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Virtual Reality Research Directions

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Virtual Reality Research Directions

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Talk Outline

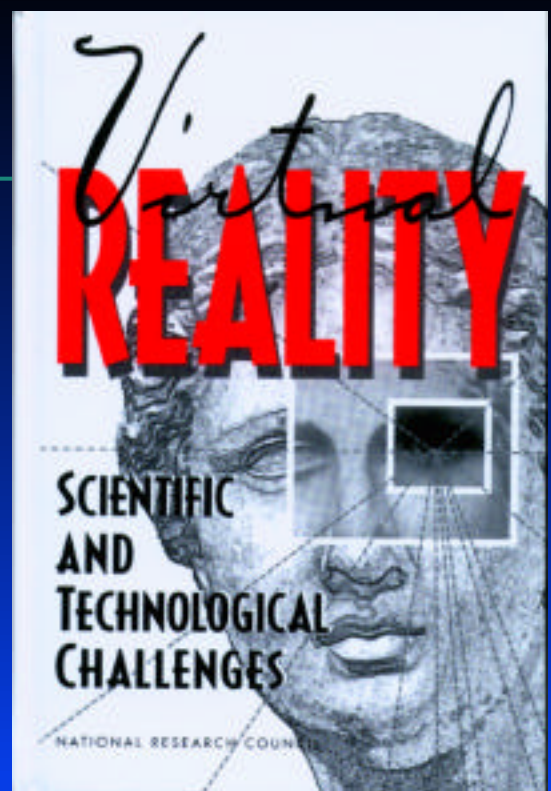
***1995 NRC report - Virtual Reality:
Scientific & Technological Challenges***

***Work not yet done - NRC report on
Modeling & Simulation: Linking
Entertainment & Defense***

Virtual Reality Research 1995

*In 1995, the National
Research Council (NRC)
issued a report ...*

*The goal of that report
was to provide a
national research &
development agenda for
VR.*



Categories of That Proposed Research Agenda

Application domains.

Some psychological considerations.

*Development of improved synthetic
environment technology.*

*Evaluation of synthetic environment
systems.*

Success of the 1995 report?

Some of the work suggested in that report was funded but not all.

- Some of the technology was funded ...
- Not enough of the human modeling work was funded ...

Now turn to 1996/1997 ...

New NRC Committee - Modeling & Simulation: Linking Entertainment & Defense

- Now the focus of this committee was not VR, per-se
...
 - But there are strong echoes of the 1995 report ...

Modeling & Simulation: Linking Entertainment & Defense

To explore how the Entertainment Industry (EI) and the Department of Defense (DoD) and its associated industries can develop a stronger technology base for modeling & simulation and profit from a closer working relationship.

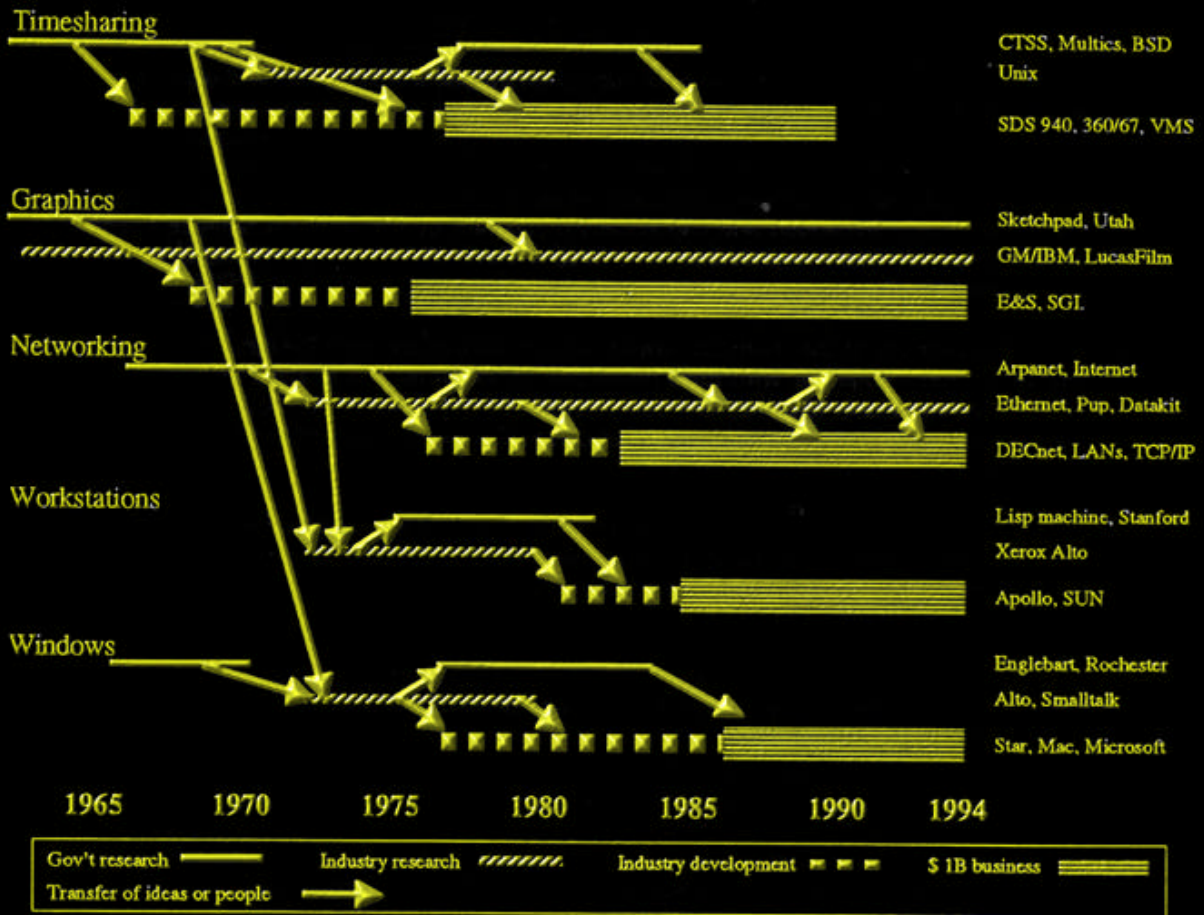
Span of Time ...

DoD Funding

- Computer graphics - Geometry Engine ~1979.
- Internet - ARPANET in late 1960's.
- SIMNET ~1984

EI Use

- Computer graphics - Nintendo-64 1996.
- Internet - Mosaic 1993, Netscape 1994.
- Networked Doom 1995.



Modeling & Simulation: the Overlap of DoD & EI

Many of the future challenges that face the movie industry, the games industry and the DoD are the same.

The task of the committee was to try and help the DoD and EI move forward in a more coordinated, and hence more efficient, manner, learning from each other's successes and taking advantage of apparent commonalities.

Research Agenda

Technologies for Immersion

Networked Simulation

Standards for Interoperability

Computer Generated Characters

***Tools for Creating Simulated
Environments***

Research Agenda

Each of these areas has sufficient overlap in interest for the DoD and EI that some common work should be carried out.

The actual mechanisms for this collaboration are discussed separately from the research agenda.

Technologies for Immersion

- *Image generation - real-time, graphics workstations capable of generating complex visual images.*
- *Tracking - technologies for keeping track of human participants in virtual environments.*

Technologies for Immersion

- *Full sensory interfaces - technologies for providing a wide range of sensory stimuli: visual, auditory, olfactory, and haptic.*
- *Locomotion - technologies that allow participants to walk through virtual environments while experiencing hills, bumps, obstructions, etc.*

Technologies for Immersion

Interfaces that allow players or participants to enter and interact with virtual environments are of great importance to the DoD and the EI.

Tracking the virtual soldier

The DoD wishes to place a company of soldiers into unobtrusive bodysuits, on locomotion platforms, in order to track those soldiers' movements and interactions in a networked virtual environment.



El & DoD need a bodysuit!



The El needs bodysuits to build keyframes for animated characters for film and videogame production.

Bodysuits are also needed for the development of full-body immersion, location-based entertainment systems.

Where is the funding for the bodysuit?



The need for research into lightweight, body tracking technology was fully described in the NRC VR report.

Yet, since that report's publication, little funding has been available for some of the hard problems involved.

Networked Simulation

- *Multicast and area of interest managers - to facilitate many-to-many communications while using limited bandwidth.*
- *Higher bandwidth networks - to allow faster communication of greater amounts of information among participants.*

Networked Simulation

- *Latency-reduction - techniques for reducing the true or perceived latency in distributed simulations.*

Standards for Interoperability

- *Virtual reality transfer protocol - to facilitate large scale networking of heterogeneous distributed virtual environments.*
- *Architectures for interoperability - network software architectures to allow scalability of distributed simulations without degrading performance.*

Standards for Interoperability

Networking capabilities that allow multiple users to interact in large-scale virtual environments is familiar territory for the DoD and new territory for the EI.

Large-Scale Virtual Environments (LSVEs)

The DoD wishes to carry out theater size battle simulations across wide area networks.

The EI wishes to build large-scale virtual environments as games.

Common protocols for scalability

Both DoD and EI need common protocols for networking their scalable virtual environments.

- Currently DoD goes its own way on this and EI slaps something together on a game-by-game basis.
- It is clear that some common research into the technology required for this would be beneficial.

Interoperability - What needs to be done?

A careful, considered, joint research program needs to be put together that actually studies the issues involved (as opposed to slapping code together for rapid demo) in designing a common, scalable network software architecture capable of supporting large numbers of players across wide area networks.

Computer-Generated Characters

- *Adaptability - development of computer generated characters that can modify their behavior automatically.*
- *Learning - development of computer generated characters that can modify their behavior over time.*

Computer-Generated Characters

- *Individual behaviors - computer-generated characters that accurately portray the actions and responses of individual participants in a simulation rather than those of aggregated entities such as tank crews or platoons, etc.*

Computer-Generated Characters

- *Human representations - authentic avatars that look, move, and speak like humans.*
- *Spectator roles - ways of allowing observers into a simulation.*

Computer-Generated Characters

- *Aggregation/deaggregation - the capability to aggregate smaller units into larger ones and deaggregate them back into smaller ones without sacrificing the fidelity of a simulation or frustrating attempts at interoperability.*

Realistic Intelligent Human Behavior

Computer generated autonomous characters are a part of every major DoD simulation system and every videogame produced. The goal behind such characters is to reproduce human behavior such that humans interacting with the characters receive a compelling experience from that interaction.

The desire for autonomous characters

The DoD wants computer generated forces that accurately mimic the behavior of humans and other battlefield entities.

El wants autonomous characters that are driven by campaign engines and storyline engines.

Adaptable Behaviors

Both DoD and EI want these autonomous characters to have adaptable behaviors, behaviors that cannot be “gamed”.

Autonomous characters and storyline development

Both DoD and EI need mechanisms for rapidly developing autonomous characters and integrating them into a coherent story.

Non-reusable autonomy

Current SAF programs are not easy to add new behaviors to.

Nor are they readily adaptable to new domains.

In addition, current SAF systems have no capability to model personalities or human character behaviors.

Human behavioral modeling

Broadening this effort to include capturing and reproducing the entire spectrum of human behavior with such systems may prove invaluable across many domains.

Tools for Creating Simulated Environments

- *Database generation and manipulation - tools for managing and storing information in large databases, to allow rapid retrieval of information, feature extraction, creation, and simplification.*

Tools for Creating Simulated Environments

- ***Compositing - hardware and software packages that allow designers to form composite images with images taken from different sources (whether live-action footage or 3D models) and facilitate the addition or modification of lighting and environmental effects.***

Tools for Creating Simulated Environments

- *Interactive tools - tools that use a variety of input devices (more than a mouse and keyboard) to construct models and simulations.*
 - When you are building 3D VEs, you need to place things with hands, not nudge things with a mouse and keyboard.

Tools for Creating Synthetic Environments

Low-cost, easy-to-use tools for creating interesting synthetic environments, terrain, buildings, 3D objects, dynamic features were described as key requirements by both the DoD and the EI.

Higher-Level SE Creation Tools

Tools that allow the rapid specification of polygonally-defined and textured worlds at a relatively high-level were mentioned repeatedly at the workshop.

- The lack of such tools for virtual environments is also mentioned in a previous NRC study [the NRC VR report].

Automatic synthetic environment creation

There is a desire in DoD and EI for tools that work at a higher level than polygons.

- There is a desire for tools that automate synthetic environment generation.
- The NRC report on VR lists these same desires.

Carrying Out the Collaboration

The main human resource issue is that there is an apparent shortage of talented, high-quality, experienced people to develop virtual environments, modeling and simulation software, digital animation, design, and scripting of virtual worlds.

The shortage of content developers ...

This is a shortage that is seen by both the DoD and EI.

Programmers with content development experience, programmers familiar with the technical problems of multiplayer/multiprocessor games and simulations are just not to be found.

Cross-disciplinary skill-sets

And the people sought are not just engineers and computer scientists.

They are programmers and content developers with cross-disciplinary skills.

- Such skills enhance the quality of virtual world development and the implementation of such cutting-edge technologies.

Interdisciplinary Infrastructures

Interdisciplinary university infrastructures, with degrees we have never seen before, need to be constructed to solve this human shortfall.

- We need people graduating with BS, MS and PhD degrees in subjects like modeling, virtual environments and simulation, electronic storytelling, ...

Carrying out the research agenda ...

The research base of the United States has at its bottom government funding.

In order to carry out the research charter between the EI and DoD, that funding may need to be delivered differently than such funding is now.

Setting research directions

In the workshop, it was pointed out that research funding today is quite different than 20 years ago.

Government funded projects are now more product-oriented than they used to be.

A return to the days of yesteryear ...

If we can return to the days of when we regarded university-trained people as the product of our funded programs, then our country will benefit tremendously.

Funding which is less product-oriented and more open-ended will also allow a greater amount of creative and innovative research.

Revolution in the university ...

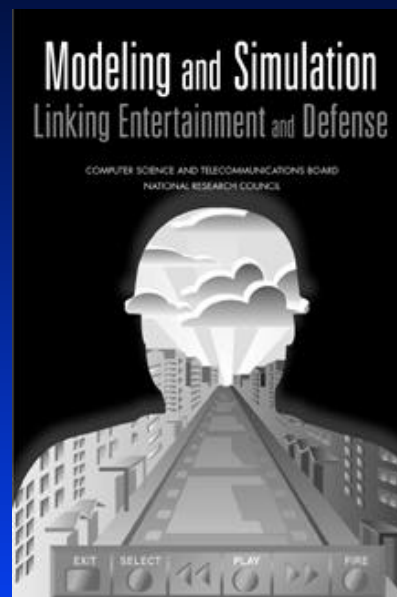
Our technology revolution is producing whole new careers and vocations which cannot be ignored.

Some of these technologies are taking us into unknown territory where crossing disciplines and university revolutions become necessary.

Where to get the report ...

***Modeling &
Simulation: Linking
Entertainment &
Defense***

ISBN 0-309-05842-2



Web site

NRC Report Web Site

<http://www.nap.edu/readingroom/books/modeling>

Send me email and I will send you the pointer:

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