

## **Ways of Working. Systematising Creative Computer Use**

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### **Abstract**

This essay presents an attempt to conceptualise and categorise how computers can be used in creative design processes. It focuses upon new experimental design techniques that have emerged from the use of graphical computers and powerful off-the-shelf software.

The material that is investigated stems mostly from the author's own practice and teaching and the teaching of associated colleagues. Inspired by open coding techniques from grounded theory, this material is investigated and systematised according to typical working principles.

Amongst the investigated techniques we find animation and dynamics based techniques, data coding and recoding, parametric design methods, genetic algorithms and mouse-based modelling and sculpting techniques.

The results show that in most of the cases that were investigated, more than one working principle is found within the same design process. The principles can appear in separate phases of the process or in parallel or cyclic processes.

Further analysis of the results has led to the concept of hybrid processes, where different types of computer-based experimental methods are ambulated and mixed with traditional methods such as sketching and physical modelling.

To demonstrate such a hybrid process a case is presented where the bridging of digital and physical representation is the core issue in the design process as well as in the final result.

Keywords: art, design, architecture, digital design, creativity, design computing, design methods, education, professional practice.

### **Introduction**

The intention of this essay is to conceptualise and categorise the emergent techniques that have appeared with the spreading of computers in design practice. The essay presents the first results from a study that still is under development.

The intention of categorising the field is not to create an authoritative typology to induce a standard for common use. The intention is to establish an overview and to be

able to discuss similarities and differences between the found categories and to arrive at new concepts. Creating categories is part of the investigation method that was applied in this study. This method is a derivation from Grounded Theory. The categories are fluid and will change and develop during this study.

This is a practice-based research based on the investigation of my own material or material produced by my students and colleagues. This kind of "first person practitioner research" is not well established as an accepted mode of knowledge production. Therefore I found it necessary to include a brief overview of my position regarding research methods in practice-based research.

### Mind the mind gap

When looking at creative design computing we have to deal with certain dogmas that obscure the understanding of what these processes really are. The computer is regarded as a rational tool and what is seen on the screen too often is taken as a simulation based on logics. If we want to understand what is going on and take advantage from design computing as a generative technique were parts of the design process are taken out of the designers control and given over to the machine, we need to accept that designers and artists playing and experimenting with computers more than often operate beyond pure rationality. Though we tend to label and explain what we do in phrases that seem to be based in rational explanations there is often not any consistency in these explanations. This may be a natural way of working, or it may be a result from an unfinished tentative exploration of the potentials in a relatively new technology.

One example is treated more in depth in the presentation of the AGORA case later in this paper. If we want to contribute or understand these processes we need to accept imaginative and intuitive ways of thinking. In fact an intuitive imagination is to my belief a precondition to explore the potential in computers used in a creative way.

Designers have a lot to learn from electronic artists who have been much more able to accept and explore the imaginative potential in new technologies.

### Background

The intentions and motivation behind the various generative techniques have been treated earlier in my essays

*Computer Aided Design Techniques* (Sevaldson 2001)

Published in the Nordic Journal of Architectural Research, Autumn 2001

and

*The Renaissance of Visual Thinking* (Sevaldson 2001)

Presented at the IT and Architectural Research Conference in Aarhus, April 2001

Nordic Association for Architectural Research

Both can be downloaded from [www.aho.no/staff/bs](http://www.aho.no/staff/bs)

In these essays I suggest a systematisation according to intentions. Here we can briefly recall some arguments for why people do compute in these ways.

*Used as a creative technique to break design schemata.*

Generative design means leaving some control to a computational process that to a certain degree produces unanticipated material. This can be a way of breaking the archetypical preconceptions that hinder the arrival at new creative solutions.

*Used as spatial organisers.*

Generative design computing is used to disturb the Cartesian void, which has such an impact on design in western culture. The produced generative material operates as spatial organisers, to replace the rectangular organisation of space.

*Used to introduce uncontrolled features to designs*

Current trends in design thinking suggest that the notions like total control and composition in design are abandoned and replaced with ideas about design as a reaction to formation forces and processes beyond the designer's control. Generative design computing fits such an ideological stand.

*Used to instrumentalise adaptability*

Negotiating "wild" material opens the design for unforeseen use.

In many cases the outlined intentional perspectives inspire us to look at the generative output from the computer on an abstract and diagrammatic level rather than using it as representation of form. An example is the use of the material as spatial organisers. This leads to the concepts of dynamic generative diagrams, which I also discuss in my earlier essays. The borders between diagram as representation of abstract / structural features and the representation of form are often blurred. This is even more the case if one studies the implementation of generative techniques as described here. The produced material is in many cases used to informing both formal issues spatial organisation and structural issues.

The discussion about the nature of the generative diagram is in this essay rested in favour of mapping out a bigger landscape based on categorising the techniques found in the study, forgetting for a moment the intentions.

## Achievements

This study aims to explore my personal practice and material that is in one way or another related to that practice. This implies that the findings and inventions achieved through this research do not claim to have general value. They must be seen more as well founded sources for design thinking. The implementation of the techniques found through this study by other designers would not result in the same output nor would it necessarily induce the same ways of thinking. The general values of this study could be summarised in this way:

- To inspire other designers to adopt and develop new ways of using the computer in the design process.
- To propagate a way of thinking that leads to researching and developing ones own practice.
- To make designers respond faster towards technological changes.
- To suggest research techniques that would help to investigate and apply the potentials in new technologies.

## Practice Based Research

We live in a time where research is under pressure to involve group projects and external companies, pushing the emphasis towards applied research and away from individual projects. At the same time practice based research is slowly accepted as a valuable source for new knowledge. The conditions for practice-based research to be successful are found in the practitioner's experience. In this chapter I will outline what are to my mind the necessary conditions for this kind of projects.

This investigation is based on personal practice. This means that this is a "First Person Practitioner Research". It takes advantage of the insiders opportunities such as a deep pre-existing knowledge, practice - research synergies and a focus on relevance as described by Colin Robson (Robson 1993)

Practice based research is not a linear process but a process where analyses, data production and data collection goes parallel and mutually influence each other. (Fettermann 1989)pg. 13

### Explorative and generative research

This study is an explorative and generative investigation in the field of practical appliance of computer aided creative design techniques. This means that there is not a clear thesis in the beginning. In contrary the field covered by the study is investigated for both existing practice and new possibilities. When opportunities open up, new techniques are developed through the investigation. A feedback cycle and heuristic spiral is established, where practice and theory modify each other through the process.

The closest analogy to this process is action research as described by Kurt Lewin as: *.....a spiral of cycles of planning, acting, observing and reflecting* (Robson 1993)

### Open Ended Research

This type of investigation is not conclusive in the traditional sense but is open ended both in its methods and its results. The implementation of open-ended methods was crucial because the empirical material to a certain degree was not only modified but came into being through the research. This implied an inductive approach where the findings were systematised and theory was derived from the analyses.

The practitioner researcher can use open-ended techniques to establish a distance between the practitioner as conductor and the practitioner as researcher. Amongst such techniques are "big net approach" and unfocused investigations. (Fettermann pg. 42 48 54 and (Jorgensen 1989)pg 20 and 82)

Also the reality of conducting complex real life studies makes exclusively rigid methodologies obsolete. The real life researcher needs to be able to adjust to the emergent issues that the qualitative research generates.  
(Fettermann pg. 12)

## Analyses

The method for analyses is based on grounded theory. The empirical material is investigated to find discrete phenomena. The phenomena are sorted into categories that are found from comparing the phenomena. The analysis is conducted as open coding and comparative discussions. (Glaser and Strauss 1967) The method is applied in a "soft" manner with the discussion (drøfting) as the central element. (Førland 1996)

To follow a full-fledged study in the way described by Grounded Theory was considered to be not suitable. In this study observation and creation lives in symbioses and synergy. A strictness that is necessary in cases based on observation would not allow for the flexibility needed in a process of creation. The need for rigour would easily "freeze" the practice into static categories and would reduce the tentative and intuitive elements in the process. The process of creation continuously overthrows and remodels what is observed, and hence asks for elastic categories and frequent remodelling of the categories. Anselm Strauss recommends the interpretation and adaptation of Grounded Theory to make it suitable in specific cases. I was also getting confidence for such an approach by reading Kari Thoresens thesis on computer use. (Thoresen 1999)

## Theory as process

Comparative analyses is described as a strategic method to generate theory.(Glaser and Strauss 1967) The generation of theory in this context is seen as an open-ended process, or as Glaser and Strauss puts it:  
*.....theory as an ever-developing entity, not as a perfect product* (Glaser and Strauss 1967) p.32

## The Material

The material comes from various sources. Amongst the most important are cases from my own work, but also work done by colleagues and students are amongst the sources, but I have only included material to which I have first hand knowledge. That means that I had a direct insight in the way the material was created and used in the design process. This choice was made because it takes direct advantage of my position as practitioner researcher (insider perspective). Also it is hard to find documentation on the design processes for other sources because the argumentations around these processes very rarely are concerned about looking at them as creative

methods. Interviewing other sources for their intentions and methodological aspects would imply giving away the insider perspective advantage and entangling in a massive, time consuming and methodologically very difficult investigation, that would have no good prospects to succeed.

## **The Analyses**

The empirical material was investigated to find distinctive phenomena in the visual material, the ideology and the process. In contrast to the earlier analyses presented in the essays mentioned above, which was concerned with the intentions behind the various processes, this analyses is based on the techniques that were developed and found through the last eight years. The distinctive phenomena were found on the criteria of what the designer actually is doing to conduct the different processes and not on what motivations he or she might have. The phenomena should then be categorised in categories that are based on differences and similarities within the phenomena.

The phenomena described here normally appear in a mixture and not in a pure isolated form. Most often two or more phenomena are found in the same material. Several of the projects appear therefore in more than one category. The intention of this analysis is to provide a better understanding of these intuitively mixed approaches.

### **Distinct phenomena and categories**

The presented table shows the different distinctive types of computer use found in the study. The table is based on techniques or found concepts and these are sorted into categories. Sorting into categories helps to establish similarities and differences between the techniques. The following categories were created in the analyses:

- Mouse-based (or other physical input device) modelling and sculpting
- Parametric Design
- Interactive Simulations
- Systems simulations
- Data decoding and recoding
- Animation Based Techniques
- Pattern Recognition
- Real life monitoring

*Mouse-based modelling and sculpting* is when there is an analogy between the physical movement of the input-device and the altering of the digitally represented geometry.

*Parametric design* means when the input factors and forces are the most central aspect. The change of the geometries is driven by the change of the value of the parameters.

*Interactive Simulations* are virtual environments where the real time interaction of the user alters and influences the environment.

*Systems simulation* is to resemble a real life situation and to let the computer run to see what is happening.

*Data decoding and recoding* is to alter the meaning of the information. This is described more accurately later.

*Animation based techniques* are most often crossover categories that can contain elements from parametric design, simulations or mouse-based modelling. But animation is so central in these new techniques that it appears as a category. When the animation process is central a technique will fall under that category.

*Pattern recognition* is not to be confused with any digital pattern recognition technology. It is used here as human visual thinking, deriving certain structural features from visual and geometric material. Digital techniques are applied to reinforce visual thinking.

*Real life monitoring* is to collect real life complex information to inform the design process and apply digital techniques to reinforce this process.

Many of the categories are not so clearly limited and their borders are blurry. The most important aspects are the techniques. But the categories are important in relating the techniques to each other. This is the reason why the table is organised from the perspective of the techniques starting with the start up material.

Start info	Processing	Tools	Technique	Category	Result	Projects
Primitive geometry	Manual geometrical manipulation	Splines-based surface modelling software (Rhino, Alias) GUI and mouse-based displacement of CV	Dragging, rotating, scaling of one or groups of CVs	Mouse based modelling	Work-process close to traditional design work	Numerous design projects.
Primitive	Sculpting	Sculpt-tool Maya sculpting, Freeform Scanning software	Sculpting with dynamic cursors on surfaces or with special force feedback devices,	Mouse- (and other input devices) based sculpting	Work process that simulates traditional design process with physical models	Small Formations
Site material or principal start conditions	Simulation	Simulation software CATIA modules, FEM analyses urban simulation etc scientific simulation and visualisation software Weather forecast	Enter start conditions, run simulation. visualisation of results	Parametric design, animation - based technique	Models that predict real life behaviour. Models can inform design process	VIZ scientific visualisation tool  Form Finding Modul IT-master
Work process set-up	Interactive simulation	IFE virtual work process simulation. Catia virtual	Interact in real-time with simulation of real life situations	Interactive simulation	Models that allow for training in real life situations,	IFE work process simulation in nuclear reactors

		ergonomics, flight simulators, games			entertainment. Can inform design processes.	
Parametric engine set-up	Altering the parameters	Parametric CAD software, other software, Processing	Altering constraints and parameters, Scripting own software Programming in Processing	Parametric design	Models that allow for easy changing within the logics of the parameters. Investigation of many instances, complex relations.	ENØK, ASTRA Hybrid Motion Graphics in IT-Master, Casey Reas
Genetic Algorithm start conditions	Running the algorithm in several generations	gener8	Scripting Modulating. Finding and investigating instances between start and end condition	Systems simulation Genetic Algorithm	Models that can be applied in self-growing designs. Creative input	Jewellery, speaker and key-ring in IT-master classes
Graphic img 2D	Mapping (bump mapping, displacement mapping)	2D and 3D software	Colour separation blurring and contrasting, Displacement mapping Polygon modelling and export to STL	Data decoding and recoding	Spatial organisers that depart from Cartesian grid "Disturbing Agents", breaking schemata, creative input	Synthetic Landscape VORB High Def texturing and rapid prototyping
Any digital data set.	Transformation of data, decoding, recoding e.g. Tidsrom	ASCCI format general data representation	e.g. Transform spatial information into sound representation Synchronising physical spatial features with auditive spatial features	Data decoding and recoding	Investigating structural features in different media. Creating related output in different forms.	Tidsrom AGORA
Dynamics set-up	Deforming geometries driven by dynamics	Maya 3DS	Fine-tuning input parameters. Forces, "materials" Introducing precise but suptile control mechanisms finding and investigating instances between start and end condition	Animation based technique	Spatial organisers that depart from Cartesian grid "Disturbing Agents", breaking schemata, creative input Design templates for "exotic form finding" Generative diagrams.	World Centre for Human Concerns High Rise Study
Animations deformations set-up	Deformation of geometries driven by skeleton kinetics	Studio, Maya 3DStudio	Setting up skeleton structure reassembling wanted relations Animating skeleton according to chosen principle Finding and investigating instances between start and end condition	Animation based technique	Spatial organisers that depart from Cartesian grid "Disturbing Agents", breaking schemata, creative input Design templates for "exotic form finding"	a_drift
Animations	Informing design by particle	Alias Studio, Maya, 3DStudio	Setting up particle animations, forces	Animation based	Spatial organisers that	Synthetic Landscape

	animations		and movements according to abstract structural intentions  Finding and investigating instances between start and end condition	technique. simulation	depart from Cartesian grid "Disturbing Agents", breaking schemata, creative input Design templates for "exotic form finding"	Jyväskylä
Video registration	Video monitoring and editing	Video editing systems Premier Ifinish Aftereffects Flash	Time collapsing and superimposing Time scaling Time sections Reversing "Scratching" "Sampling"	Real life monitoring Parameter generation	Understanding real life events and relations. Breaking preconceptions (schemata) discovering patterns	Conceptual design 3.rd year
Graphical filtering still	Manipulating the filters	Photoshop	Contrasting Blurring edge Sharpening and others  Diagramming, coding	Pattern recognition. Spatial pattern recognition	Transforming material (mirror effekt) Discovering global patterns. Discovering local patterns.	Synthetic Landscape, Ambient Amplifiers, Conceptual Design
Graphical filtering video	Manipulating the filters	Video editing systems, After Effects Photoshop , Flash	Contrasting blurring edge sharpening diagramming rhythm analyses. repetitions. intensity monitoring	Pattern recognition. Time and space pattern recognition	Understanding real life events and relations. Breaking preconceptions (schemata) discovering patterns	Conceptual Design

The table has been useful to establish an overview and to map out the landscape and the relations between the techniques. Further investigations intend to map the techniques according to how they appear in the design process.

## The Examples

The complete material that was the bases for this analysis is too vast to be presented in the frames of this paper. Therefore I will present a few samples very briefly and then present one project as an example of a hybrid process.

### Example 1 data decoding and recoding

Data decoding and recoding takes real advantage of the fact that all information in the computer is stored in bits and bytes. Bits and Bytes do not in them self carry any information other than 0 and 1. It is when they are defined to represent something that they will carry information and knowledge.

This means coding the data. We have decided that a certain chunk of bits and bytes represents visual information, while another chunk is sound. This is described to the computer through defining the data in a certain file format, like the JPG format contains bits and bites that resemble an image while the bits and bytes in a file in TXT format represent letters and numbers. But as this coding of the data is necessary it is also easy to remove and to alter.

An example most common in any 3D cad software is to apply an image to create a bump map. In this case colour intensity is recoded to describe the depth of a geometric pattern.

In more advanced formats that contain several types of information the information has to be labelled. An example is the VRML format that I have used in many occasions because of it is readable with a normal text editor. In a VRML file the type of information is labelled in the beginning:

```
geometry      DEF _0 IndexedFaceSet {
              coord Coordinate {
                point [ -62.1905 -46.595 0,
                       -60.5114 -45.5535 0,
                       -60.2812 -45.023 3.58227,
                       -58.7217 -44.1826 3.43377,
                       -58.8324 -44.5119 0,
                       -57.1621 -43.3421 3.28527,
                       -58.6675 -43.7307 4.68593,
                       -57.2028 -43.0636 4.59038,
                       -55.7382 -42.3965 4.49483,
```

The example shows a section of a VRML file that defines a polygonal geometry. The title section defines the geometry the following data array defines. Here just the points in the polygonal faces are described with X, Y and Z-coordinates. In a following section of the VRML file there is a description of how the points are connected.

The XYZ-coordinate data could be recoded to produce other data, like RGB values or sound data.

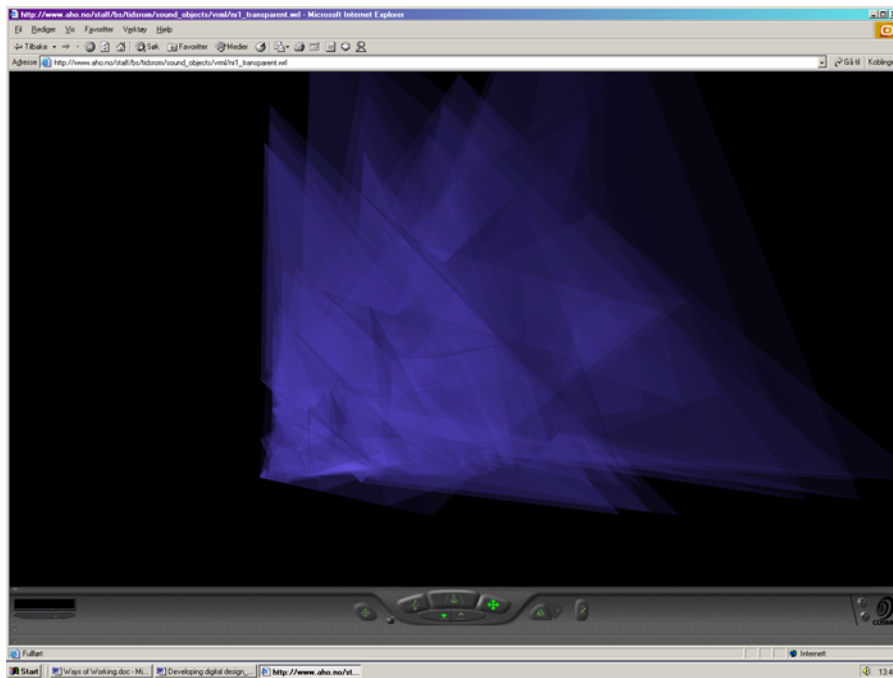
Data decoding and recoding is about removing the coding from digital information and recode the information with another framework. The reason to do this is to transfer structural features from one representation to another, (e.g. from spatial representation to sound) and to explore how these structural features appear in different interpretations. Data decoding and recoding is concerned with information as such and to gain new understanding through translating the information into ever new representations.

An example of such an investigation comes from an experimental cooperation between a group of designers and musical composers in the project called "Tidsrom" (translating to Time-Space). The project investigated the transfer of data between different geometrical and auditive representations.

The initial dataset was generated by a group of persons who registered several very mundane facts about their surrounding at specified moments. These where number of doors, windows and people in the room they occupied. This established a common database with information that initially was not representing auditive or geometrical information. The database was explored and developed into several different forms both 3D- spatial models and sound compositions.

See detailed description of the decoding and recoding, hear the sound samples and see the VRML files at:

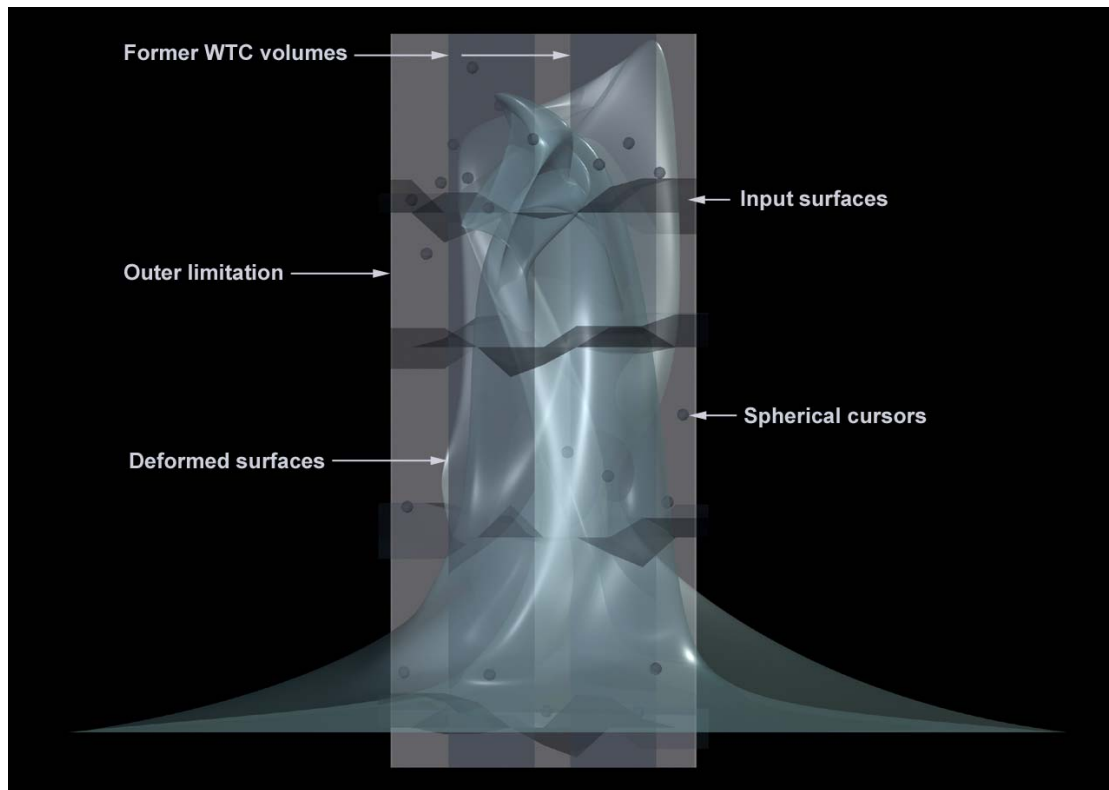
<http://www.aho.no/staff/bs/tidsrom/> (Sevaldson 1999)



VRML-model of sound file translated into spatial information.

## Example 2 dynamics set up

In 2000 the experimental design and architecture group OCEAN NORTH was invited to contribute to the exhibition at the Max Protetch Gallery in New York collecting suggestions for a new World Trade Centre Our contributions was designed on the basis of a generative animation driven by dynamics in the software MAYA. The concept was to wrap new skins around a space defined by the local conditions and by the volumes of the former WTC. I wanted to create an output that was at the same time controlled and "wild", living its own life. I constructed an engine of a relatively large number of spheres that where used as cursors to deform the CVs of two initial surfaces. The spheres were captured in a vertical space divided with deformed polygonal, mainly horizontal surfaces, the "input surfaces". Also the volumes of the former WTC were inserted as spatial limitations and the global volume within the spheres were allowed to travel was limited. The spheres were activated by forces that in the software were called gravitation and wind, but in this set-up were considered only abstract triggering forces. Also the spheres were modulated to bounce off the input surfaces in a way that would keep them moving as long as the animation was running. The animation spanning from frame 0 to 500 was stopped every 10th frame and a 3D model of the surfaces was exported. These geometries informed the later stages of the design.

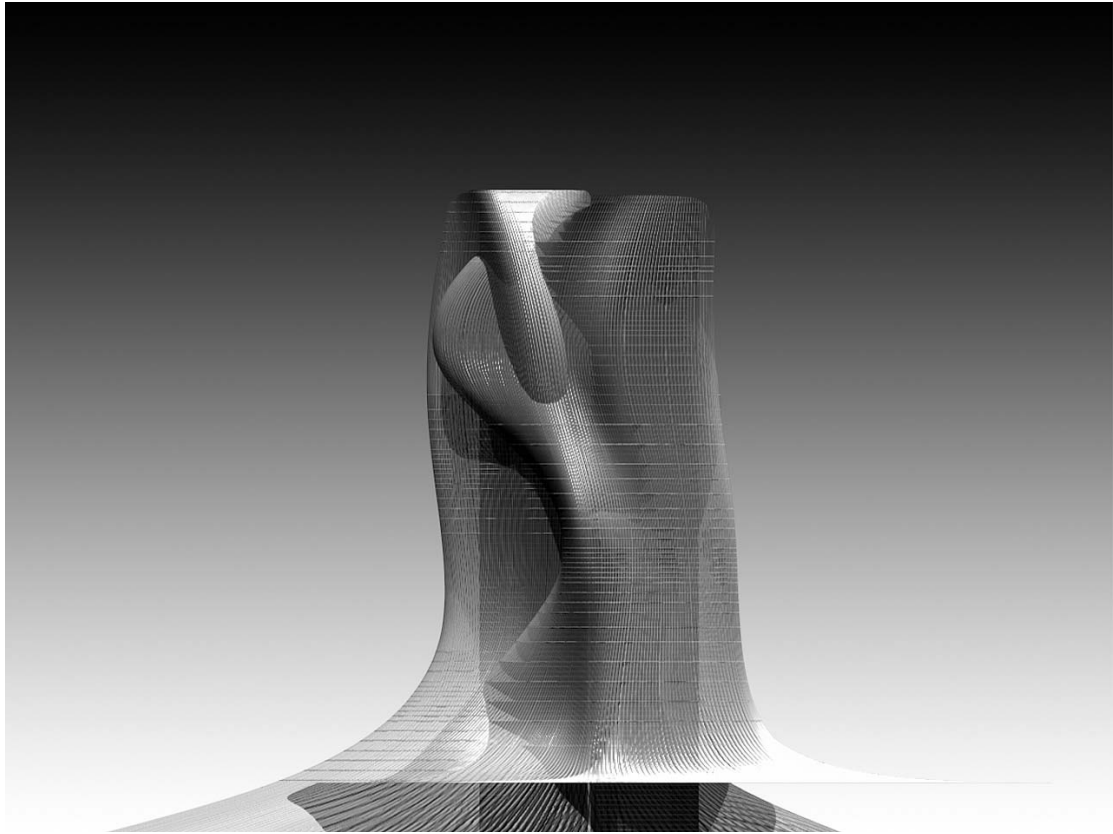


*Side view of the dynamics set-up showing the different elements involved.*

This approach implements a very accurate control mechanism into a generative design engine that normally produces "wild" and unexpected output. By modulating the input surfaces it was possible to monitor the degree of deformation during the animation. Also the layered design of the set-up made it possible to have local variations. The engine was an attempt to combine the generative self-emerging design machine with very precise control mechanisms. A game of losing and taking control.

This experiment was successful in the sense that it produced a design template that was rich enough and inspiring for the design team to work with. But the control mechanisms did not really result in very big variations when altered and there is a potential to further develop other "taming"-mechanisms. In an earlier experiment for a high-rise building more local variation was achieved by altering the weight of the surfaces control points (CV) in local areas.

For more information on the project go to [www.ocean-north.net](http://www.ocean-north.net).



*Side view of final suggestion for a new World Centre for Human Concerns*

### Example 3 Video-monitoring and graphical filtering

Digital video and related time-based techniques can be used in a design process not only to report and register but also as an active design tool involving a wide range of techniques. Video monitoring helps us to see patterns of use over time. But most often the raw footage has to be processed to make patterns visible. The patterns might be hidden for direct observation because they are distributed over a time span that is not within the time scale we normally can observe directly. By manipulating the time scale, slowing down or compressing the video, these patterns can become directly visible.

*Designing Time* is an experimental design studio at the Oslo School of Architecture, where the students are engaged in time-based issues. The studio serves as a laboratory to invent, develop and test strategies and techniques relevant to time-based design.

Working with time helps to move focus from object to relations between entities and how these relations unfold. The time-based approach leads towards understanding action and performance and life cycles. It involves working with time-based

structures, intensities, rhythms and repetitions. It connects to user experience thinking and it helps the students to develop their capacity of abstraction.

The *Designing Time - studio* is mostly operating on a structural level, avoiding semantics, metaphors and symbols. This is a way of breaking our preconceptions of how things really work. We do have schematic conceptions about processes in a similar way as we have schematic conceptions of objects. The schemata are simplified symbols that help us to operate efficiently. But to really understand things these preconceptions have to be broken. Breaking the preconceptions through careful observations helps to bring forward creative responses.

In the first phase of the project several observation and analysing techniques are invented and developed. Even monitoring one-self will reveal new unexpected experience. In the studios a student's self-observation of him cooking a bag of instant noodles became a classic case. He discovered that there is a minimum of seven to ten containers involved in the seemingly simple operations. The schematic preconception of this process is so strong that normally people do not believe this statement before we start to count: The cabinet where the noodles are kept, the plastic bag with noodles, the bags of herbs, the drawer for the spoon, the spoon, the cabinet for the pot, the pot, the cabinet for the bowl, the bowl, the sink for washing up, the soap dispenser..... Mapping the relation over time between the objects reveals a complex pattern.

During and after monitoring the students analyse the material. There is an emphasis on finding distinct phenomena and to recognise patterns. Relations are rendered as patterns more than e.g. bubble diagrams. The students have to invent and develop visual analyses for their cases. For registration digital video is central, but also manual drawing techniques from comics or story boarding are used together with diagrammatic drawing and counting. For visual analyses the students can use filters like blurring, sharpening, contrasting and colour separation in Photoshop and After Effects. For time analyses they can use video editing tools or other software with time lines (e.g. Flash) They find time based patterns through manipulation analyses like time collapsing, stretching, reversing, "scratching" and "sampling".



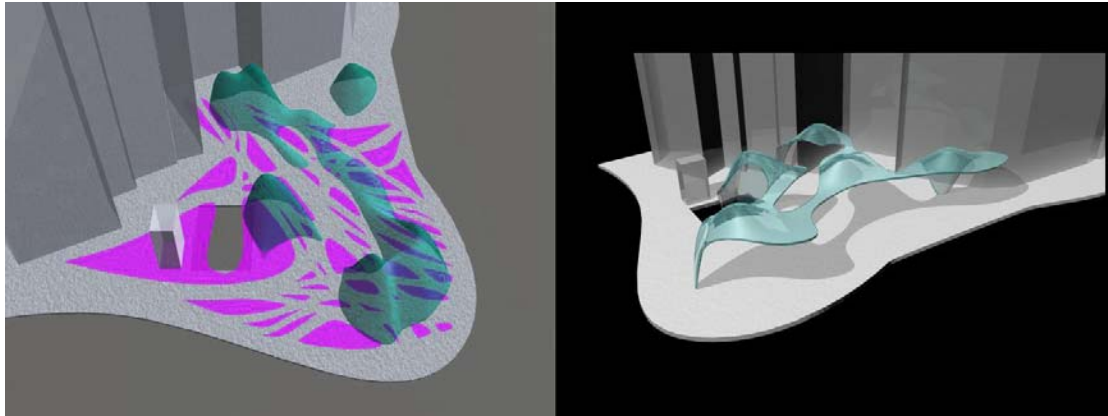
*Visualisation of traffic pattern. The visualisation is based on digital video material that was treated in Photoshop and Flash.*

The analysis produces an output that is more or less diagrammatic. Sources for inspiration are scientific visualisation, Edward Tufte (Tufte 1983) and Marey, (Braun 1992) but also generative diagramming as seen in the architecture of 90ties.

The analysis of the material produces new categories and finds phenomena from the patterns. In a sense a new theory about the observed real life processes is developed. This relates closely to e.g. grounded theory.

The cases span from the scale of small objects, domestic spaces, public spaces, to urban scale spaces.

Based on the monitoring process and the analyses the students have the task to do an intervention that softly modulates or describes the observed event. Understanding the patterns of relations should make it possible to softly modify them or to express them through a media of own choice. Examples are: Video installation in cafe environment, sculpture of a snowboard jump, advanced kitchen timer, flexible territorial furniture, soft modulated waiting area, furniture / lee wall / dockside / sculpture and a complex shelter in public square, which is presented below.



*Left: Pattern recognition: Diagram of activities outside a shopping centre in Oslo, showing the still areas least influenced by pedestrian paths (pink) and the most intense crowding areas (blue).*

*Right: Suggested intervention that softly modulates the crowding behaviour. (Student: Ambjørn Viking)*

## The Hybrid Process

As mentioned the categories seldom appear alone in a process. In most cases we find combinations and mixtures of the many techniques. This case is chosen because it demonstrated such a hybrid process. Other cases could have been chosen but what makes this case unique is that it also reflects the hybrid processes in its results.

The presented case is the AGORA project, a cooperation lead by me and the composer Natasha Barrett. AGORA resulted in two events, one sound and space installation at the Oslo Central Station, called AGORA: *boundary conditions*, and an installation / music theatre / performance at the Black Box Theatre in Oslo (AGORA).

The intention in AGORA was to investigate the relations between various types of physical and auditive spatial representations. Also the gap between digital and analogue representation was bridged, especially in the design process but also during performance.

### Short description:

With modern audio techniques (ambisonics) it is possible to produce a three-dimensional sound space where sound is located accurately in space. The result is best understood as a parallel to a hologram. Together with the physical elements of the installation it is possible to create a new space where sound and architecture reflect each other. This is the framework for the concept of AGORA.

It was a natural step to use a common database for both sound spatialisation and the spatial organisation of the physical installation. This source information was produced in a simulation specially programmed for the project.

The installation was built from 150 meters of aluminium tube, creating trajectories through the space, and five semitransparent textile surfaces. In addition there were physical elements that produced sound: Five electronic hammers with long aluminium

rods and eight plastic membranes that were driven by parts of old hard disks. All physical sound elements were controlled from a central computer.

The audio systems varied in the two set ups. In *Boundary Conditions* there was an ambisonic cube with eight speakers and a stereophonic system with four speakers. In the Black Box performance there was an ambisonic hexagon with six speakers and additional eight speakers in a stereophonic system.

In *Boundary Conditions* at Oslo Central Station the installation was running full time for ten days. There also was an infrared trigger that responded to the movement of the audience and slightly changed the automated computer program.

At Black Box there was a one hour performance which included taped sound, real time sound processing, physical sound actuators (membranes and hammers), a computer monitored lighting system and a live performer, the soprano singer Kristin Norderval. The performer was operating as a spatial element equal to the other spatial elements in the installation in the spirit of Oscar Schlemmers theatre.

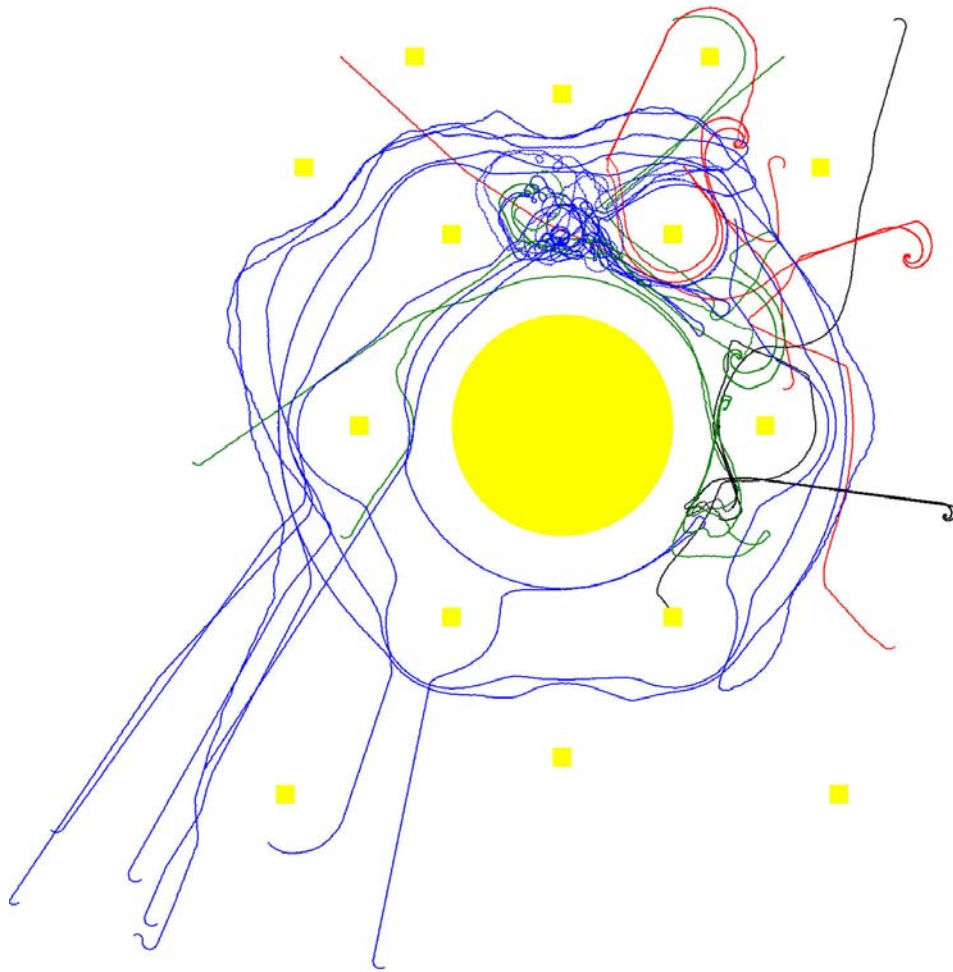
### The hybrid process and its elements.

This case is chosen because the design of the physical space demonstrates several of the digital techniques described above and combines them with physical modelling techniques. This describes the hybrid process.

The hybrid nature of the process is also reflected in how the musical composition was created, containing electronic synthetic sounds, recordings of real life sounds including the voice of the real time performer and others. In this description I will limit myself to discuss the design of the physical installation and the *techniques* that were involved.

### **Simulation:**

To create a common database special software was programmed to simulate the behaviour of several pairs of virtual persons or “agents” who seek towards certain places and simultaneously avoid colliding with each other or the physical parts of the space.



*Simulation: Image showing the trajectories drawn by pairs of "agents" in one instance of several thousand possible runs. Yellow elements indicate speaker systems and in the middle audience space.*

*Mind the mind gap:* The agents do not represent the movement of real persons, they might mimic the potential movement of the actor but are even in this case not used directly to guide her movements.

**Spatial organisers and design template:** The trajectories from the simulation were translated into image data that was used as design template and spatial organiser for the installation.

**Graphical filtering:** The underlay from the simulations was treated graphically to clarify and simplify main structural trends and patterns.

**Direct modelling:** The digital model of the installation was partly modelled directly. The output from the simulation was only 2D and the mapping in space was done through direct modelling in a complete site model of the central station. The geometries informed by the template were negotiated towards the complex geometry of the site.



*Merged CAD model of central station, installation and real life image.*

**Data decoding and recoding:** The final digital model of the installation was via VRML-format translated into spatialisation-data to be fed into the software that controlled the ambisonics system. The model was cleaned, all unnecessary elements were removed and the remaining trajectories, which were the most important elements were reduced to be presented only as polylines and then exported in VRML format. The VRML data is organised as a data array that is possible to read by a normal text editor. Therefore the data is easy to modify and translate into another format like the data needed to spatialise the sound system. The VRML model was also a visual aid and needed for orientation.

**Complex geometries: advantage of using 3D-tools for prefab and recycling.**

The prefabricated elements from the station were recycled in Black Box. This recycling was also done in a computer model where the elements were negotiated towards the design template and the new space.

In addition the design teams went through several stages of physical modelling including an almost complete trial set-up in a specially hired space for tests and rehearsals.

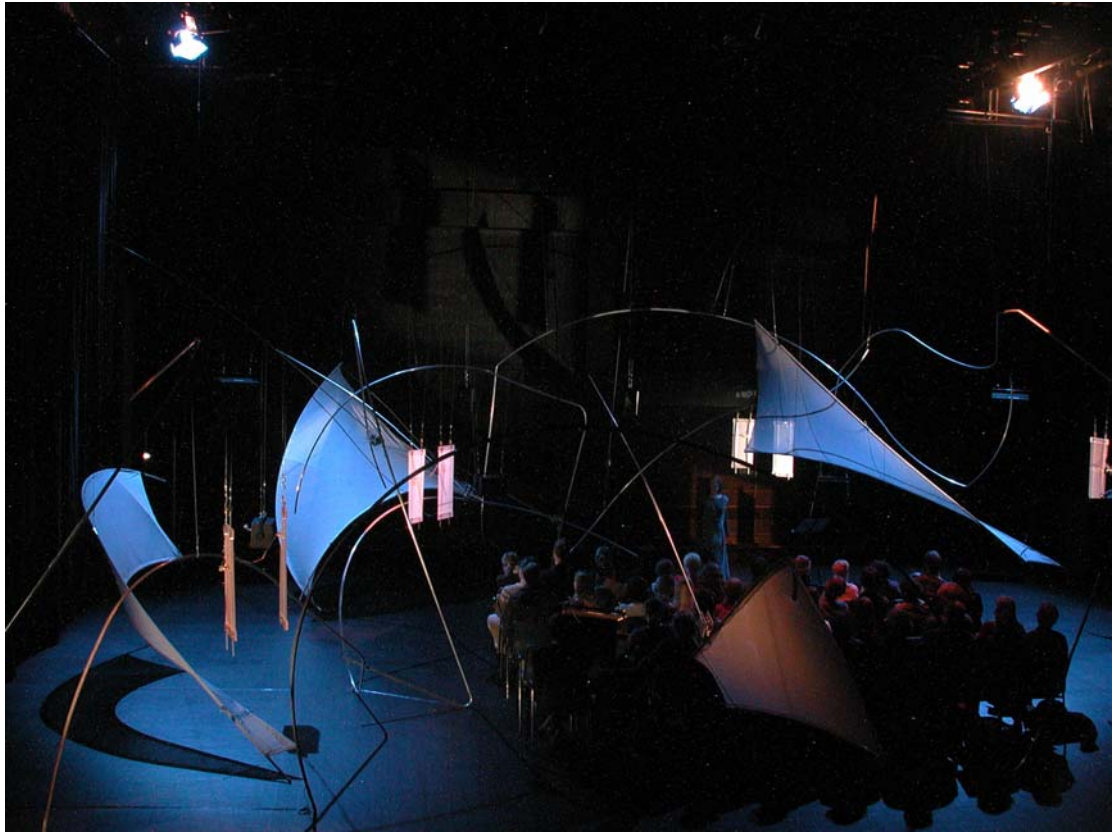


*Installation at the Oslo Central Station*

## Hybridification

The effect from this way of working was in many cases an achieved synergy and jumps in the design process. The different categories were applied during the design process in various ways and combined with traditional drawing, CAD and physical model building. Some techniques, like Direct Modelling, appeared frequently and in repeated cycles. It was also central in the negotiation necessary for recycling the installation from the first to the second event. Other techniques were conducted in very distinctive phases, like the simulation that was produced in the beginning of the project. Others again like the appliance of the simulation material as spatial organiser and design template was repeated in several distinctive modelling events.

The hybrid process implies to switch between media and methods. The switching between ways of working has a potential to speed up the progress and to trigger leaps. Changing media or technique helps to see new aspects of the design and will in many cases help to lead the process out of dead ends. The hybrid process as described here intends to take full advantage of these effects.



*Performance at the Black Box Theatre in Oslo. The audience is surrounded by the installation.*



*The soprano singer Kristin Norderval acts as a spatial cursor through the performance.*

## **Summary**

The emerging creative techniques inspired by computer technology have led to a more complex and varied design process. The computer has not replaced any existing design technique but widened the scope and the available ways of working with design projects. I consider this a general trend that can be observed amongst design students and younger practitioners. Also recently a new focus on the traditional techniques has spread to some design schools. Hand drawing techniques are far from abandoned but are part of a widened palette of tools that go together in intricate synergies.

This phenomenon is here called hybrid processes. By introducing such a concept it is clarified and the awareness of this new and more complex way of working is developed.

The categorisation and conceptualisation demonstrated here is still under development, though it has proven to be useful. The intention to categorise has not been to establish an authoritative vocabulary but use categorisation as a tool for theorising. Further investigations also conducted by other practitioners will hopefully fill in the picture and suggest other techniques not mentioned here.

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