

1. Visualisation-projects in Denmark

Visualisation-projects in Denmark can be categorised as either civilian or military. Civilian projects are either commercial or research and development. They will be mentioned in the next chapter. Military VR-projects are either simulators or research and development. The military projects will be mentioned in the last chapter.

1.1. Civilian VR-projects

Commercially VR is used by television stations and advertising agencies. VR in research and development is of growing interest. Three universities have established VR laboratories or centres. These will be mentioned in the next section. Examples of research and development VR-projects will be mentioned in the following section.

A Danish Virtual Reality Society (DK-VRS) was established in 1999 (for further information, see <http://www.dk-vrs.dk/>).

1.1.1. Civilian VR research laboratories

1.1.1.1. Centre for Pervasive Computing

Pervasive computing is the next generation computing environments with information & communication technology everywhere, for everyone, at all times.



Information and communication technology will be an integrated part of our environments: from toys, milk cartons and desktops to cars, factories and whole city areas - with integrated processors, sensors, and actuators connected via high-speed networks and combined with new visualisation devices ranging from projections directly into the eye to large panorama displays.

Figure 1.1 Large CfPC displays

The Centre for Pervasive Computing (CfPC) contributes to the development of

- new concepts, technologies, products and services
- innovative interaction between universities and companies
- a strong future basis for educating IT specialists.



Pervasive computing goes beyond the traditional user interfaces, on the one hand imploding them into small devices and appliances, and on the other hand exploding them onto large scale walls, buildings and furniture. The activities in the centre are based on competencies from a broad spectrum of research areas supporting pervasive computing.

Figure 1.2 Small CfPC device

Currently, the centre involves the following research areas:

- [Ambient Intelligence with Tangible Objects](#)
- Center for Advanced Visualization and Interaction - CAVI (described in section 1.1.1.2)
- [Computer Supported Cooperative Work](#)
- [Database Technology](#)
- [Design Anthropology](#)
- [Embedded Systems - Embodied Agents](#)
- [Interactive Workspace](#)
- [Mobile Systems and Wireless Communication](#)
- [Modelling and Validation of Distributed Systems](#)
- [New Ways of Working](#)
- [Object Technology](#)
- [Sound as Media](#)
- [Tangible User Interaction](#)

Some research areas are well-established, like Object Technology, some are emerging. Each area is headed by a research manager.

Most of the work in the centre is organised as research projects involving both companies and universities. Many projects cut across research areas.

Most of the work in the centre is organised as [Research Projects](#) involving both companies and universities. The 3D visualisation and interaction projects at CAVI will be mentioned later.

Further information on CfPC can be found at <http://www.pervasive.dk/index.html>.

[Center for Advanced Visualization and Interaction - CAVI](#)

1.1.1.2. Centre for Advanced Visualisation and Interaction

CAVI (Centre for Advanced Visualisation and Interaction) is one of the research areas in the CfPC (see section 1.1.1.1).

3D visualisation is becoming increasingly widespread in as diverse areas as industrial design, architecture, city planning, medicine, moving images as well as the arts. The ability to interact in new ways with 3D models offers new possibilities for the professionals in these areas.

In a unique combination, the following 3D visualisation technologies are available in CAVI:

- 3D Panorama Cinema
Curved screen
Active stereo glasses
Tracking



Figure 1.3 3D Panorama Cinema at CAVI



Figure 1.4 3D Panorama Cinema at CAVI with consoles

- TAN Holobench (horizontal and vertical screens, both 180 cm x 110 cm)



Figure 1.5 Holobench at CAVI

- Virtual studio

Live persons and physical objects can be mixed with virtual computer generated objects.



Figure 1.6 Virtual Studio at CAVI

- Onyx2 Infinite Reality2 Rack, 6X250 MHZ MIPS R10000, 1.5 Gb RAM, 2 graphics pipelines (each 64 Mb texture memory)
- Polhemus FASTRAK (3 sensors)
- Stereographic glasses.
- 6 Octanes
- 20-30 O2

Several CAVI-projects will be mentioned in a section 1.1.2.

For further information on CAVI see

http://www.pervasive.dk/resAreas/CAVI/CAVI_summary.htm.

1.1.1.3. VR Media Lab

VR Media Lab (previously VR Centre North) is located at the University of Aalborg. Its main feature is:

- Cave with 6 walls (2,5x2,5x2,5 m)
Active stereo glasses



Figure 1.7 CAVE with 6 walls at VR Media Lab

- Powerwall
Big screen (8mx2.85m)
Passive stereo glasses



Figure 1.8 Powerwall at VR Media Lab

- Panoramic screen
160-degree screen (diameter 7.1m, height 3.5m)
Active stereo glasses
Magnetic-tracking device.



Figure 1.9 Panoramic screen at VR Media Lab

These are run by:

- Onyx2 Infinite Reality2 Rack, 6 graphics pipelines



Figure 1.10 Onyx2 at Aalborg University

For further information on VR Media Lab see http://www.vrmedialab.dk/pr/index_e.html.

1.1.1.4. VR•C

VR•C is a VR centre at the Technical University (DTU) in Lyngby north of Copenhagen. It is collaboration between UNI•C (a national IT-centre under the ministry of education) and The Technical University (DTU). VR•C's main facilities are:

- TAN Powerwall (6.5 m x 2.5 m)
2×3 projectors (TANORAMA/Electrohome) for passive stereo
Ascension Flock of Birds Tracking system with 2 trackers + 1 6-degrees-of-freedom mouse
8 active speakers
3 subwoofers
1 Microsoft SideWinder Forcefeedback Pro joystick
1 control for audio panel and SGI terminal
- 3 n-vision DataVisor HiRes Head Mounted Display
See-through (augmented reality)
2xXSGA CRT
Headphones and microphone
Ascension MotionStar tracking system with 8 trackers
3x24" Monitors



Figure 1.11 HoloDeck Laboratory at VR•C

- SGI Onyx2 InfiniteReality2 Graphic Supercomputer
16 195 MHz MIPS R10.000 CPU's
8 GB RAM
356 GB Hard disc
3 graphic pipes each with 2 Rastermanagers and up to 24 displays
- Lake Huron 20 sound computer
8 Quad DSP processors
32 I/O ports
- 4 SGI O2 Workstations
- 1 SGI 320 Personal Workstation



Figure 1.12 Supercomputer at VR•C

Keywords for VR•C are industry, education and research. Areas of interest are architecture and landscape modelling, scientific visualisation, visual simulation and education, and collaborative VR. For further information on VR•C see <http://www.uni-c.dk/generelt/english/index.html>.

1.1.1.5. FORCE Technology

FORCE Technology merged in 2002 with DMI - Danish Maritime Institute - bringing with it an extensive expertise in model testing, computations, simulator based training and pc based simulators for the maritime sector.

For further information on FORCE Technology see <http://www.force.dk/gb/default.htm>.



Figure 1.13 Ship simulator

1.1.2. Civilian Visualisation research and development projects

1.1.2.1. Virtual Urban Planning

Partners

The partners of the project are [Aarhus University](#), [Cadpeople](#) and [COWI](#).

Aim

The project's goal is to develop and investigate the use of virtual reality technology, as a basis for improvement of decisions to be taken in a city region that is continually undergoing development. Virtual Urban Planning (VUP) has to function as a combined tool for the benefit of

politicians, public administrations, building constructors and architects, private businesses and the town's citizens. For example, the advanced visualisation technologies available to CAVI will provide citizens and politicians with the possibility of a simultaneous experience that can be discussed during the presentation and offer an opportunity for focusing on specific details, a particular view from a definite point in the city or something similar.

The research aspect initiates from a series of earlier projects with the feature in common that they all discuss the spatial planning with the aid of digital technologies. They range from *Karlskrona2*, an internet-based multi-user system for use in citizen-based discussion of town planning, to the mixed reality game [*kollision:6400*], where a physical lp-record is augmented by 3D models and is used for illustrating complex interrelations in the city space. The project's motive, *the town in the computer, the computer in the town*, is to deal with planning our city environment, with the aid of dynamic models of the city's space, an environment that can be experienced purely digitally or by means of, say, augmented reality-technologies in interaction with our physical world.

Results

A 3D-model is created on many levels of detail-addition, where future alterations to the physical relation in the town space can be inserted and tested. In this way, the model becomes dynamic. If, for example, there are several construction suggestions for the same project, they can be "turned on and off" in the model and the individual changes can be evaluated in a more extensive context, since the surroundings are created in 3D. After this, not only the building process, but also its relation to the surroundings can be evaluated.

Team

[Kim Halskov Madsen](#), Morten Lervig, Rune Nielsen, and Bo Degn.

1.1.2.2. Visualization of the Cardiovascular System

The cardiac morphology in patients with congenital heart disease is often very complex and variable from individual to individual. Consequently, accurate morphological information remains of utmost importance when planning the surgical intervention. Magnetic Resonance Imaging (MRI) is the imaging modality that currently provides the best soft tissue contrasts. New visualization techniques based on three-dimensional MRI have been developed and is now being implemented and tested clinically at Aarhus University Hospital.

Partners

- CAVI, University of Aarhus
 - Thomas Sangild Sørensen
- Aarhus University Hospital MR Research Center
 - Erik Morre Pedersen, MD, DMSc, PhD
Dept. of Cardiothoracic Surgery
 - Ole Kromann Hansen, MD
Dept. Cardiology
 - Keld Sørensen, MD

- Systematic Software Engineering
- Søren Vorre Therkildsen

Results

The preliminary results show that cardiac morphology in congenital heart disease can be accurately reconstructed and represented by virtual models. As MR image quality continuously improves, image processing times are being reduced rapidly. This will undoubtedly make three-dimensional MRI with virtual reconstructions an important clinical investigative tool within the nearest future.

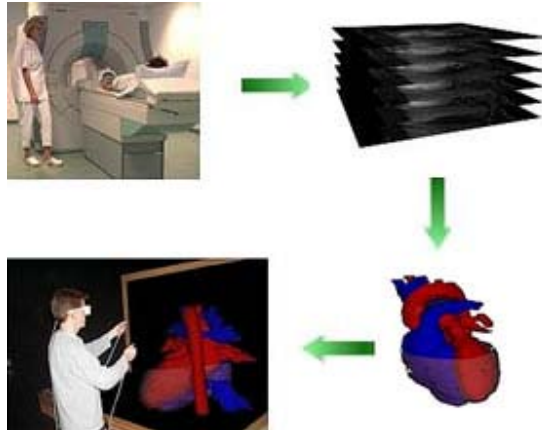


Figure 1.14 The process from scanning to visualization on virtual reality equipment.

Related research will implement elastic tissue properties, allow cutting the model and inserting patches, as first steps towards a surgical simulator/trainer.

Links

Systematic Software Engineering: [Virtual Reality Heart](#)

1.1.2.3. Digital Theatre – Hyperopticon

The use of digital media in theatre and other time based art forms is increasing as the cost of computers decreases and the development of software programmes has been made more available to theatre technicians. Still there are many fields still to be researched and explored.

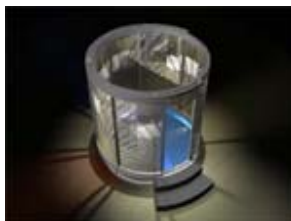


Figure 1.15 Digital Theatre

The members of The Digital Theatre from the University of Aarhus have worked in the following fields of digital theatre research: the dramaturgy of digital media, virtual puppet theatre, motion capture/animation, and reactive spaces. Through experiments and productions The Digital

Theatre group has explored the production and reception of theatrical spaces in order to explore interactive possibilities in digital media.

HYPEROPTICON was created from a concept of developing a particular site i.e. in a library, where a small audience might have the opportunity to explore a specific theme, a play or an event through interaction in a mixture of digital media and real life performance.

Partners

The partners of the project are [Aarhus University](#), Denmark, [The Academy of Figurative Theatre](#), Norway, Studio di Progettazione, Italy, and [CAVI](#), Aarhus, Denmark.

Goals

The scientific goal is to develop concepts and produce digital theatre experiments that can be used to further the knowledge of dramaturgical understanding and broaden the knowledge of perception of digital time based art.

One focus of the research has been to develop new forms of staging plays through an idea of exhibiting a story or a plot and to make this an interactive experience. So the investigation of space and digital technologies is also a crossover art experiment with digital media as means of production.

Themes

The last production An Angel's View was staged as an exhibition in seven stages and set up as a walk through elements of a theatre experience and an art gallery. The experiment was made to find a new concept of staging – or rather exhibiting - a text that would give the audience an opportunity to interact with this text and compose their own impression of the play.

The concept of Hyperopticon was created to bridge between the dream of being linked to everything everywhere and the nightmare of being seen everywhere by everyone to explore if there is still a human necessity in interesting interaction. The concept of an Angel's View was to see a “hyperoptic view” in light of the metaphor of an angel's view and apply this meta-view to a dramatic text (Beckett's That Time).

Results

A performance and dramaturgical theory of performance-based visual exhibitions based on a reactive space that can pick up inputs and make it possible to compose words and images.

People

- Torunn Kjolner
- Niels Lehmann
- Janek Szatkowski

Project Manager [Kim Halskov Madsen](#)

1.1.2.4. Video prototyping

Within experimental system development there is a long tradition that visions for future technologies are concretized by means of prototypes, mock-ups, scenarios and video.



Figure 1.16 Video Prototyping

The virtual studio makes it possible to mix digital elements with persons and physical objects, thereby opening up new prospects of combining the above mentioned concretization possibilities in the form of video prototypes.

An internationally known example of a visionary video is Appel's Knowledge Navigator from 1987 (see www.billzarchy.com/clips/clips_apple_nav.htm).

Purpose

Through production and application of a number of video prototypes the purpose of the project is to investigate their application 1) in the communication of visions for future technologies and 2) in design workshops etc.

Results

The results are video prototypes within the following areas:

1. Handheld display
2. The future hospital ward
3. The virtual architect
4. The future drawing office
5. The future school
6. Living and interactive buildings

Project Manager [Kim Halskov Madsen](#)

1.1.2.5. 3D experiences

Scandinavia and Denmark hold a prominent place in the film media. Good story telling is an imperative, and international successes are evidence of a high standard in both dramaturgy and production. 3D opens up completely new avenues and sets entirely new demands on all aspects of filming, whether dramaturgy, production or staging.



Figure 1.17 Using VR for staging.

Also in the case of exhibitions, communication, entertainment and education, 3D technology is increasingly important. Today 3D is already in use in adventure parks, such as Legoland parks and Universal Studios, but 3D technology confronts great challenges and possibilities not only in this area but also in showrooms, exhibitions and education.

Partners

The partners of the project are [Aarhus University](http://www.aarhusuniversity.dk) and Zentropa Interaction (<http://www.zentropainteraction.dk/forside.html> (in Danish)).

Aim

The overriding aim is to investigate and develop the potential for 3D within film, interactive TV and other forms of sense-stimulating and educational areas.

The research goals are:

- to reveal and develop present and future technological possibilities and challenges within the 3D narrative and experiences;
- to investigate new possibilities and visions, which arise when classical film artistry meets virtual reality.

The industrial goal is

- to contribute to Danish film production's development and expansion into new business areas in the context of 3D.

Results

As a result, 2 pilots will be available and one or more future scenarios:

- 3D short film pilot
- 3D pilot for interactive TV design
- Scenarios for 3D realistic experience space and communication



Figure 1.18 Filming real actors on a VR background.

Team

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1.1.2.6. 3D Sound in 3D space

3D visualisation in Panorama displays is a widespread means of communication within a number of areas including architectural-design and experience-oriented applications. At the same time, it has been confirmed that sound similarly provides a powerful instrument which so far has been exploited to a limited degree in 3D visualisation in panoramas and similar interactive 3D display facilities.

TC Electronic is unquestionably one of the world's leading developers and producers of sound effect equipment, including equipment for spatial simulation of multi-channel music, but has only worked to a limited extent with real-time design of the sound experience, where the listening position and the sound source are in relative motion to each other.

Partners

The partners of the project are [Aarhus University](#) and [TC Electronic](#).

Aim

It is the project's overriding aim to develop and investigate the use of 3D sound in three-dimensional graphical spatial models.

The research goals are:

- to develop the immersion experience in 3D presentations in Panorama using the audio dimension;
- to identify future potentialities for exploiting the audio dimension in conjunction with 3D visualisations within architecture, design and experience-oriented applications;
- to improve simulations of the natural sound experience in an interactive environment.

The industrially oriented goal is:

- to develop real-time generation of 3D sound experience more fully, for example, by increasing the speed of sound processing.

Results

Software will be developed to make it possible in connection with a visual 3D model to move around in it, where 8 sound sources are positioned in the model and the sound reception corresponds to the sound position and orientation with respect to the sound sources and where the sound experience reflects the 3D room's acoustic properties. In this way the sound can be "coloured" so that it reproduces the virtual environment's sound-reflective properties more faithfully, and thereby strengthen the immersion experience, which the panorama provides.

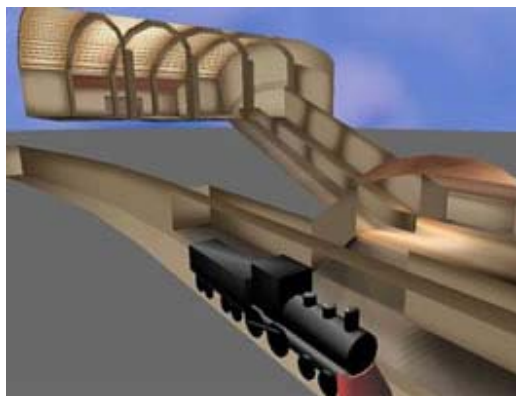


Figure 1.19 3D Sound in 3D Space

An algorithm will be developed, whereby the sound can find its way to the listener in the virtual world. That is, the sound's path to the listener takes the height of the walls, doors, corridors, etc. into account.

This has the effect that the sound not only reflects the single virtual room, in the way made possible by TC Electronic's System 6000, but also allows the sound experience to be simulated in virtual worlds consisting of many rooms.

Team

[Kim Halskov Madsen](#), Morten Lervig, Gorm Lai, Bo Degn, and Peter Friis

1.1.2.7. Distributed Multimedia Technologies and Applications (DMM)

The DMM project focuses on research issues central to the development and use of distributed multimedia. Distributed multimedia technologies possess much potential for improvement of work-practices and collaboration in network organisations, e.g. through intranets; in society, e.g. electronic commerce and mass communication; and in distributed education, e.g. virtual seminars and distance learning. To explore this potential, the project will undertake three main kinds of experimental research activities:

- participatory analysis and design in the three listed application domains
- technology research and development within the areas of collaborative hypermedia, virtual reality, and real-time multi-modal communication
- demonstrator development, pilot tests, and evaluation in an industrial network organisation as well as an educational setting

With respect to network organisations and electronic commerce, the empirical and the demonstrator activities will take place in modern Danish network organisation applying

multimedia technologies both in products, commerce, and business processes. With respect to distributed education, the corresponding activities will take place in the context of establishing joint multimedia courses at Masters and Ph.D. levels between the Technical University of Denmark and Aarhus University. The results of the project will include theories about distributed multimedia, prototypes of new, distributed multimedia technologies, and documented user experience. Further information can be found on <http://www.intermedia.au.dk/projekter/dmm/index.html>.

1.1.2.8. CAE and CFD into Virtual Reality (CCVR)

A post-doc planning research activity at [VR Media Lab](#) by [Truc Huynh](#) and Henrik R. Nagel

Computer-Aided Engineering (CAE) and Computational Fluid Dynamics (CFD) are developed for structural engineering application, typically on the personal computer monitor.

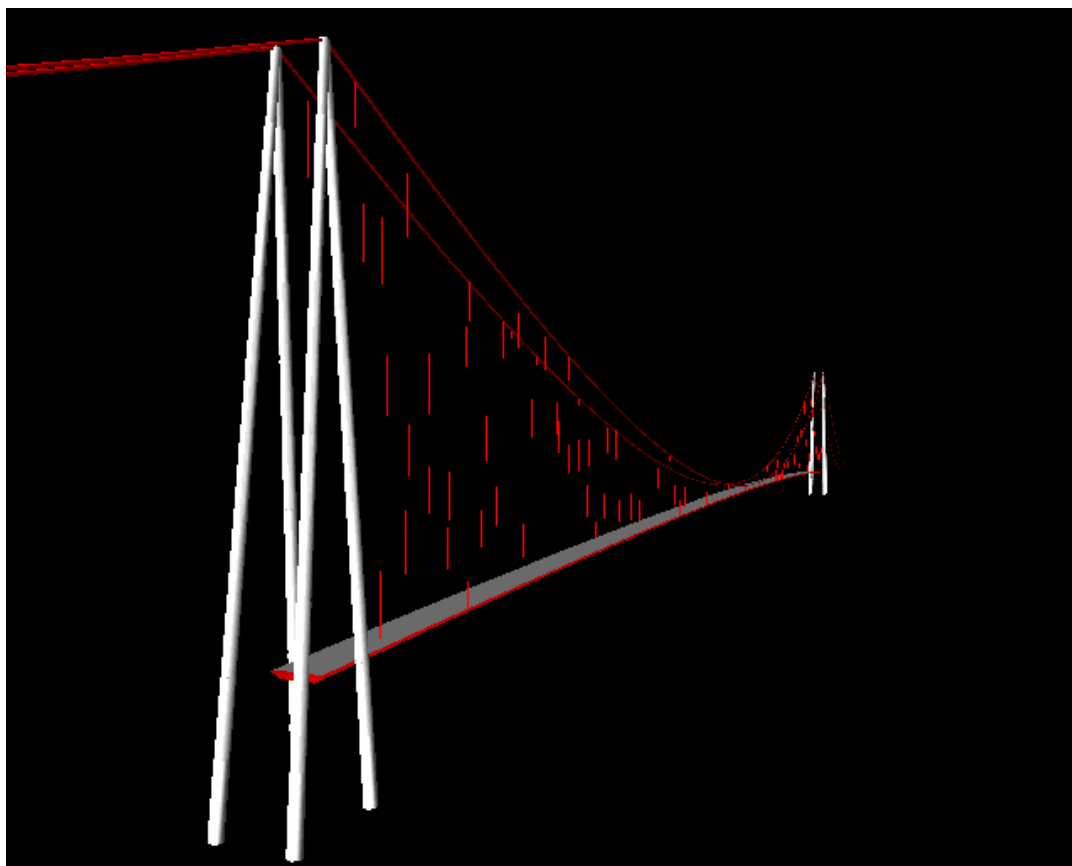


Figure 1.20 Computer-Aided Engineering (CAE) and Computational Fluid Dynamics (CFD) visualized in VR

However, it is a common desire for structural engineers that a large screen is needed for large structure, where the whole construction can be analysed in global dimension or zoomed in into a local part as well. Further, the large screen and the virtual reality device will also make the idea visible during the research step and the final presentation.

To this purpose the following is available at the VR Media Lab:

- [Panorama](#) wide screen in arc of a circle of 160°, 7.1m diameter and 3.5m height
- [Wide screen](#) of 8x2.85m
- [Cave](#) på 2,5 x 2,5 x 2,5m (C-language Application Virtual Environment)

The CCVR research is to the effect the creation and analysis of a construction in virtual reality (VR), where the suspension bridge is an example. A post-doc on "Wind-Bridge Interaction" is planned on the developing Ph.D.-thesis "[Suspension Bridge Aerodynamics and Active Vibration Control](#)", Truc Huynh, July 2000. The physical idea behind the thesis is that the girder-flap-wind interactions are studied theoretically and numerically with the goal to obtain the vibration reduction of the wind-exposed suspension bridge girder using the motion of the separate control flaps attached along the [girder](#).

This problem can now develop graphically on the Panorama with full-span bridge-wind interaction analysis. Hence, the bridge and its motion due to the wind can be studied in three dimensional dynamic translation and rotation (also on Silicon Graphics computer monitor).

The research is planned to be a cooperation between VR Media Lab, [Department of Building Technology and Structural Engineering, Aalborg University](#) and Engineering Consulting with the similar interest to fund the project.

Step of work is planned to consist of two separated parts. One refers to CAE and CFD. The other is the transformation of the CAE and CFD graphical results into VR.

First step of CAE natural mode shapes into VR has been done sufficiently, where the bridge construction and its dynamic eigenvectors are transformed into virtual reality animation. Also the real box-girder can be animated together with the bridge vibration using geometrical assumption at the VR step.

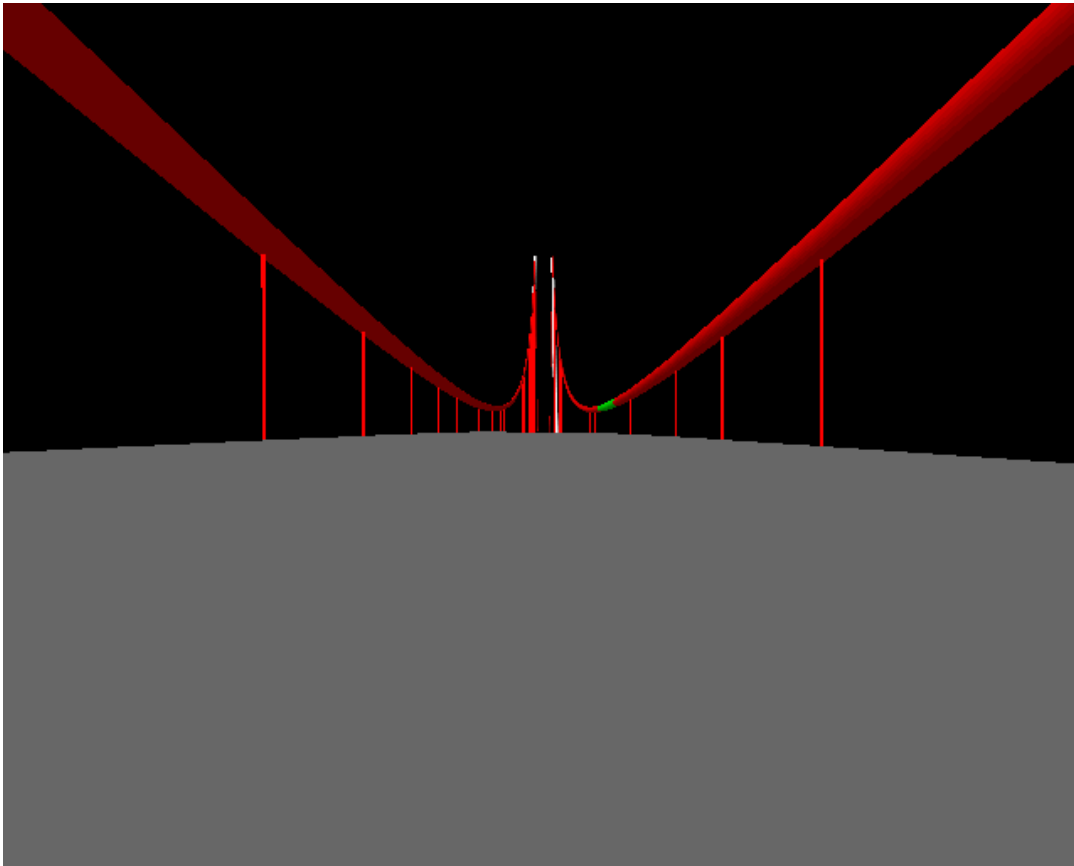


Figure 1.21 CAE and VR in Bridge Construction

1.1.2.9. Data Mining

Data mining is a research project at [VR Media Lab](#). The goal of data mining is to obtain useful knowledge from large collections of data. The discovered knowledge can be rules describing properties of the data, frequently occurring patterns, clusterings of the objects in the database, etc. Current technology makes it fairly easy to collect data, but data analysis tends to be slow and expensive. In most standard database operations nearly everything the user sees is something that they knew existed in the database already. Data mining extracts information from databases, which the users did not already know about.

Visual data mining is visual, explorative analysis of large amounts of data. The starting point is data without the any hypotheses about the data. The process of analysing the data involves interactive, usually undirected search for structures, trends, etc, and the result is visualizations of the data, which provides the users hypotheses about the data.

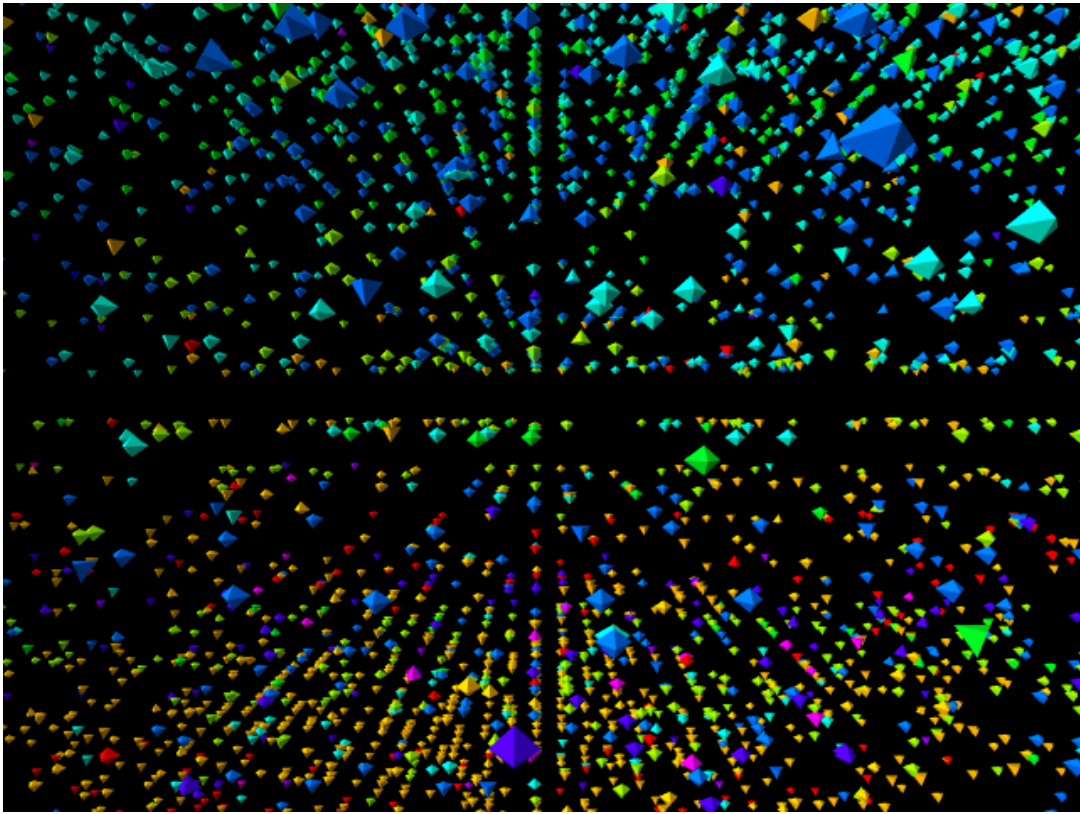


Figure 1.22 Data Mining

1.1.2.10. 3-d Visual Data Mining

3-d Visual Data Mining is a research project at [VR Media Lab](#).

Technology to store and process large amounts of data has during the last decades improved dramatically. This has led many companies to store ever increasing amounts of customer information in large databases. The hope has been that it would be possible to discover unknown relationships in the data, and thereby obtain a knowledge which could give commercial advantages. This could, e.g., be the knowledge of which good customers would soon leave the company. This knowledge could then be used by the company to make the customers concerned a more attractive offer.

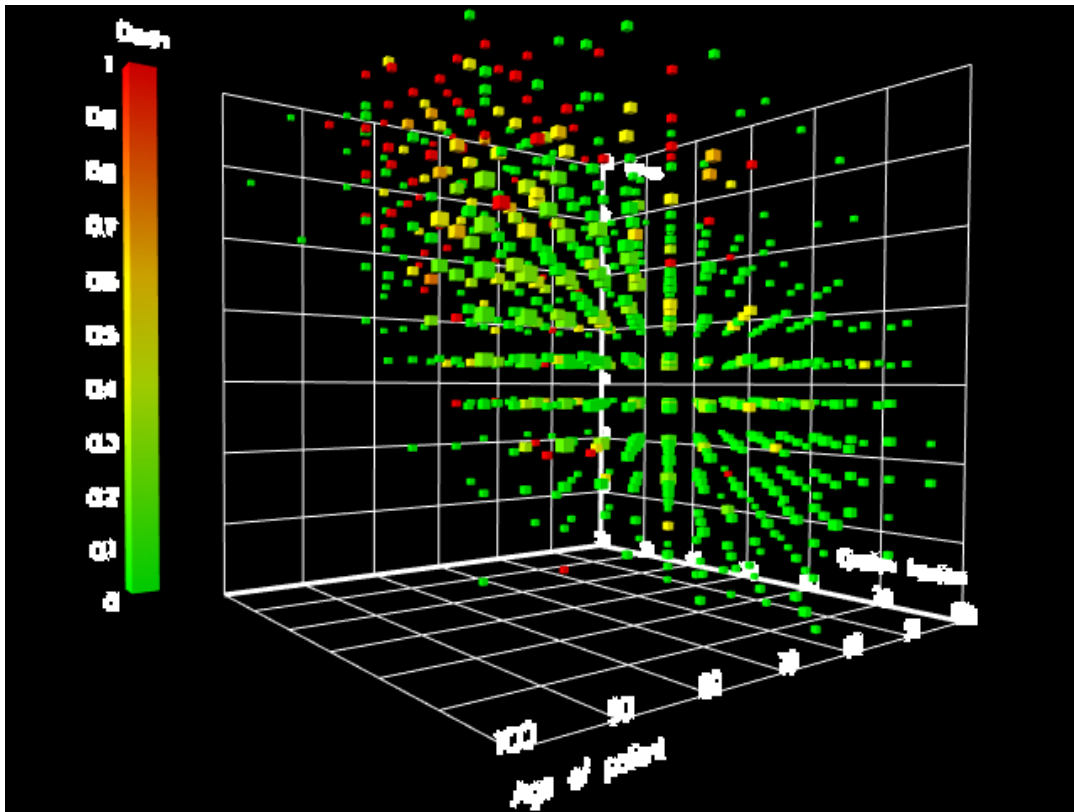


Figure 1.23 3D Data Mining

However, finding hidden relationships in large amounts of data is not easy. Purely numerical methods have been supplemented with visual methods. This has led to the emergence of "Visual Data Mining". Visual Data Mining has traditionally employed 2D techniques, such as geometric, icon-based, pixel oriented, hierarchical, and graph-based methods. With the 3D Virtual Reality (VR) facilities available at VR Media Lab it is now possible to explore how the ability to interpret 3D objects can be used in Visual Data Mining.

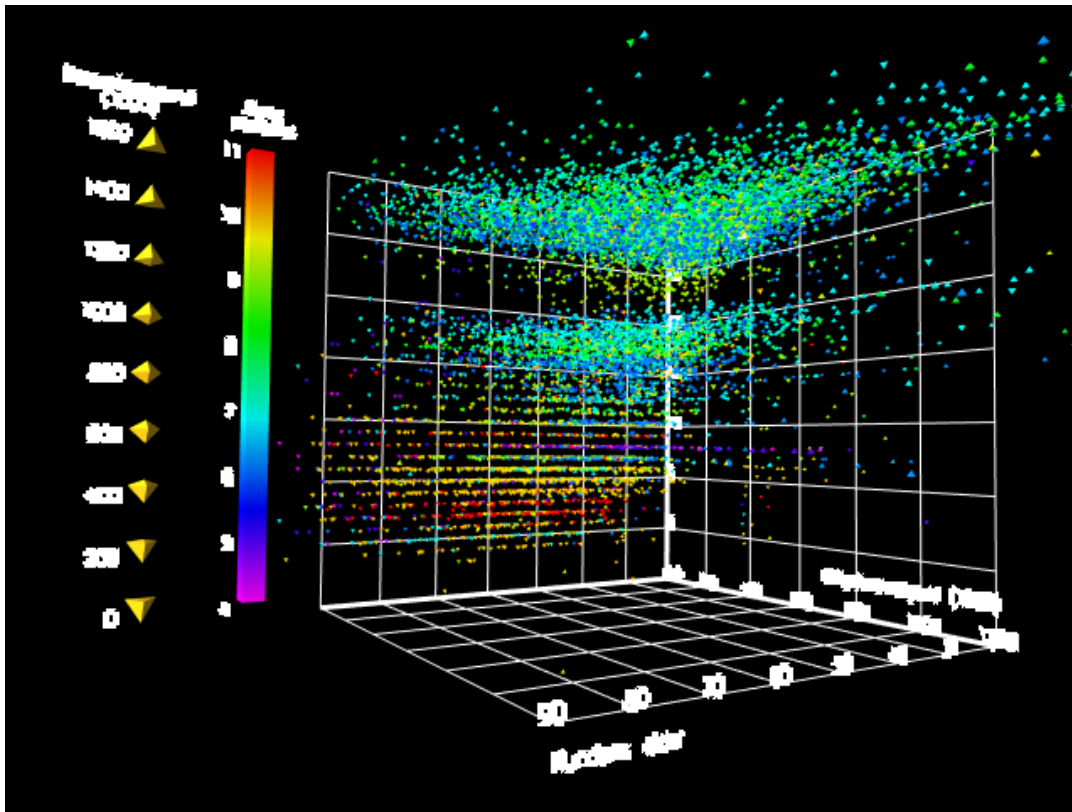


Figure 1.24 Visual Data Mining

The [3DVDM](#) project aims at exploiting all the possibilities that immersive 3D VR technology may provide to Visual Data Mining, and then adapt the data processing methods to this. The project has collaborators from four areas of science: Database Systems, Statistical Analysis, Perception Psychology, and Visualization. Researchers in the database area are responsible for handling and delivering large amounts of data from databases. Statisticians are responsible for finding interesting problems, creating statistical models for data analysis, and guiding the entire project in experiments of 3DVDM system. Perception psychology researchers are responsible for finding ways of good interaction and human perception of VR environment. Visualization researchers are dealing with the visualization of data using VR Media Lab facilities and implementation of a novel VR environment for data mining.

For further information contact [Linas Bukauskas](#).

1.1.2.11. Research projects at VR•C

The following sections gives short presentation of research projects at VR•C. For further information on the projects please contact info@uni-c.dk.

1.1.2.11.1. Interactive 3D visualization of projects

Interactive 3D visualization is an area of growth where interactive virtual models are used to support decision-making in connection with large projects and design of new products. The virtual model is used to improve the level of information and communication. The virtual

environments are based on CAD models and technical 3D drawings that are imported into the VR system thus enabling the user to navigate and work interactively with different 3D objects.

1.1.2.11.2. Scientific visualization

With scientific visualization researchers have a tool for handling and visualizing theoretical results of their research work. It is possible to obtain new insight by making abstract models and large complex amounts of data accessible and intelligible.

1.1.2.11.3. Network-based VR technology

Network-based VR technology is an innovative research area. With visualization and broadband technology it is possible for groups across subject boundaries and geographical distances to collaborate on complex problems in a virtual 3D environment.

1.2. Military Visualisation-projects

Military Visualisation-projects are either ready-made bought simulators or research and development. An exception is **RTP 6.14 Virtual Environment in Military Decision Making** mentioned below. Military research and development takes place at the Danish Defence Research Establishment (<http://www.ddre.dk/>).

1.2.1. Mission Debriefing System for the Royal Danish Air Force

The Mission Debriefing System mentioned in previously Danish updates is not developed further due to lack of interest from the Royal Danish Air Force.

1.2.2. RTP 6.14 Virtual Environment in Military Decision Making

The Western European Union (WEU) places contracts for research and development (R&D) projects under the European Co-operation for Long Term in Defence (EUCLID) programme. EUCLID's objectives are to provide European defence with basic technologies fully consistent with the aim of the Western European Armaments Organisation (WEAO) and to promote European industrial co-operation in R&D.

EUCLID consists of a set of Common European Priority Areas (CEPAs). CEPA 6 concerns "Advanced Information Processing and Communications". Within CEPA 6 the WEU is running a Research and Technology Project (RTP) number 6.14 entitled "Virtual Environment for military decision-making". The objectives of the RTP 6.14 project are to:

- Demonstrate the feasibility of using Virtual Reality (VR) techniques and a Virtual Environment (VE) in military decision-making in two functional areas: intelligence and logistics.
- Show how the military decision-maker's situational awareness is improved by using a demonstrator developed in the RTP.

The scope of RTP 6.14 is limited to decision-making at battalion and brigade levels during wartime and peace support operations on the (battle)field.

The RTP 6.14 project is being performed by an industrial team, led by Atos Origin (Netherlands). Atos Origin's partners are IFAD (Denmark), INTRACOM (Greece) and

DATAMAT (Italy). The industrial team is named "Military Applications for VE in Logistics and intelligence" (MARVEL). The demonstrator to be developed during the MARVEL project will be named the "MARVEL demonstrator". The client is the Western European Armaments Organisation's Research Cell (WRC). A Management Group (MG) of the Ministries of Defence of Denmark, Greece, Italy, and The Netherlands manages the RTP 6.14 project on the WRC's behalf. The Dutch Ministry of Defence leads the MG.

There are four Work Packages (WPs) in the RTP 6.14 project:

- *WP 0 Management and Integration.* The objective of WP 0 is to manage the project and to integrate the various components into the MARVEL demonstrator.
- *WP 1 Preparation Elements.* The objective of WP 1 is to prepare for the research and implementation phases of the project.
- *WP 2 Research Elements.* The objective of WP 2 is to perform research in the various areas that are relevant for the evaluation of VE for military decision-making.
- *WP 3 Implementation and evaluation of demonstrator.* The objective of WP 3 is to implement and evaluate a demonstrator supporting military intelligence and logistics decision-making for the land-battle domain using VE display and user-input devices.
- *WP 4 Presentation.* The objective of WP 4 is to communicate the technical results of the project to parties outside the MARVEL consortium.

The status of the project is: WP 0, 1, and 2 are done, and WP 3 is partially done. The project is scheduled to finish medio 2003.

1.2.3. HCI-Lab.

The HCI-Lab at the Danish Defence Research Establishment is used for testing VR hardware and software. In 1999 the laboratory had the following hardware:

- Intergraph ZX10 VE 5U (dual Pentium III 1GHz MHz)
1 GB RAM
Wildcat 4210
90 GB hard disk
- TDZ 2000 GT1 (dual Pentium II 700MHz)
512 MB RAM
Wildcat 4105
35 GB hard disk
- TDZ 2000 GX1 (dual Pentium II 450MHz)
512 MB RAM
Wildcat 4000
27 GB hard disk
- Assorted PC's
- Ascension's Flock of Birds
- V6 helmet
- I/O glasses
- Gloves
- Logitech Spacemouse

The laboratory has the following software:

- SuperScape
- Sense8
- Multigen Creator
- DI-Guy

1.2.4. Tactical trainer for a group leader.

The tactical trainer for a group leader is a research and development project at the Danish Defence Research Establishment. It started 1998, and is a tactical trainer for education and training a group leader. It combines a programmed simulation model with a geographical information system and a VR system and will have a speech interface. The duration is estimated to 5 years. The first prototypes are 'Attack of mechanised infantry'. The conceptual model is pictured in Figure 1.25. The ordering of the soldier is done by voice. Since last update the development of the VR in Superscape has stopped, and the next generation of the VR will be done using Multigen Creator to create the “world” and DI-Guy for the soldiers.

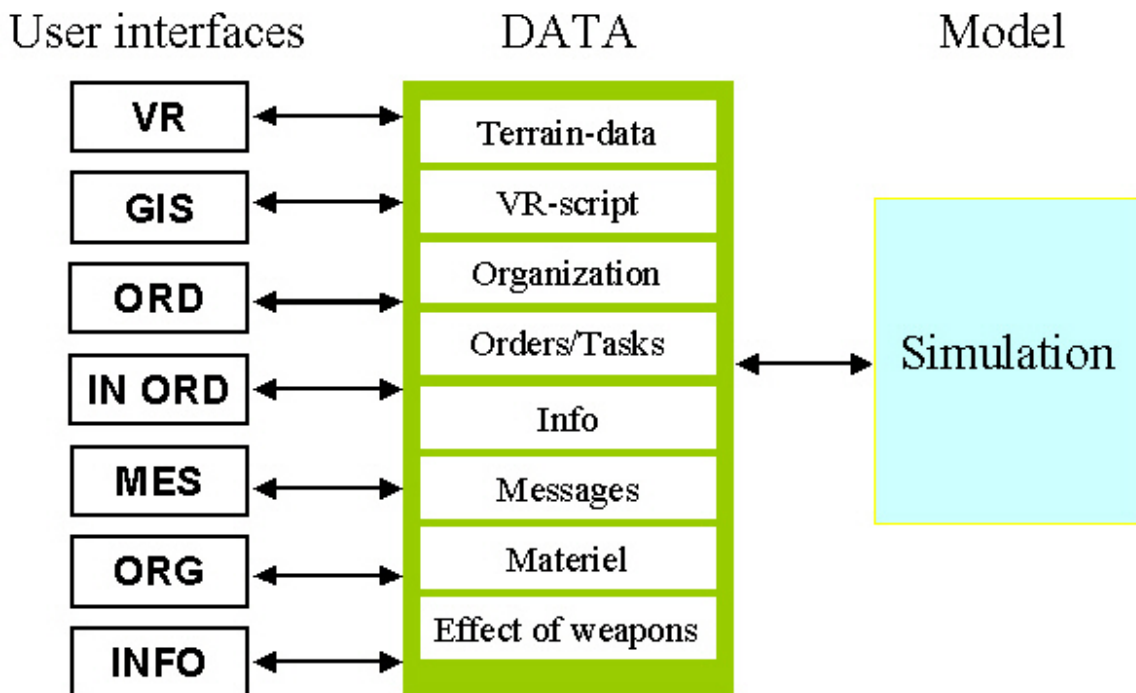


Figure 1.25 Conceptual model

1.2.5. VIKING GIS

Denmark, Norway, and Sweden have a joint project. They want to design a common new submarine that can be purchased for all three nations. In this project different studies are made. One of these is VIKING GIS. All the defence research establishments from the three countries participate in this study (which is the first common project between all three establishments).

VIKING GIS is divided into two parts:

- Establishing a database describing available data and its sources and quality.
- Building a demonstrator to show how GIS can be used in the submarine.

The database will contain description of available digital and digitisable relevant marine geographic information from both civilian and military sources. An overview of future planned marine surveys shall be included. Special emphasis shall be given to the following parameters: depth, bottom characteristics, wrecks/objects, temperature and salinity or sound velocity profile, current, and acoustic and magnetic properties. The study shall include an assessment of data quality such as accuracy, resolution, and coverage. The database will have a graphical interface, where you can ask what information is available for defined areas.

A first version of a demonstrator package, named Concept Presenter (ConPres), shall be developed. Issues concerning modelling and visualisation of seabed terrain shall be addressed, especially evaluation of methods, technologies and functionality. ConPres shall demonstrate the use of GIS technologies for navigational purposes, more specifically:

- 1) use of several types of marine geographical information such as seabed topography, sediment types, acoustic profiles and wrecks/objects;
- 2) assess quality parameters as data resolution and data accuracy;
- 3) illustrate compression and visualisation techniques for large amounts of data;
- 4) use of sensor information.

ConPres will be composed of individual, more or less coupled components as articles, pictures and software.

Second version of the demonstrator (if approved) will show how GIS can be incorporated in other functions in the submarine.

1.2.6. F16 flight simulator

The F16 flight simulator is a readymade bought system from Hughes for the Air force. It consists of a mock-up of a cockpit standing in front of 3 screens as shown in Figure 1.26. The simulation is run on a Silicon Graphic's computer from a control room.

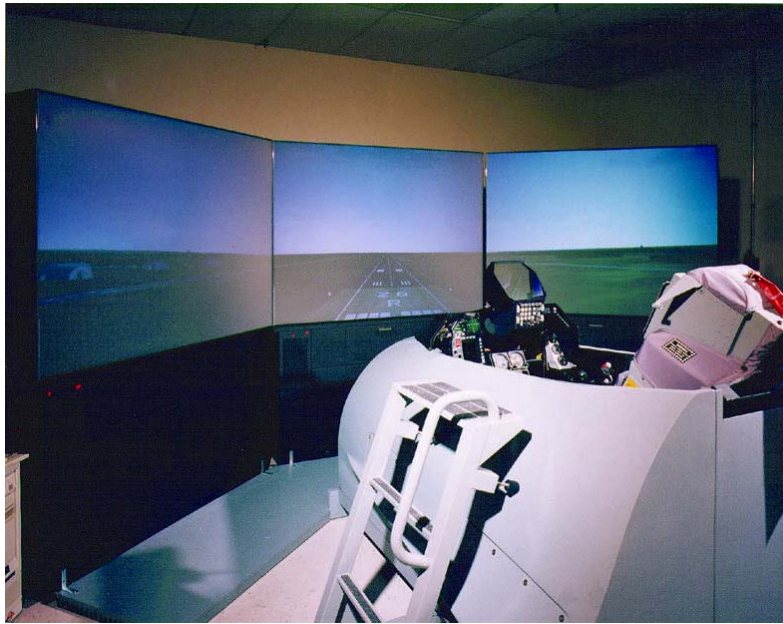


Figure 1.26 F16 flight simulator

1.2.7. The Tank simulator

The Tank simulator is a readymade bought system from Siemens (NL) and Simtech (Israel) for the Army. It is for shooting and battle exercises for platoon and below. The simulator has 4 40-foot containers. 3 of the containers have a technician room, a leopard 1A5 DK mock-up, a local instructor control panel, and a leopard 2A5 DK mock-up. The last container has a technician room, a central instructor control panel, and a report room with 12 seats. The set-up is shown in Figure 1.16 and Figure 1.17 show a picture from one of the containers.

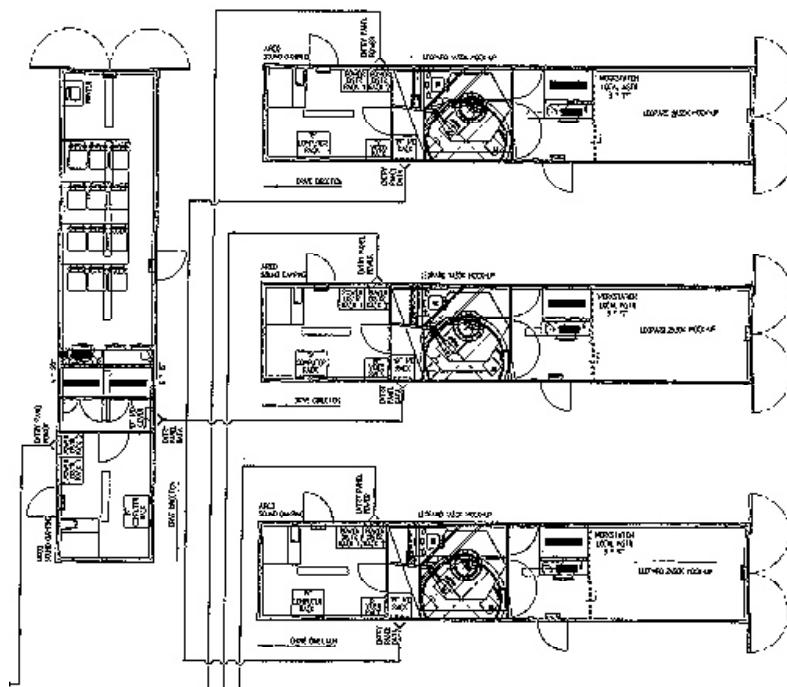


Figure 1.27 Tank simulator

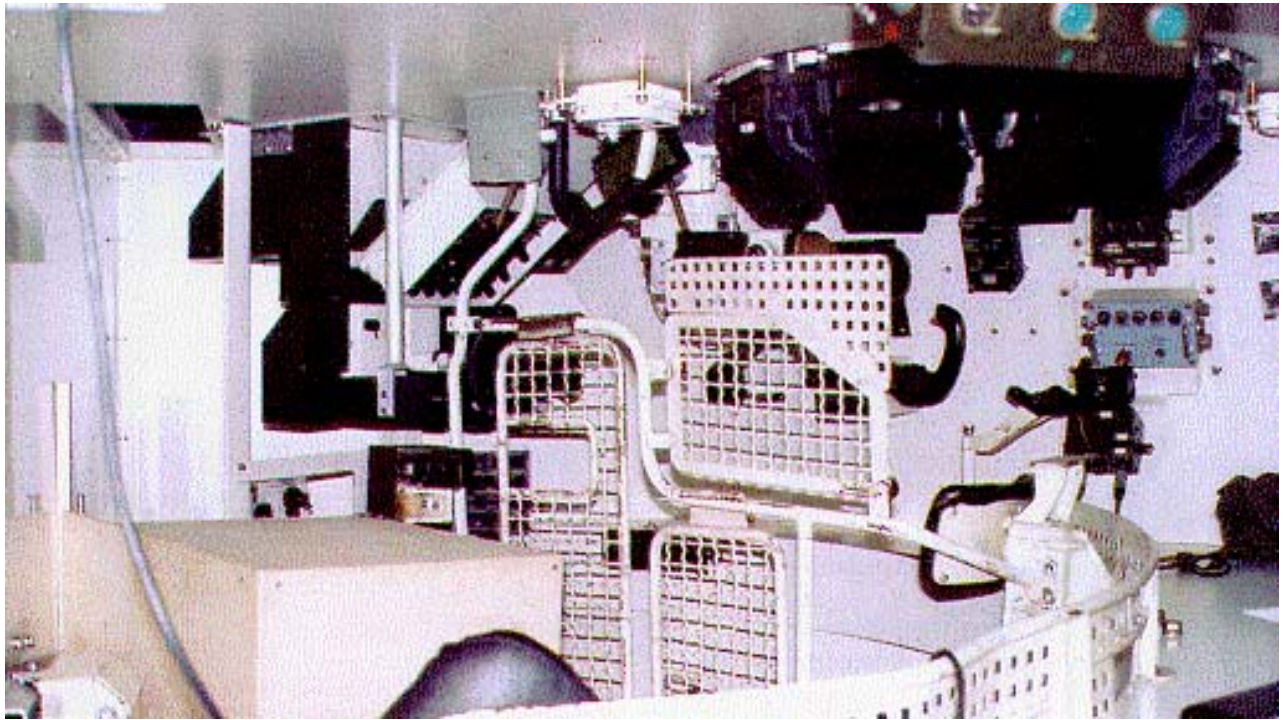


Figure 1.29 Tank simulator