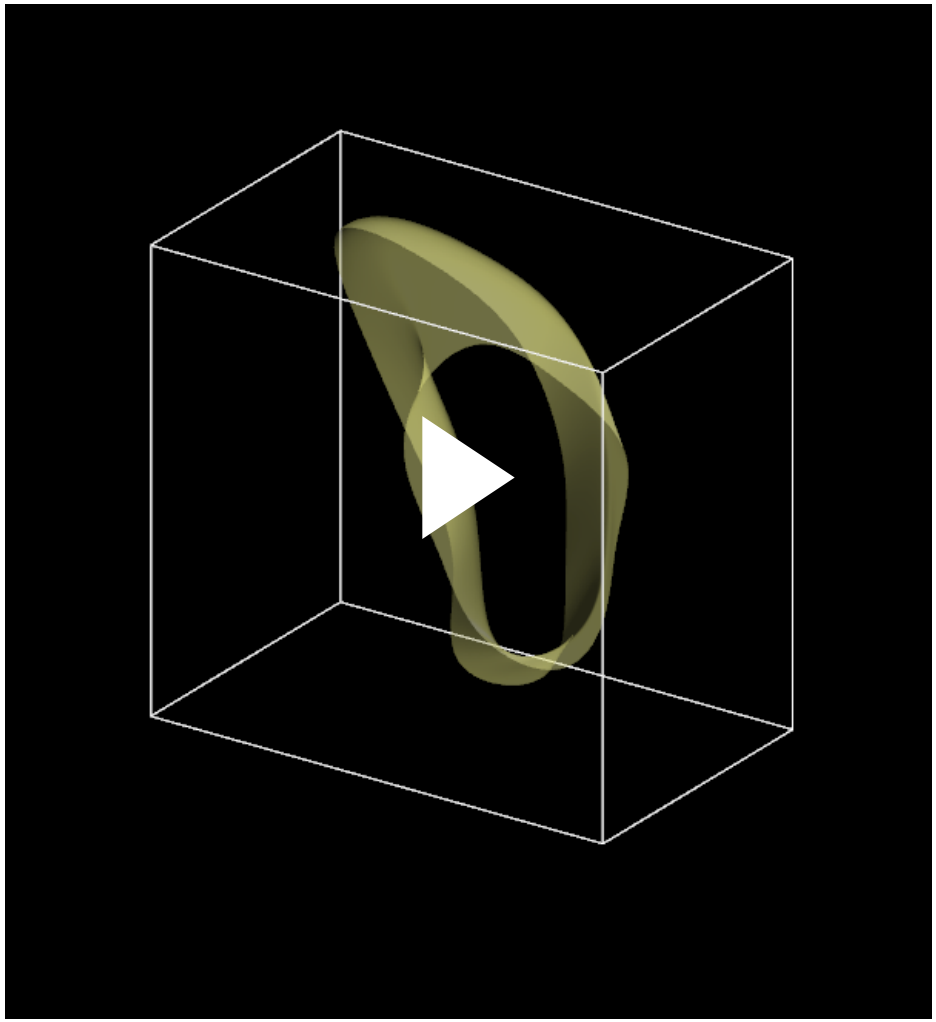
cooking 1



cooking 2

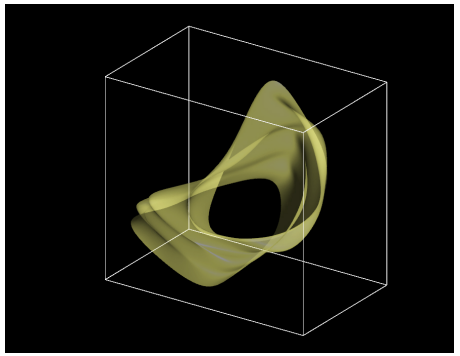


cooking 3

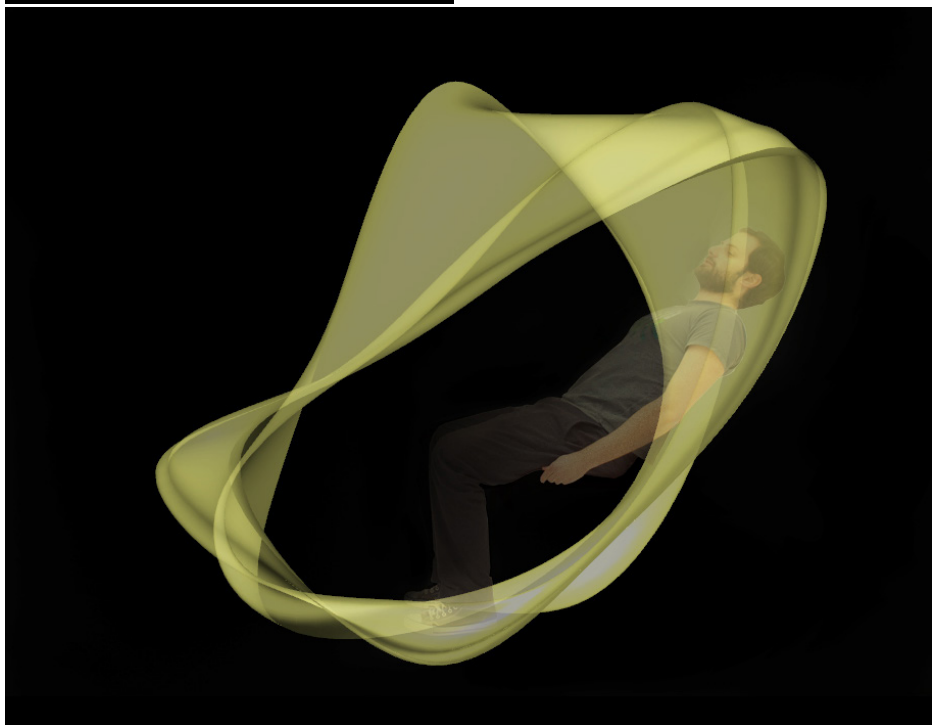


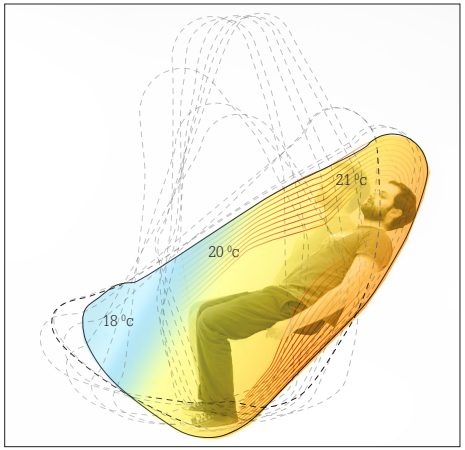
Isolating activities

3.15 Device
isolating activities and analysing conditions

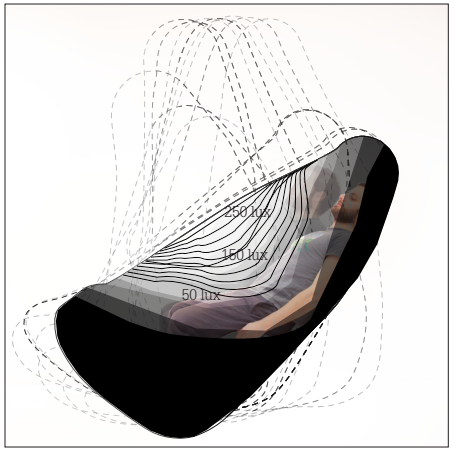


>> activity profile
space for sitting after 40 seconds of mapping

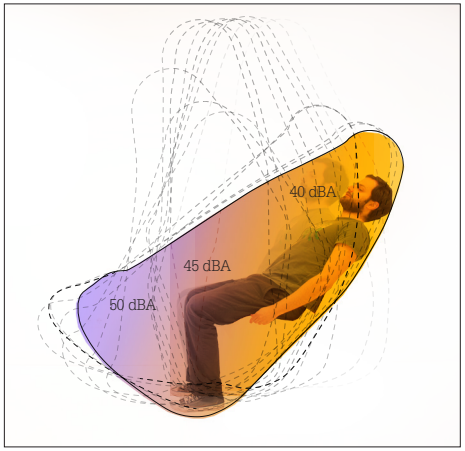




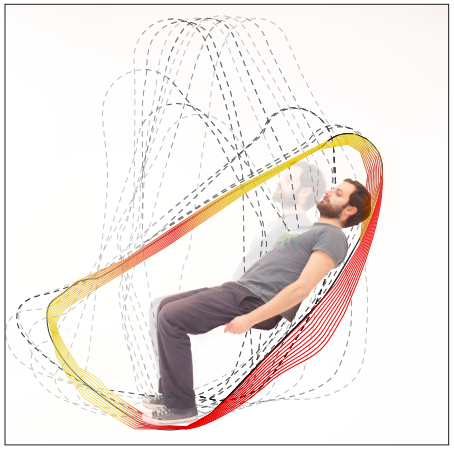
>> temperature (°c)
temperature profile ideal for sitting and associated activities



>> Light (lux)
light conditions necessary for sitting and associated activities

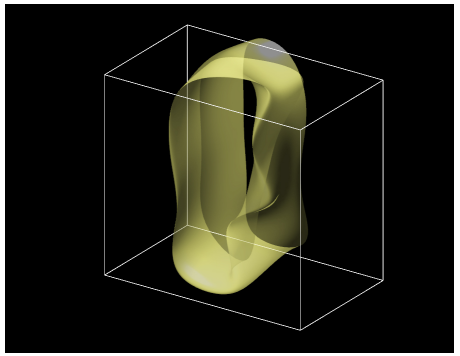


>> noise (dBa)
noise conditions necessary for sitting and associated activities

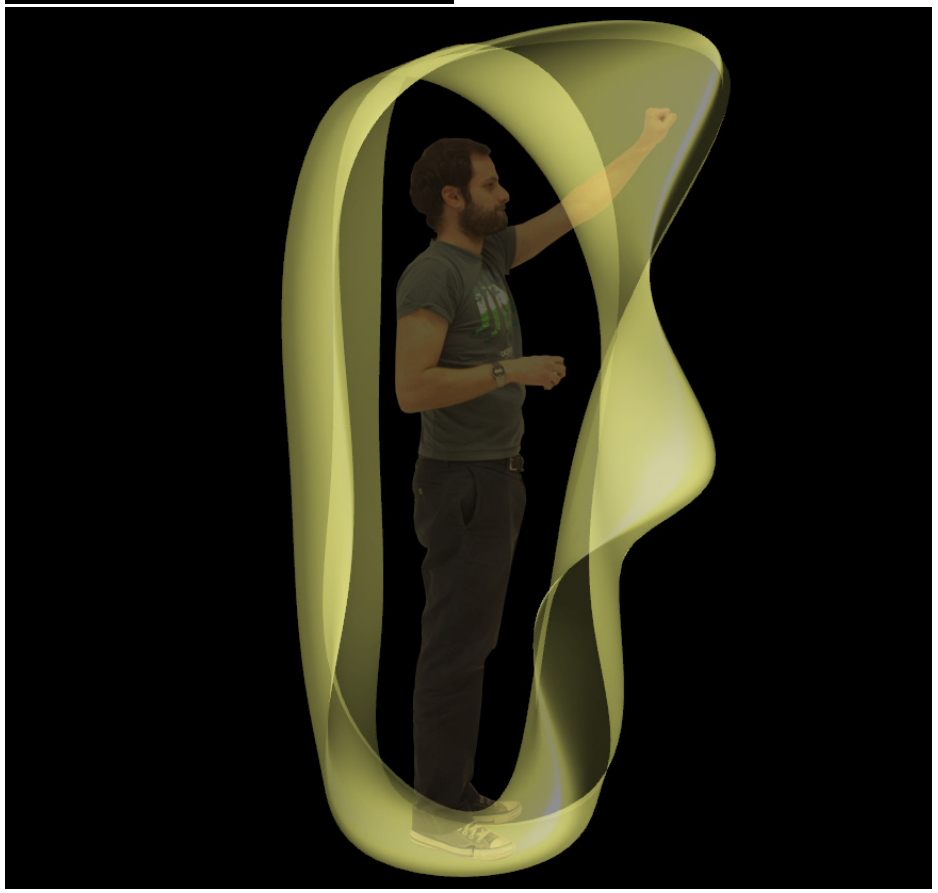


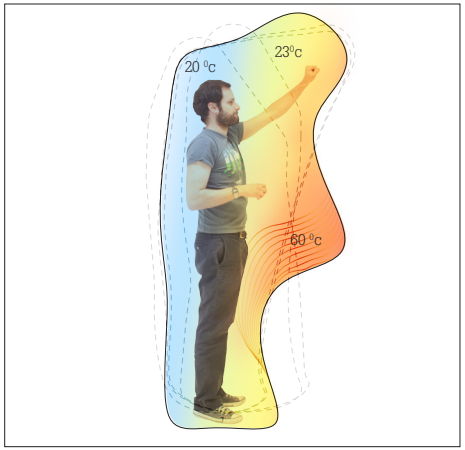
>> stuctural requirements
structural requirements for sitting in this profile and associated activities

3.16 Device
isolating activities and analysing conditions

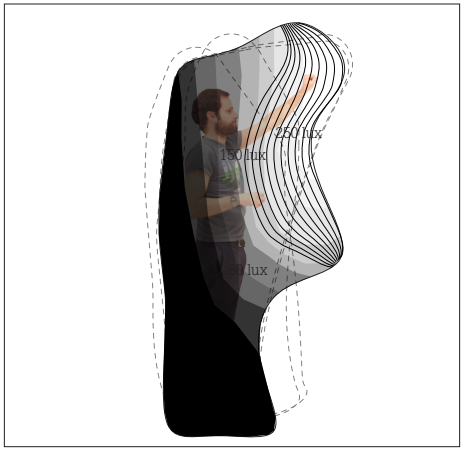


>> activity profile
cooking and cupboard space

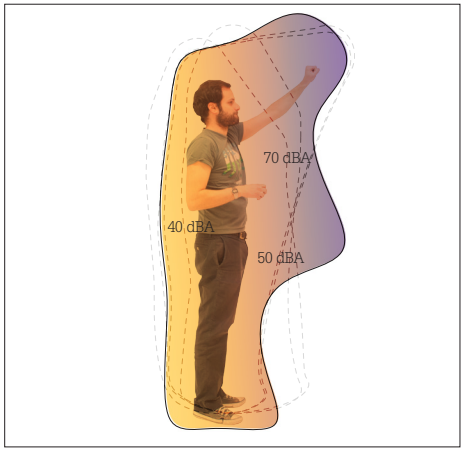




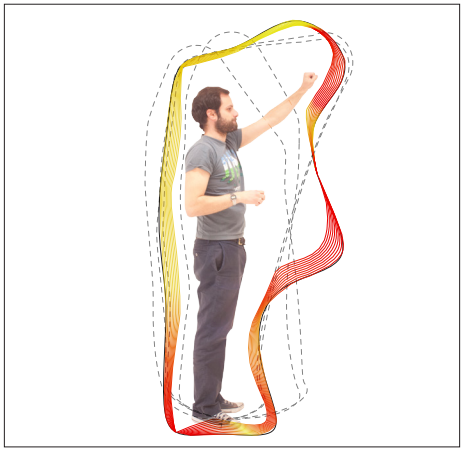
>> temperature (°c)
temperature requirements
for cooking



>> Light (lux)
light requirements for
cooking

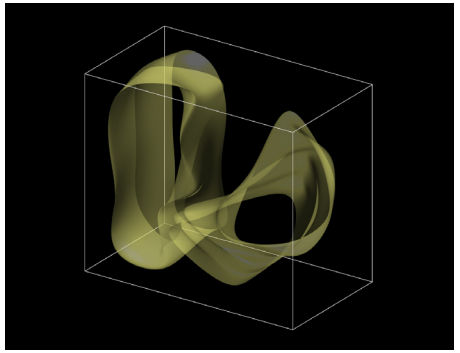


>> noise (dBa)
noise production during
cooking activity

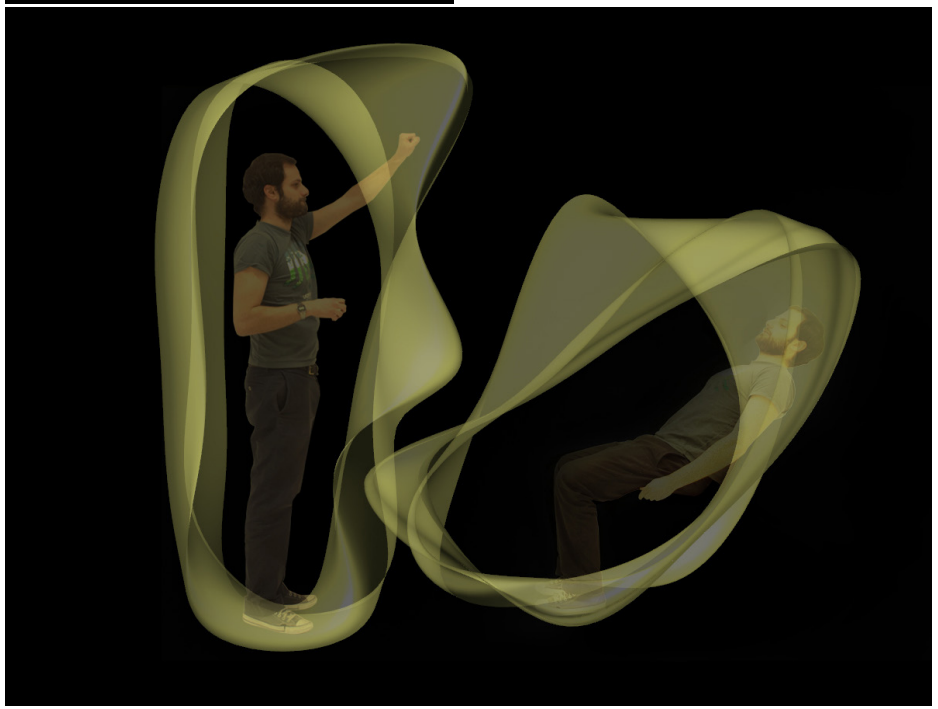


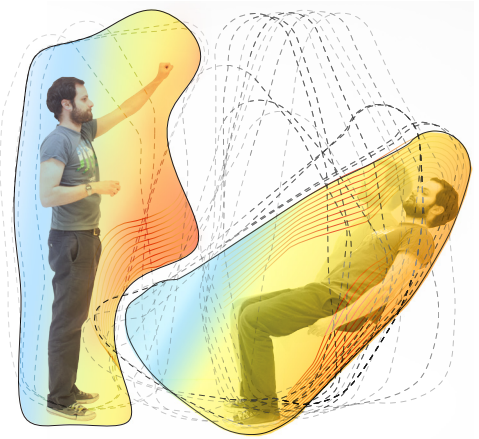
>> structural requiremetns
structural requirements for
cooking activity

3.17 Device
information attached to each activity

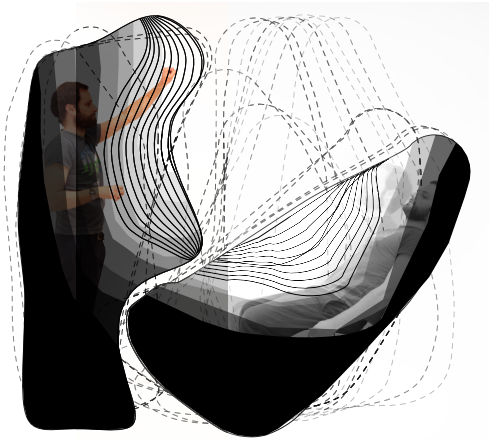


>> activity profile
cooking and sitting
overlapping

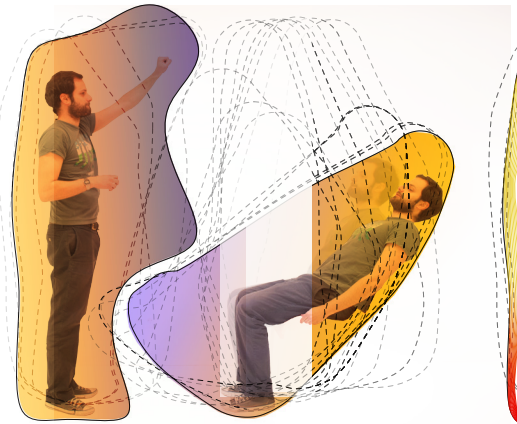




>> temperature (^{0}c)
temperature transfer from
the cooking to sitting
activity must be controlled

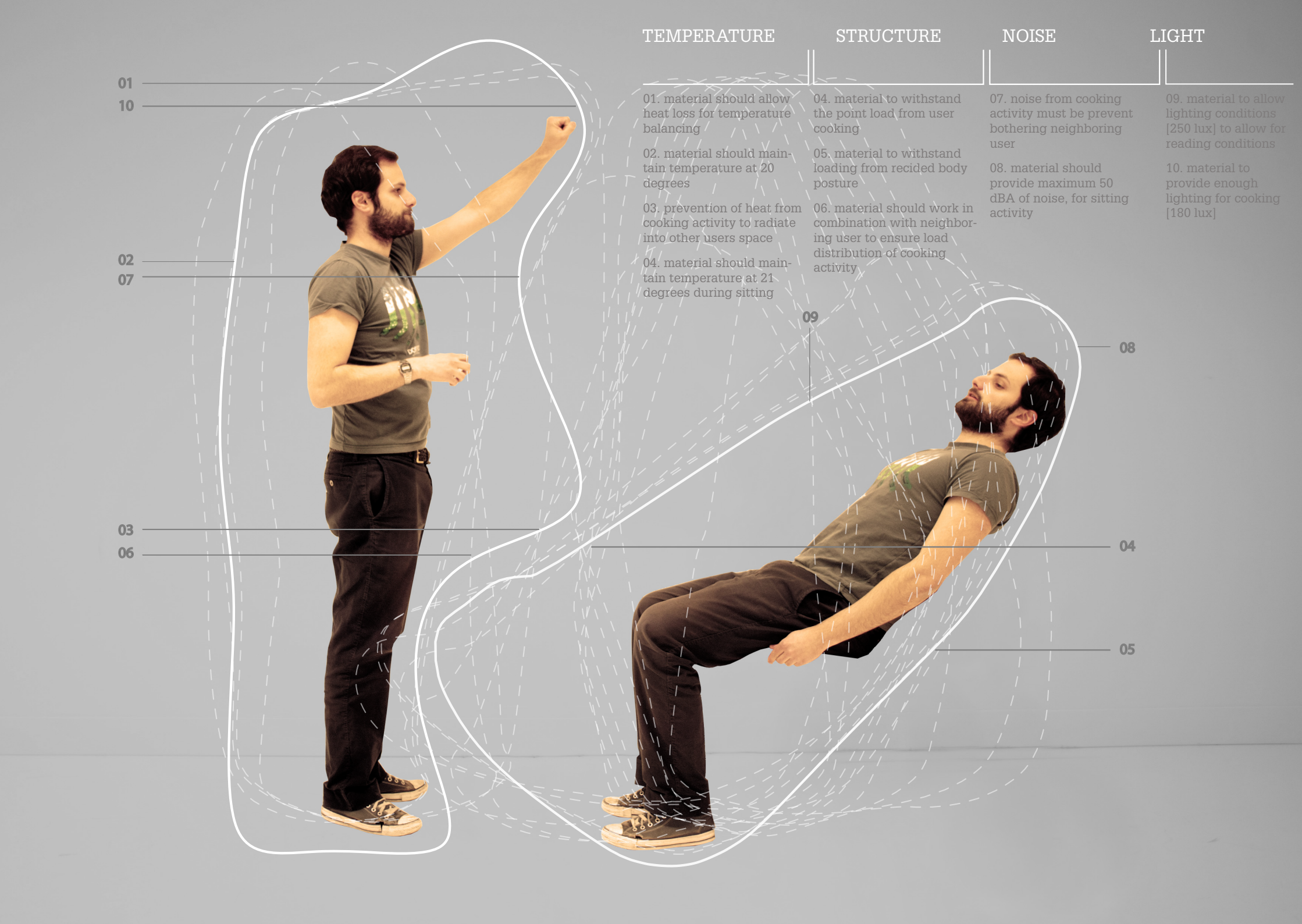


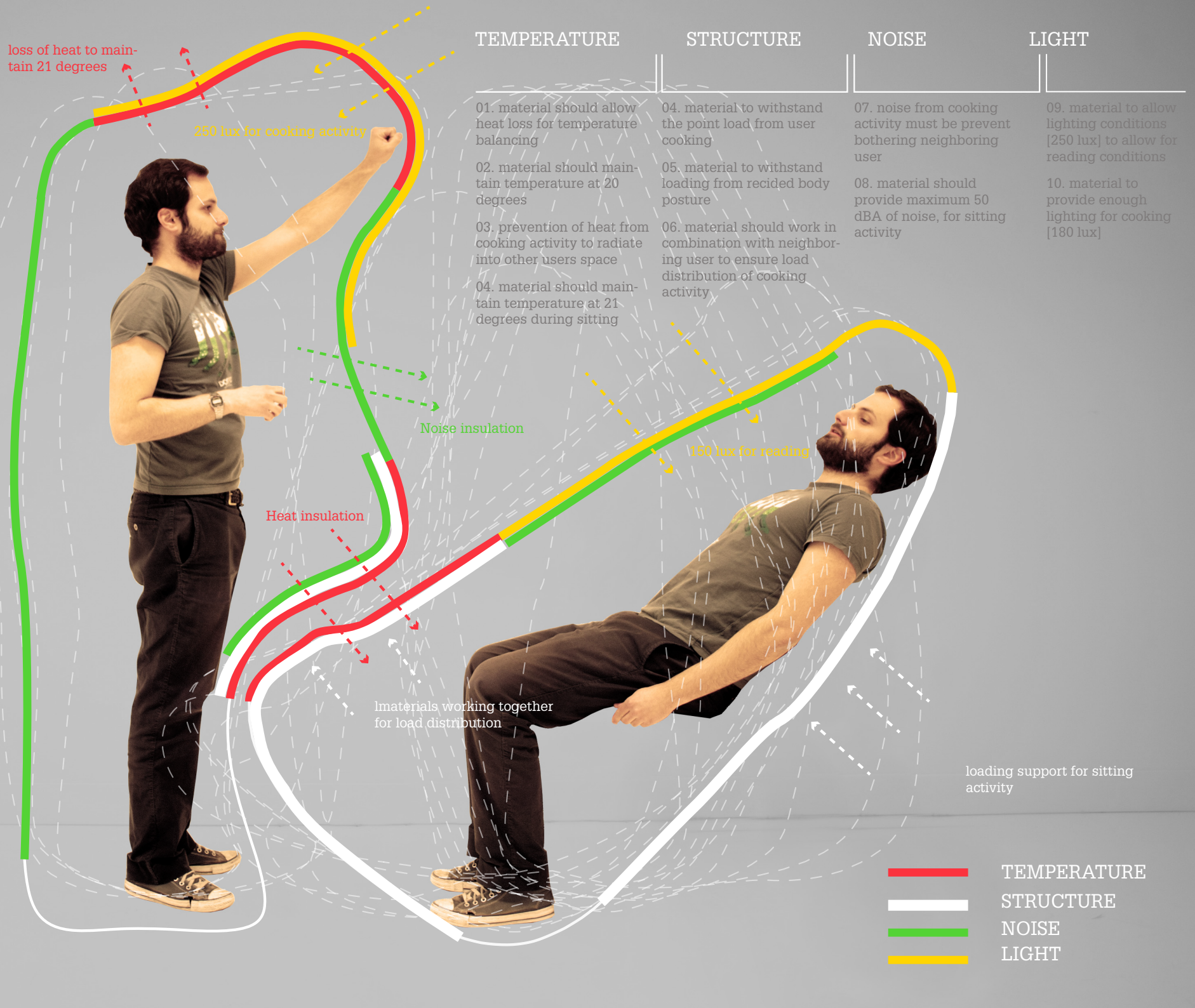
>> Light (lux)
light requirements for the
two overlapping activities



>> noise (dBa)
noise transfer should be
controlled from the cooking
to the sitting activity

>> structural requirements
structure should accomodate
for overlapping conditions
between the two activities


TEMPERATURE
STRUCTURE
NOISE
LIGHT
01. material should allow heat loss for temperature balancing
02. material should maintain temperature at 20 degrees
03. prevention of heat from cooking activity to radiate into other users space
04. material should maintain temperature at 21 degrees during sitting
04. material to withstand the point load from user cooking
05. material to withstand loading from recided body posture
06. material should work in combination with neighboring user to ensure load distribution of cooking activity
07. noise from cooking activity must be prevent bothering neighboring user
08. material should provide maximum 50 dBA of noise, for sitting activity
09. material to allow lighting conditions [250 lux] to allow for reading conditions
10. material to provide enough lighting for cooking [180 lux]
01
10
02
07
03
06
09
08
04
05



TEMPERATURE

01. material should allow heat loss for temperature balancing

02. material should maintain temperature at 20 degrees

03. prevention of heat from cooking activity to radiate into other users space

04. material should maintain temperature at 21 degrees during sitting

STRUCTURE

04. material to withstand the point load from user cooking

05. material to withstand loading from recided body posture

06. material should work in combination with neighboring user to ensure load distribution of cooking activity

NOISE

07. noise from cooking activity must be prevent bothering neighboring user

08. material should provide maximum 50 dBA of noise, for sitting activity

LIGHT

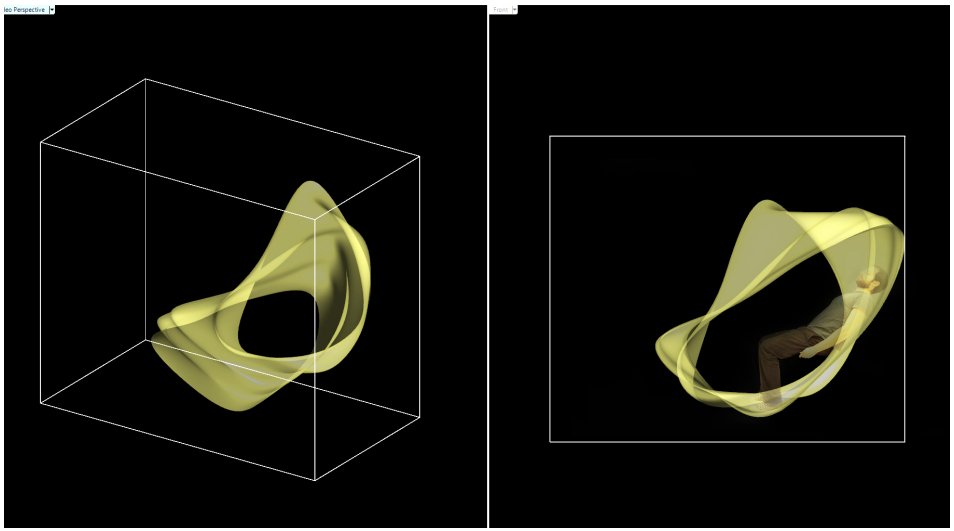
09. material to allow lighting conditions [250 lux] to allow for reading conditions

10. material to provide enough lighting for cooking [180 lux]

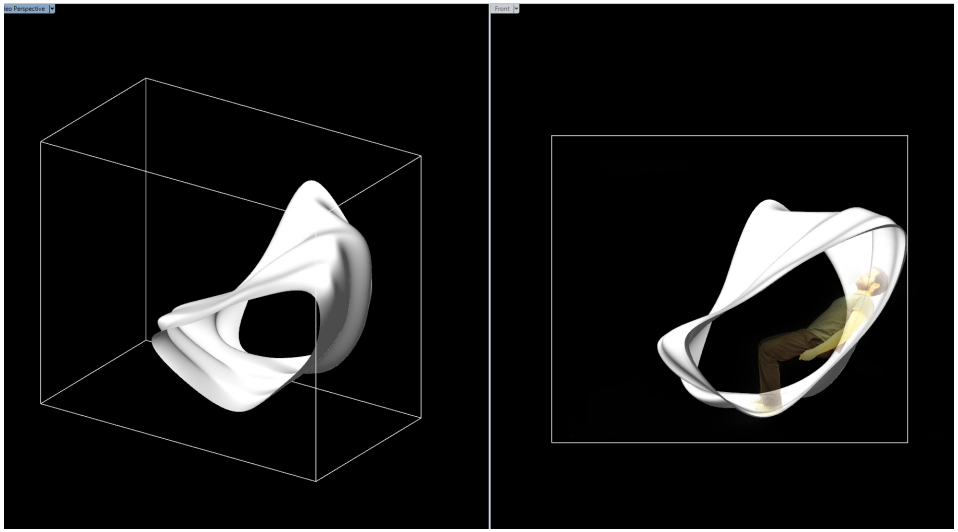
4.0
From Virtual to Material

writing a program for material innovation

4.1 material
from virtual to material

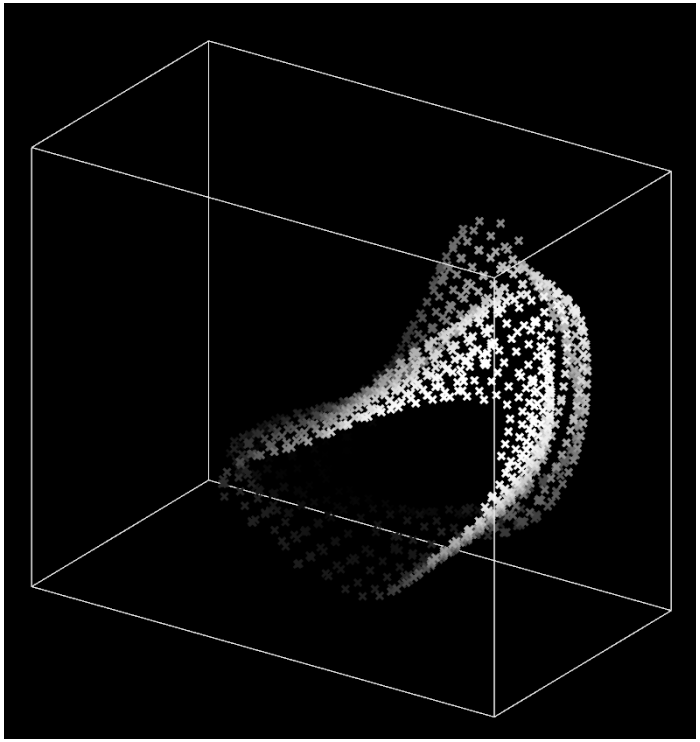


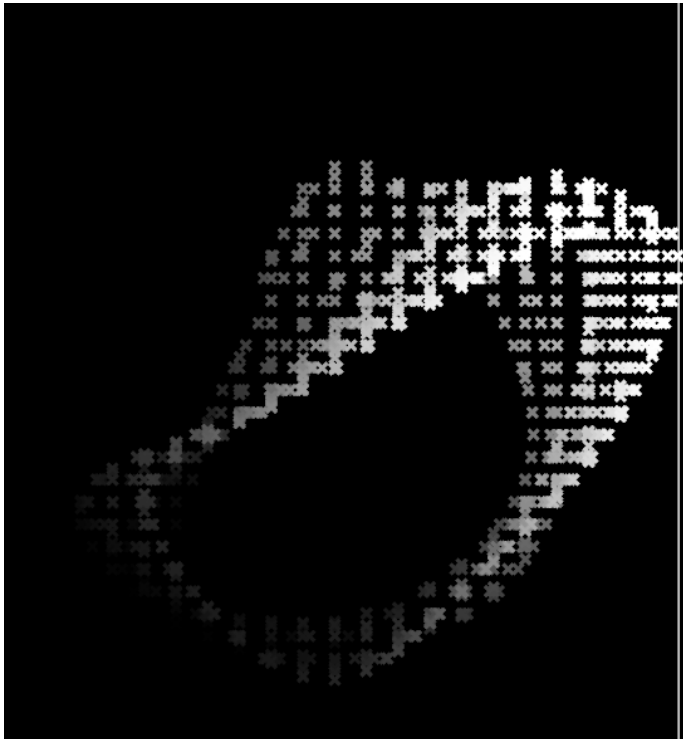
>> Virtual

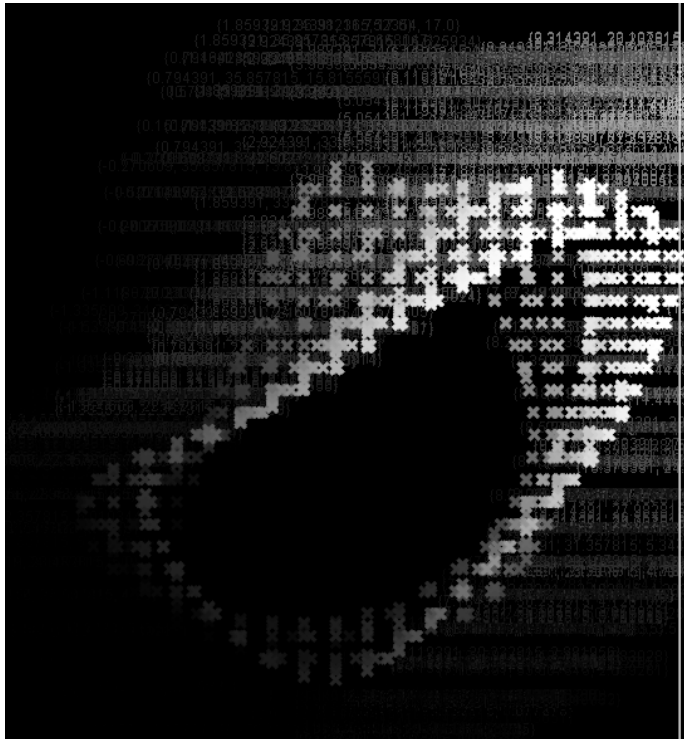


>> Material

4.2 material
from virtual to material



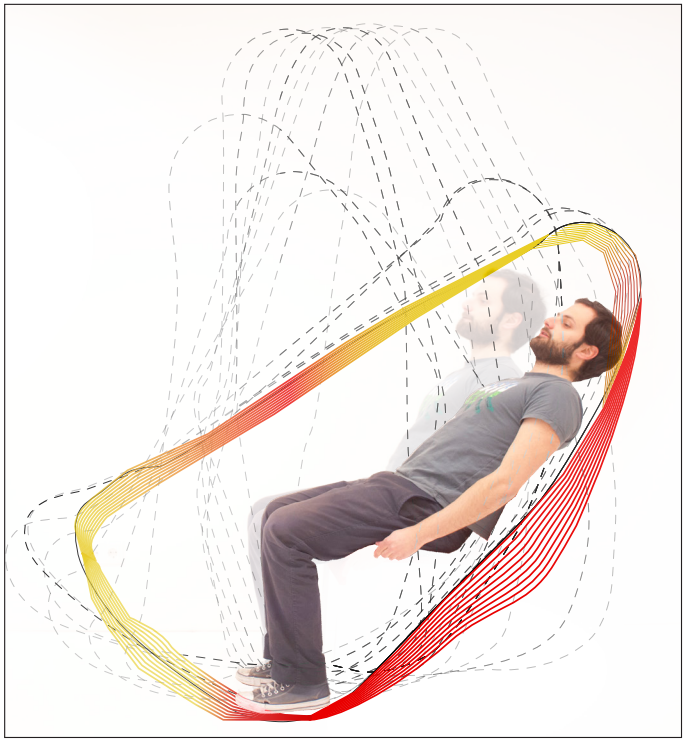




>> skin
composed of a complex grid of information points

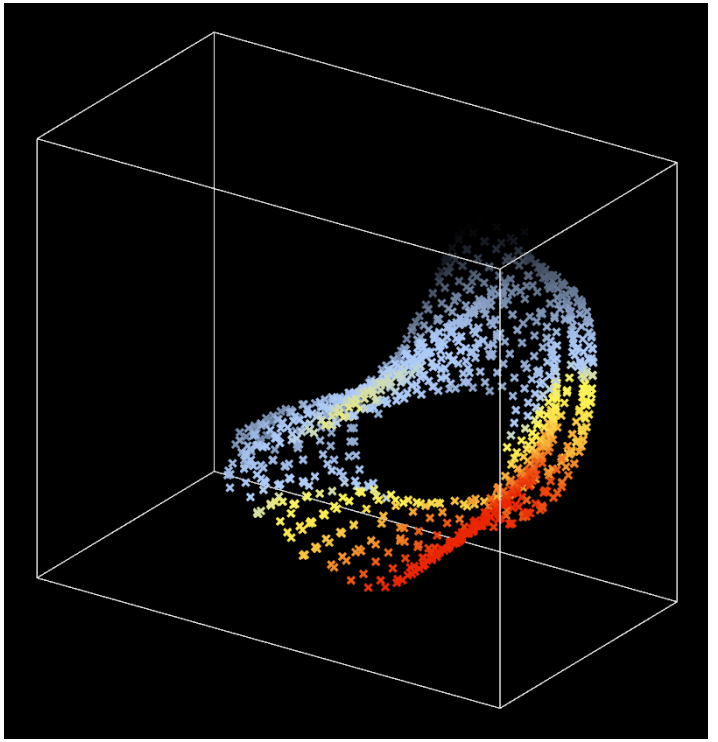
>> information
each point within the grid carries important information relating to the conditions of temperature, noise, structure and light that the skin needs to perform

4.3 material
Information points

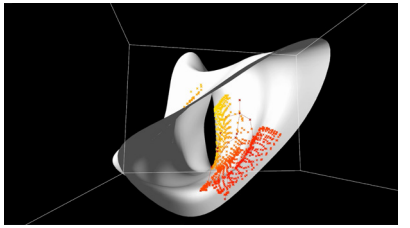


>> structure
the condition of structure required is passed to the information points of the grid

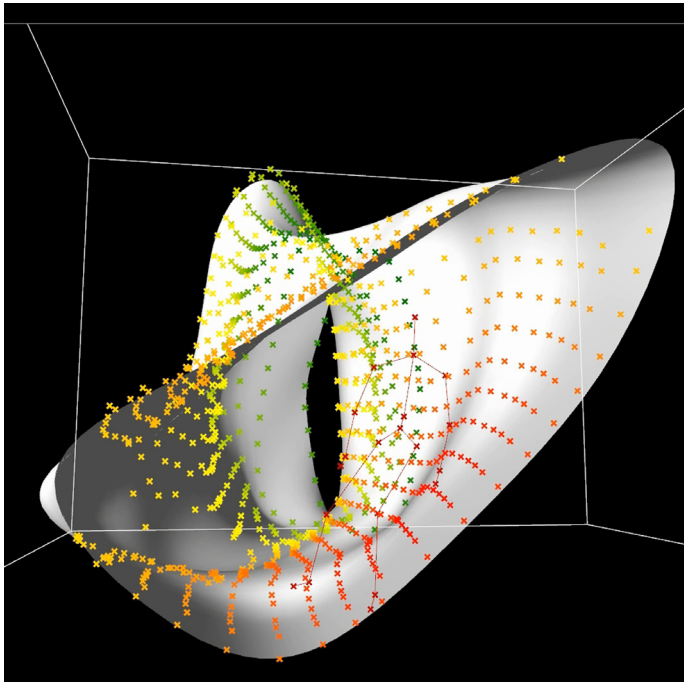
>> grid points
information points will re-arrange and densify where needed to accomodate for the structural need

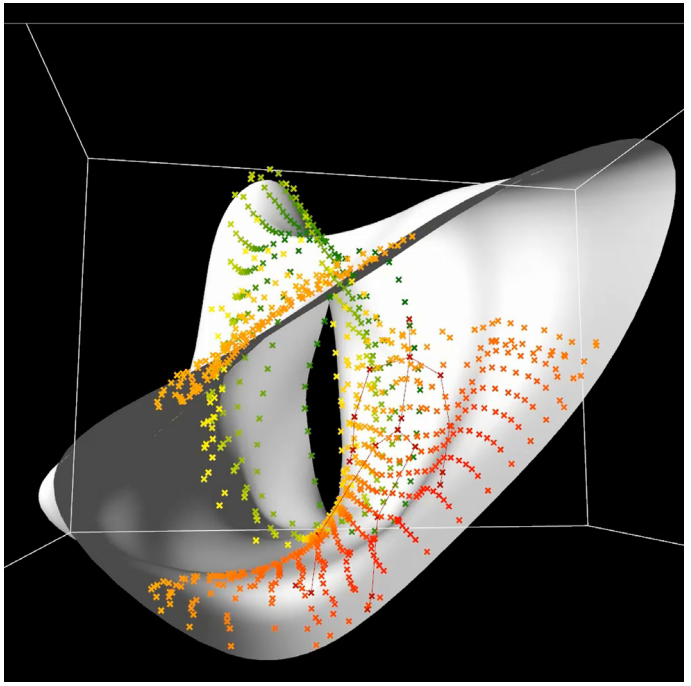


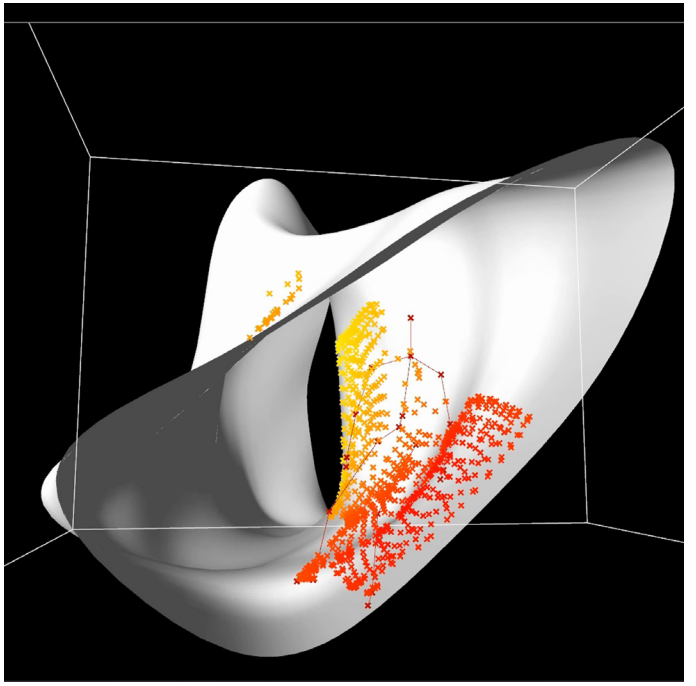
4.4 material
Information points



click for animation





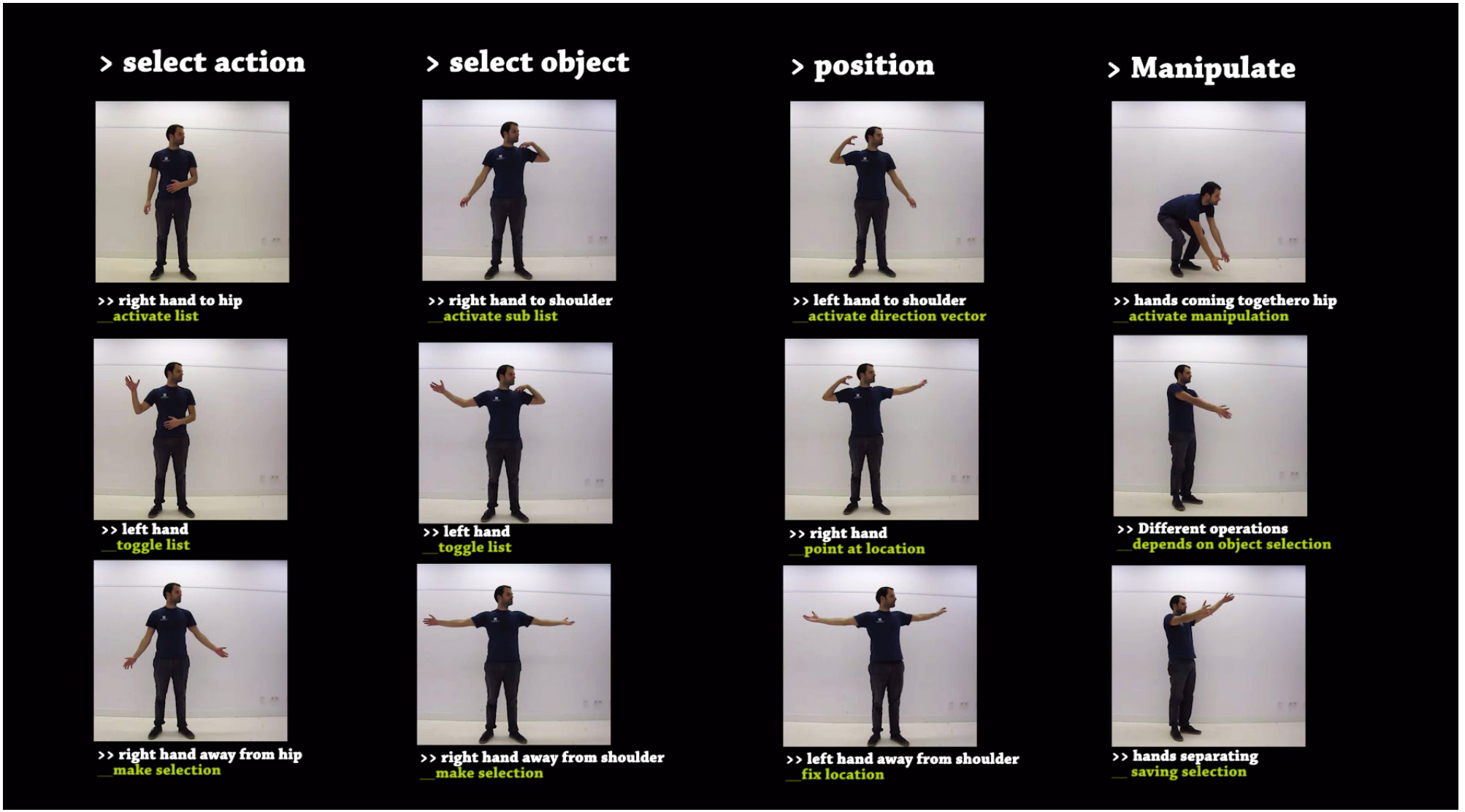


>> information points
information points intensify where
needed for structural needs

5.0
Interacting with the material

[user - material interface]

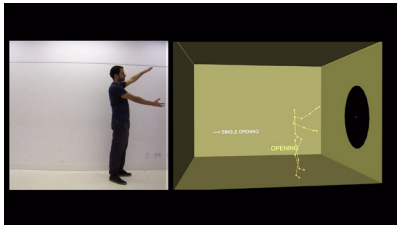
5.1 overriding the system
Interacting with the virtual material



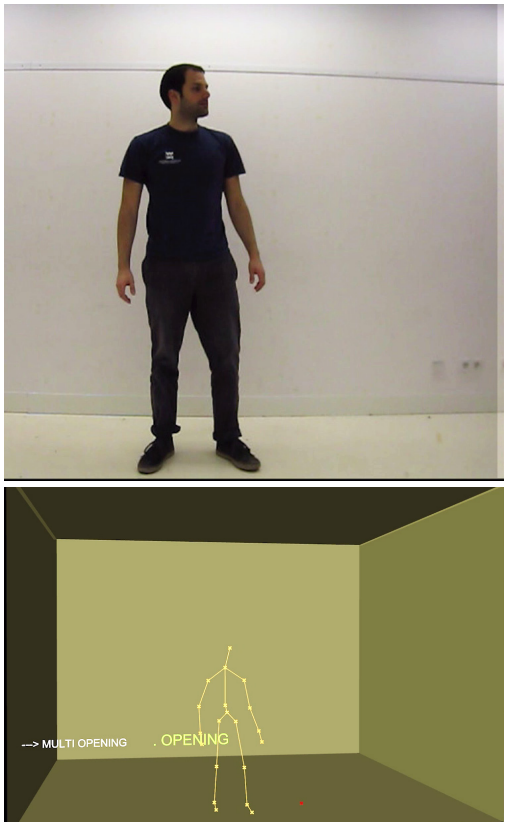
>> gesture recognition
series of gestures with which a user interacts with the virtual model

**based on proximity*

5.2 overriding the system
Interacting with the virtual output

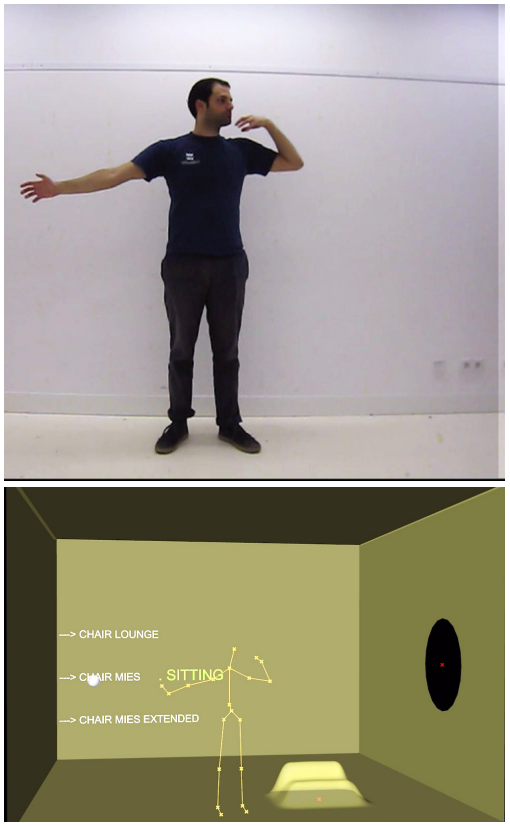


click for animation



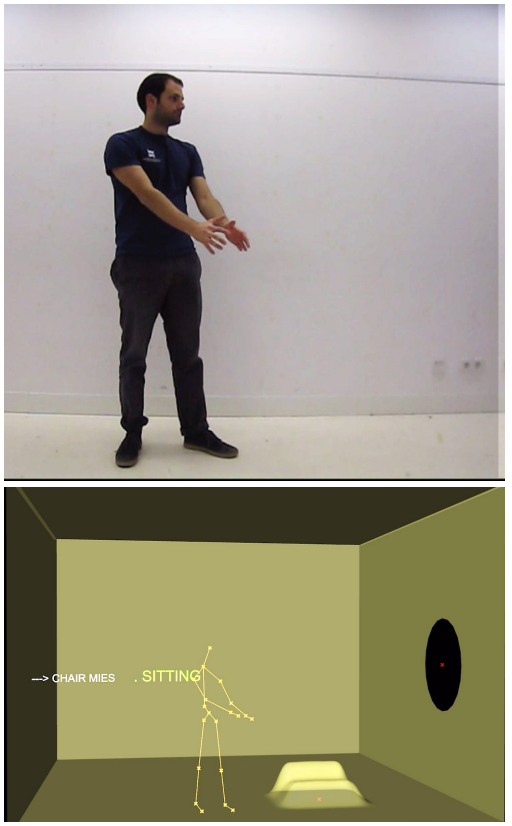
>> toggle menu
user can toggle through a menu to chose how he wants to change the space

**right hand on stomache*



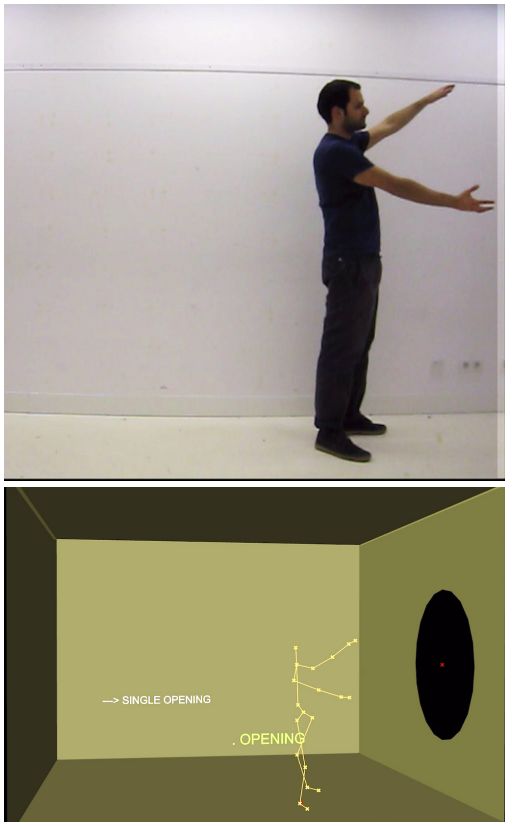
>> furniture maker
selection of specific furniture for secondary menu

**right hand on shoulder - toggle through with left handise it*



>> furniture maker
after specific furniture is selected, user can chose location and height

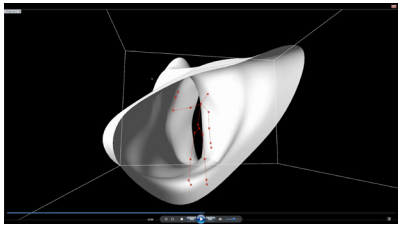
**two hands together - control the height of the furniture*



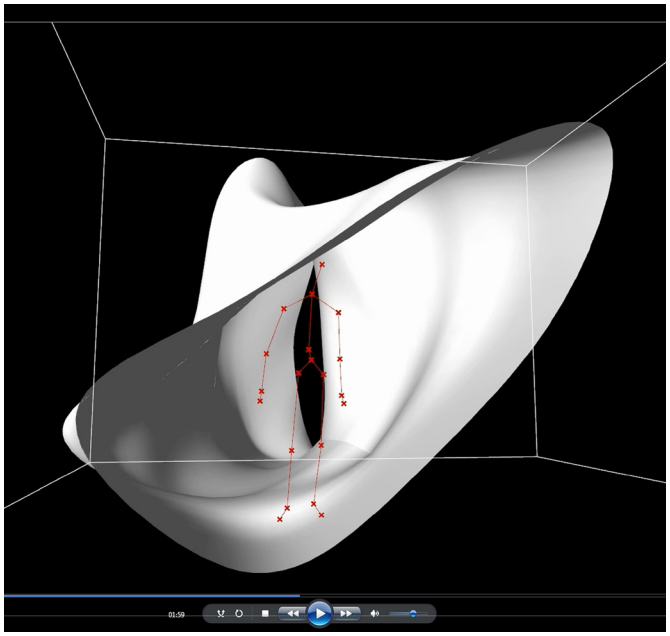
>> opening in the room
user can select location and size of opening

**distance between hands denotes opening size*

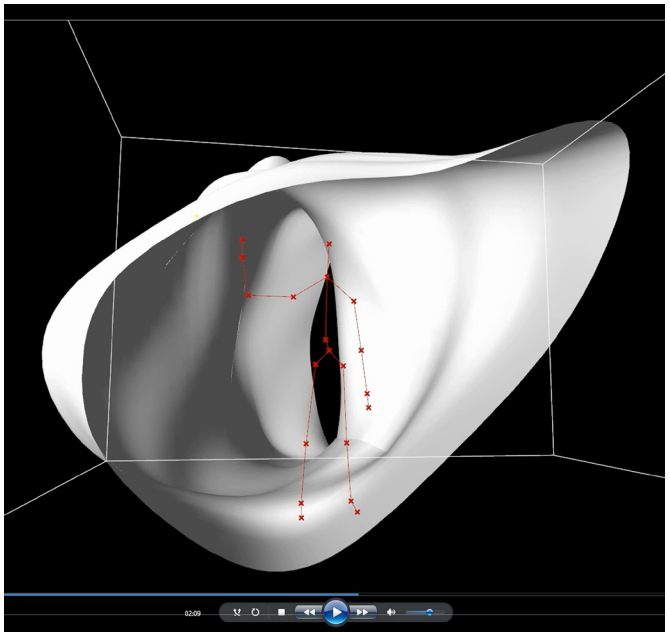
5.3 overriding the system
user interacting with the virtual output



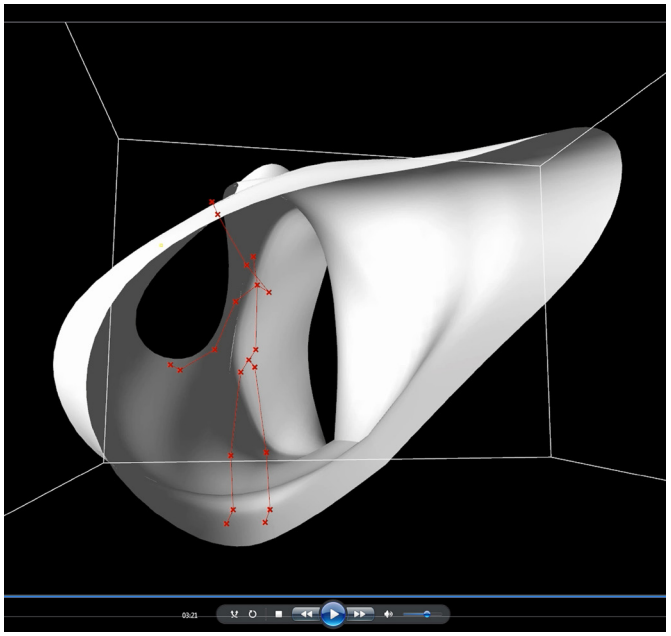
click for animation



>> minimum wasted space
the system predicts the minimum wasted space and transform to this



>> enlargement
user makes the space larger for comfort



>> opening
user creating opening in the material

6.0
Simulation Models

a day in the life of a 4 person family

[from 2 perspectives]

6.1 4 person scenario

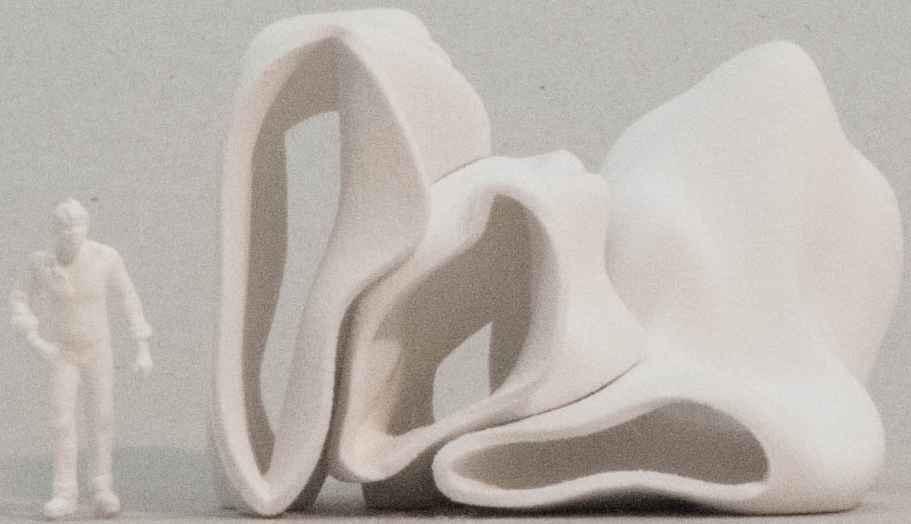
user interacting with the virtual output

6.1 Models - Zero Wasted Space

user interacting with the virtual output

19:00

22:00



02:00

6.2 Final Model - Inhabited Zero Wasted Space

4 person simulation

4 Person Scenario

The conventional 4 person house studied at the outset of this research projects is now broken down to Inhabited Zero Wasted

Section [Time: 18:17 - 18:20]
1:20

Key:

01. Control of Comfort:

while during eating and reading the user will require a big deviation from full ergonomy, during food preparation, the distance between the user and the space can remain much closer to the zero wasted space value.

02. Temperature monitoring:

the material will need to control the temperature of a space within which heat generating activities are carried out. This should also prevent heat transfer between spaces of different activities; for example from cooking spaces to sitting spaces.

03. Noise reduction:

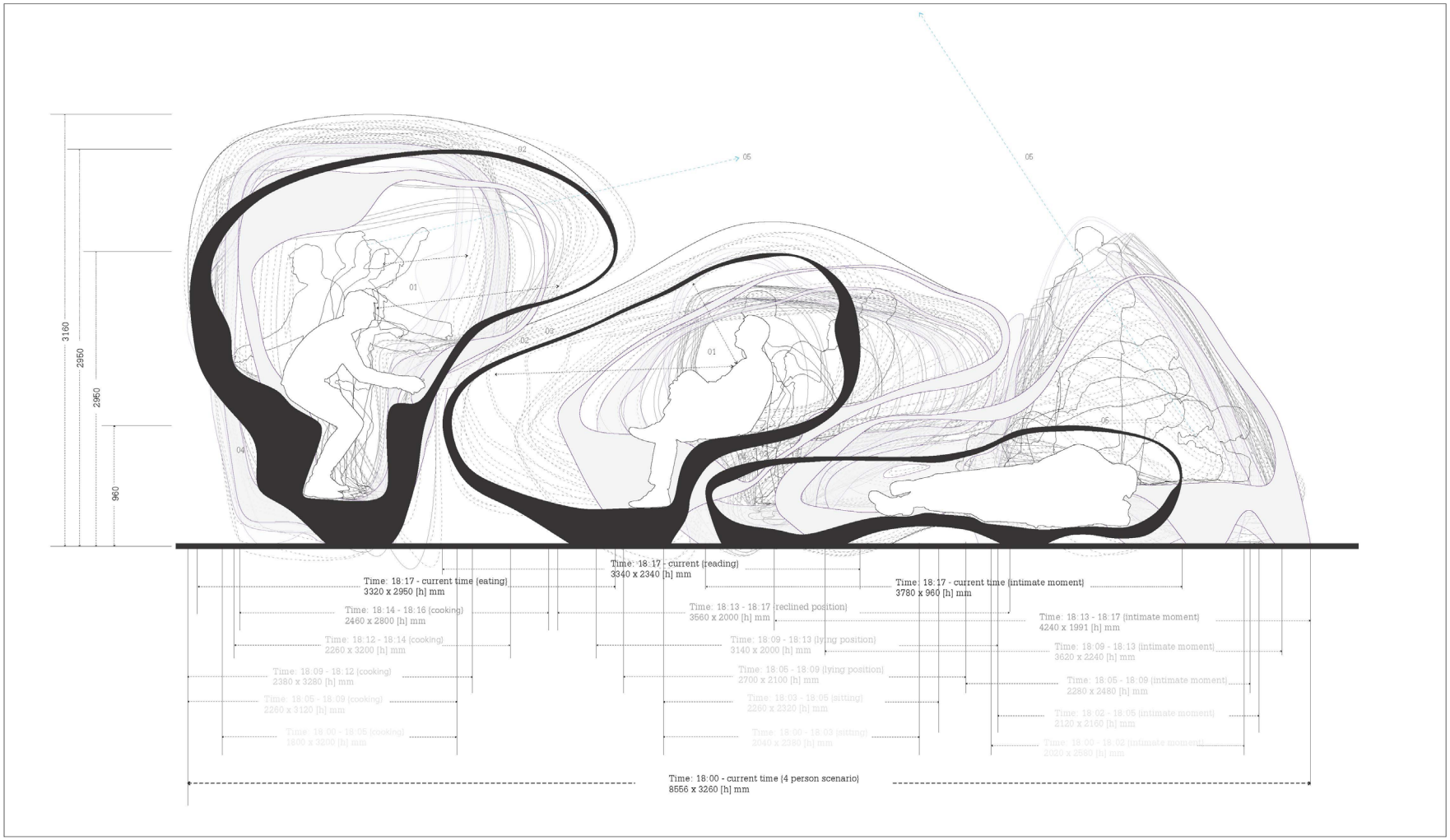
noise transfer must be controlled between activities.

04. Structural Performance:

the material must accomodate for the particular loading characteristics of each activity instantaneously; by generating load paths.

05. Transparency

The material must be able to alter its transparency to accomodate for required views as well as for privacy, for more intimate activities.



Scan

The project represents a frozen moment in the day of a 4 person household. [18:00 - 18:20]. The space is analysed as a series of timeframes which are associated with particular body requirements. This [brain] scan allows two things. Firstly one could study the relationship between spaces [hence people] at any timeframe of the day. Secondly, it allows one to explore the relationship between the time-frames, hence studying the changing requirements of space, even within a singular activity.

This exposes the relationship between the body and the space it occupies, from two angles; from the individual relationship it has with the space, as well as the implication of this on the space of the other.

This research tries to expose the implications of studying human occupation of space from these two angles.

Time: 18:00 - 18:02

Time: 18:02 - 18:05

Time: 18:09 - 18:12

Time: 18:12 - 18:14

Time: 18:14 - 18:20

Time: 18:17 - 18:20

Plan
1:20