2

History of virtual reality

The ideas behind immersive and interactive environments

Étienne Peillard
IMT Atlantique

COURSE NOTES

VR developed through several converging histories: surrounding images, depth perception, simulation, tracking and interactive computation. Following these developments shows how the experience of a represented world changed as spectators gained new ways to perceive and act.

Course outline

Illusion and representation

2.1

Depth and multisensory media

2.2

Interactive simulation

2.3

Research and commercial systems

2.4

Diffusion and recurring questions

2.5

COURSE NOTES

VR developed through several converging histories: surrounding images, depth perception, simulation, tracking and interactive computation. Following these developments shows how the experience of a represented world changed as spectators gained new ways to perceive and act.

The sequence connects the following topics: Illusion and representation ; Depth and multisensory media ; Interactive simulation ; Research and commercial systems ; Diffusion and recurring questions.

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Part 1 of 5

2.1

Illusion and representation

COURSE NOTES

Immersive media have a cultural history beyond computing. The cave is an analogy about appearances and knowledge, not an early technical VR system. Theatre, perspective and staged environments demonstrate attempts to shape a spectator's relation to a represented world. Keep these conceptual precedents distinct from tracked interactive systems.

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2.1 Illusion and representation

Immersion before computers

Perspective

Organising a view

Enclosure

Occupying the visual field

Staging

Directing attention



Teatro Olimpico: architecture and staged perspective



Plato's cave as an analogy about perception

COURSE NOTES

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Total theatre

Audience position

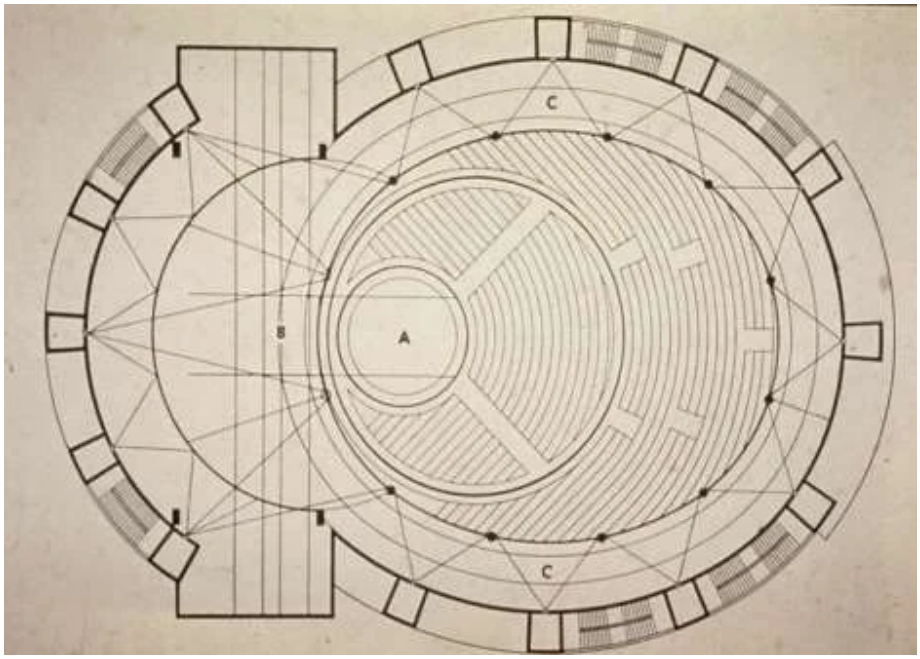
A designed viewpoint

Stage and projection

A surrounding scene

Collective experience

An audience shares a place



Gropius and Weininger: proposals for immersive theatre

COURSE NOTES

The Total Theater proposal and spherical theatre experiments extend the relationship between architecture, projection and the audience. Artaud is relevant to the cultural use of virtual reality language. The point is the continuity of questions about space and spectatorship, not a claim that these projects implement modern VR.

Panoramas

Continuous image

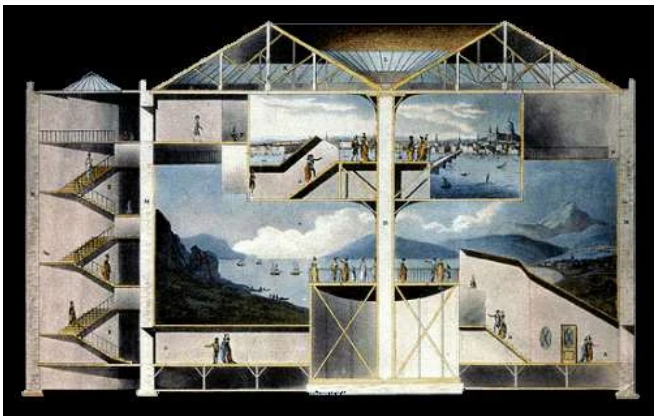
A surrounding painted scene

Viewing platform

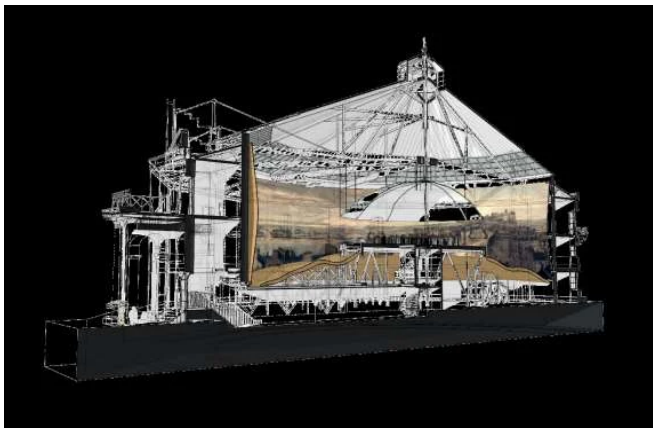
A controlled observer position

Concealed boundary

Lighting and foreground disguise the frame



Barker’s panorama

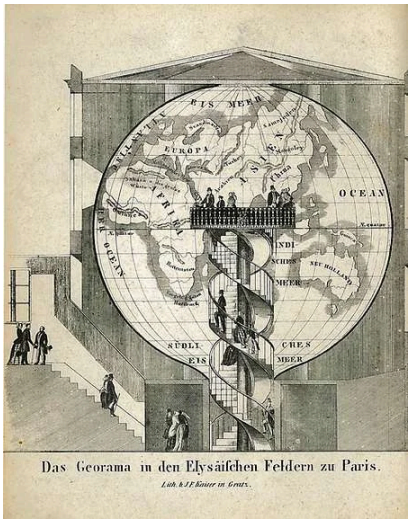


A panorama building and its viewing geometry

COURSE NOTES

A panorama combines a cylindrical image, a viewing platform, an access route and sometimes a three-dimensional foreground. These elements conceal the boundaries of the representation and organise the spectator’s viewpoint. The spectator can turn to inspect the surrounding scene, but the painted perspective does not update when they move away from the intended viewing position.

Globes and panoramic buildings



Historical globe attraction



A panoramic building

COURSE NOTES

The Georama and Great Globe turn a represented territory into an architectural experience. Their scale and controlled circulation are part of the medium. Compare them with later projection rooms: all create a spatial interface, but only some update imagery according to an observer’s tracked position.

Moving panoramas

Moving scenery

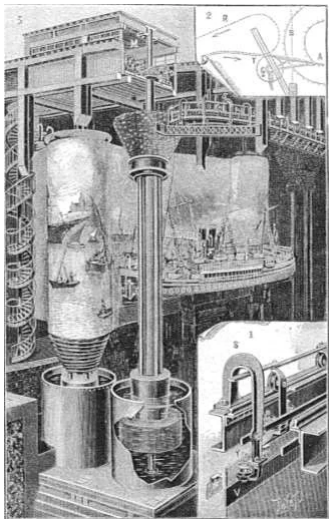
A journey without travelling

Physical staging

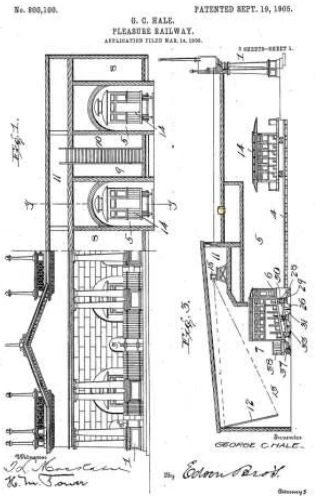
A ship, carriage or viewing platform

Multisensory illusion

Images combined with motion cues



Maréorama at the 1900 Paris exposition

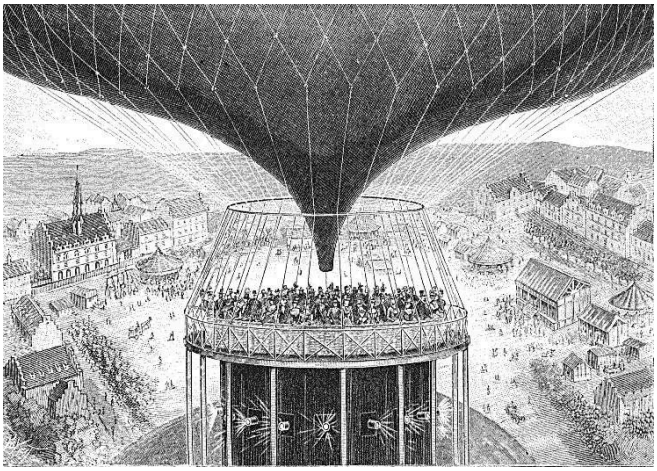


Hale’s Tours: a staged railway journey

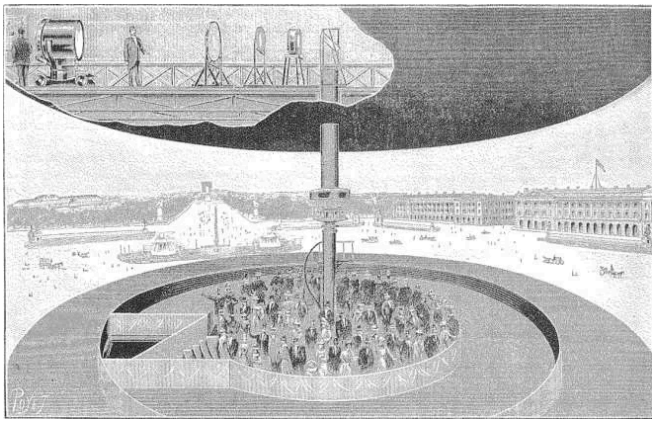
COURSE NOTES

Moving panoramas, the Maréorama, Trans-Siberian panorama and Hale’s Tours place spectators inside a simulated journey. The Cinéorama and Photorama explore surrounding projection and panoramic photography. Distinguish a documented proposal or exposition attraction from a technically reliable operating system; historical narratives can simplify those differences.

Circular projection



Cinéorama: a circular projection arrangement



Photorama: panoramic photography and display

COURSE NOTES

These systems distribute images around an audience. Their engineering problems include field of view, seams, synchronisation and collective viewing. Those problems recur in immersive rooms, even though the content generation and tracking methods differ considerably.

Lanterns, projection and apparent space

Light and image

A scene appears beyond its carrier

Audience position

The viewing arrangement shapes the effect



A historical projected-image illustration

COURSE NOTES

The magic lantern projects an image onto a surface, enlarging it and placing it within a staged space. Lighting, projection surfaces and the audience’s position influence how the image is experienced. The illusion is produced by the arrangement of the physical apparatus and the image; it does not require head tracking or an interactive computer simulation.

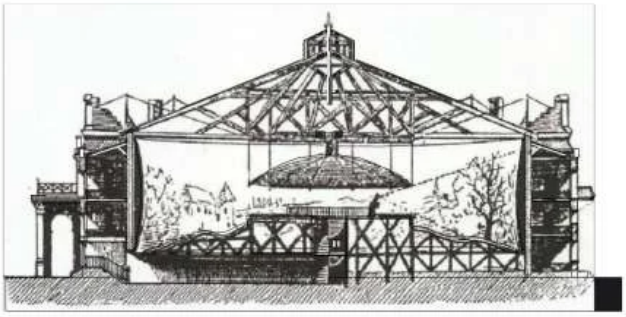
Panorama: image and architecture



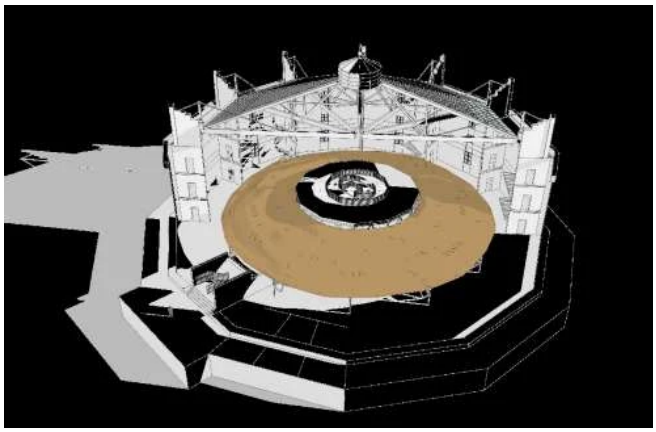
A surrounding landscape



A painted panorama



A panorama in section



The viewing platform and foreground

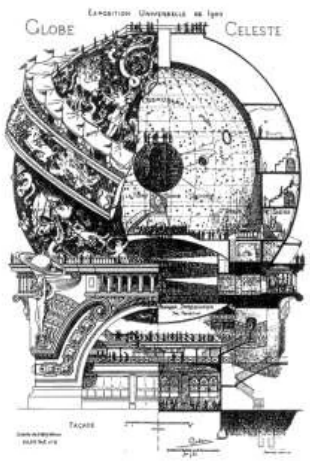
What hides the boundary of the image?

COURSE NOTES

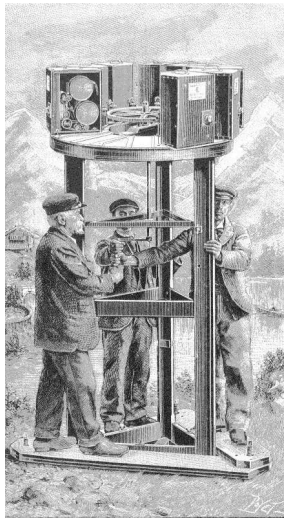
The image and the architecture work together. The cylindrical enclosure surrounds the spectator, while the access path limits advance views of the apparatus. A physical foreground can connect the viewing platform to the painted distance. The impression of a continuous space depends on the transition between these elements and on where the spectator stands.

2.1 Illusion and representation

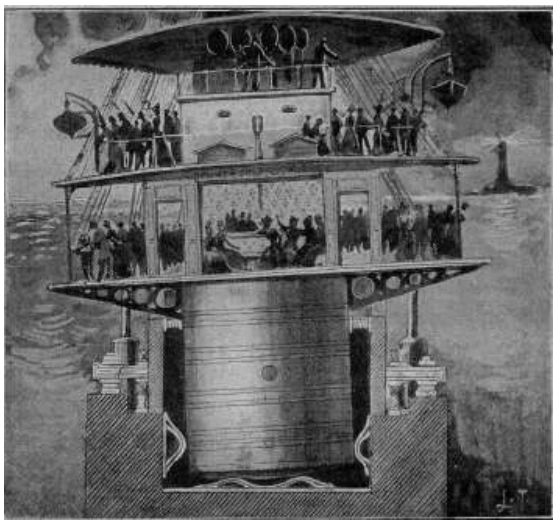
Panoramic journeys at the 1900 exposition



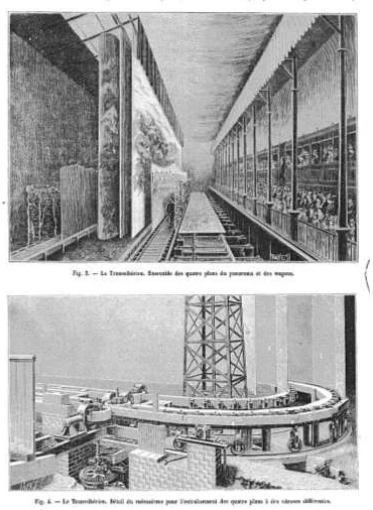
The exposition setting



Cinéorama apparatus



Maréorama staging



The Trans-Siberian panorama

> Which elements move: the image, the platform or the audience?

COURSE NOTES

A simulated journey can combine moving imagery, a vehicle-like enclosure and bodily cues. Movement may come from the image, the platform or their combination. The spectator’s actions usually do not determine the route. These attractions distinguish the sensation of travelling from the ability to navigate freely through a represented space.

2.2

Depth and multisensory media

COURSE NOTES

A stereoscope presents a different image to each eye. Their differences provide binocular disparity and can produce an impression of depth. The images remain fixed, however: moving the head does not reveal a new viewpoint on the represented objects. Stereoscopic depth and viewpoint-dependent rendering are therefore two distinct contributions to a spatial experience.

The stereoscope

Two images

A separate view for each eye

Binocular disparity

A cue to depth

A fixed viewpoint

Limited response to movement



Historical stereoscopic viewing



View-Master

COURSE NOTES

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Individual viewing devices

Kinetoscope

Individual moving-image viewing

Mutoscope and Kinora

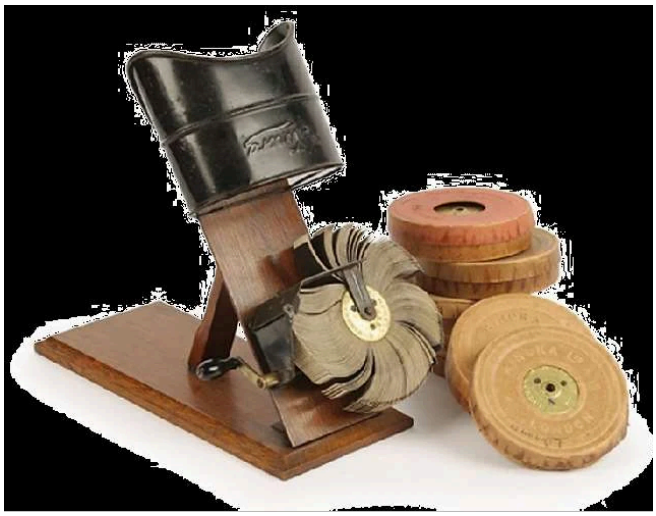
Mechanical image sequences

Headset viewing

A later personal display arrangement



Edison-era individual film viewing



Kinora viewing device

COURSE NOTES

Personal viewing devices isolate an image for one observer, whereas collective cinema organises a shared viewing space. This difference concerns posture, access to the image and awareness of other spectators. It does not by itself determine whether the scene is interactive or follows head movement. Individual viewing, stereoscopy and tracking are separate design choices.

Stereoscopic cinema

Projection

Separate channels for the eyes

Optical separation

Filters or active shutters

Audience

Shared content and a constrained viewpoint



Stereoscopic cinema

COURSE NOTES

Stereoscopic cinema provides binocular disparity to an audience. It usually does not render a separate perspective for every person as they move. This limitation will explain why multi-user stereoscopic projection is more complicated than displaying a single stereo image pair.

Sensorama

Vision and sound

An enveloping recorded experience

Additional cues

Motion, airflow and smell

Limited interaction

The recorded events remain fixed



Morton Heilig's Sensorama

COURSE NOTES

Heilig's Sensorama combines several sensory channels in a dedicated viewing device. The sequence can surround the spectator with coordinated stimulation without allowing continuous manipulation of the represented world. This distinction separates multisensory richness from interactivity: an experience can stimulate several senses while following a predetermined sequence.

Personal optical media



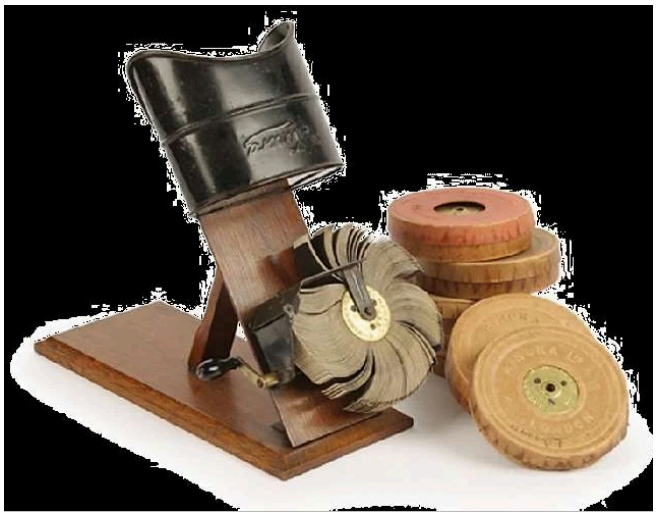
Wheatstone-style stereoscopic viewing



A stereoscopic viewing instrument



Mutoscope



Kinora

> A personal display does not imply an interactive world

COURSE NOTES

An individual optical device controls how the image reaches the eyes: viewing distance, optical separation and the visible frame. Still images and moving sequences can use similar viewing arrangements while offering different temporal experiences. The enclosure directs attention toward the representation, but does not necessarily allow the observer to act on it.

Optical and spatial milestones

Date	Example	Main contribution
1787	Barker’s panorama	A surrounding depicted place
1838	Wheatstone’s published stereoscope paper	Separate images and binocular depth
1900	Paris exposition panoramas	Architecture, projection and staged travel
1939	View-Master	A portable stereoscopic viewing format

Wheatstone’s 1838 paper ↗

COURSE NOTES

The table places selected examples in chronological order. Wheatstone developed his work earlier in the 1830s and published the binocular-vision paper in 1838. These milestones are not an exhaustive list of inventions. Each illustrates a different contribution to how a person experiences a represented scene.

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Part 3 of 5

2.3
Interactive simulation

COURSE NOTES

Training created a strong motivation for simulation. Early devices combined cockpit controls and motion before rich real-time computer imagery was available. Later systems used cameras above physical models and then graphics generated from the simulated viewpoint. Each development expanded which conditions could be practised without using the actual vehicle.

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2.3 Interactive simulation

Flight simulators

A real task

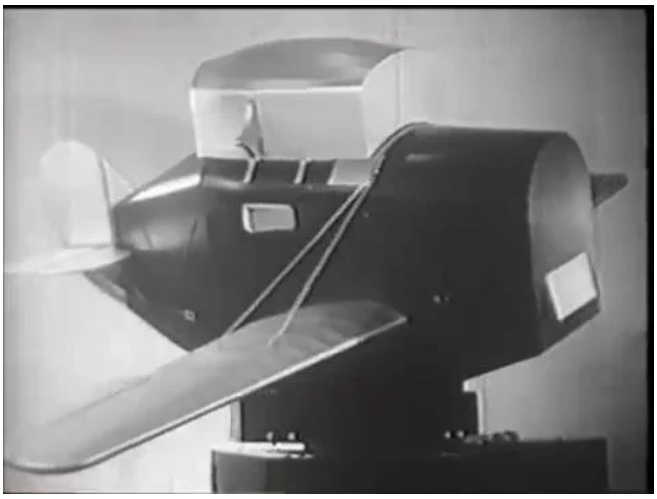
Practise control of a vehicle

A physical cockpit

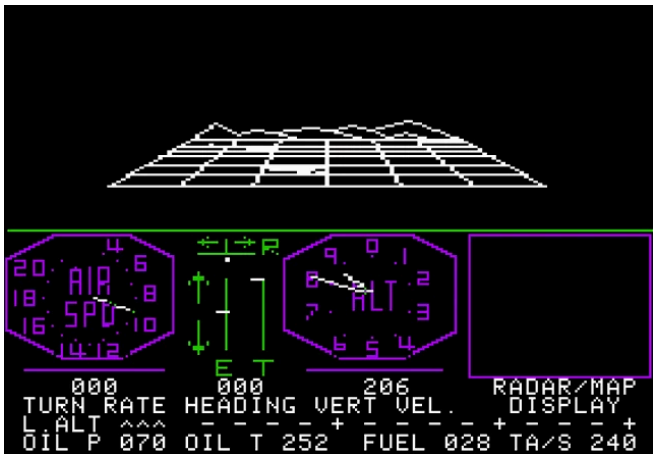
Controls and motion

An evolving visual system

Models, cameras and computer graphics



Link Trainer



Early computer-generated airport imagery

COURSE NOTES

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Link Trainer archive



Link Trainer archive

Watch the video ↗

COURSE NOTES

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Head tracking and head-mounted displays

Tracked orientation

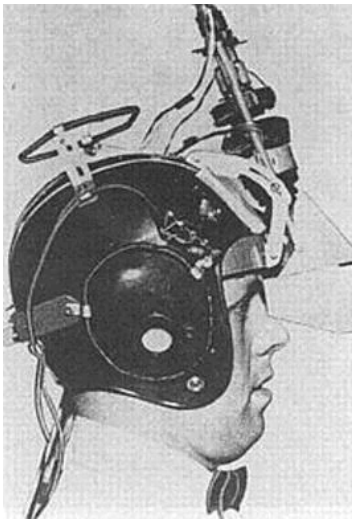
The view responds to the head

A personal display

Images close to the eyes

Generated imagery

A simulated scene



Philco Headsight



Sutherland’s head-mounted display

COURSE NOTES

Headsight used camera imagery and head-related control. Sutherland’s system combined stereoscopic computer graphics with tracked viewing. The often-reproduced Sword of Damocles illustrates both the potential and the mechanical constraints of early systems. Its optical arrangement also connects the history of VR with see-through augmentation.

Sutherland’s research vision

Sketchpad

Interactive graphical construction

The Ultimate Display

A computational world that responds

Beyond reproduction

Physically impossible virtual behaviour



Sketchpad and interactive graphics

COURSE NOTES

Sketchpad demonstrates interactive manipulation of graphical structures. The Ultimate Display text describes a broader vision of a computer-mediated environment that could respond to action and potentially exceed physical reality. Treat this as a research vision rather than a list of features that the contemporary apparatus already delivered.

Aerospace and NASA systems

Pilot information

Simulation and augmented displays

Tracked body input

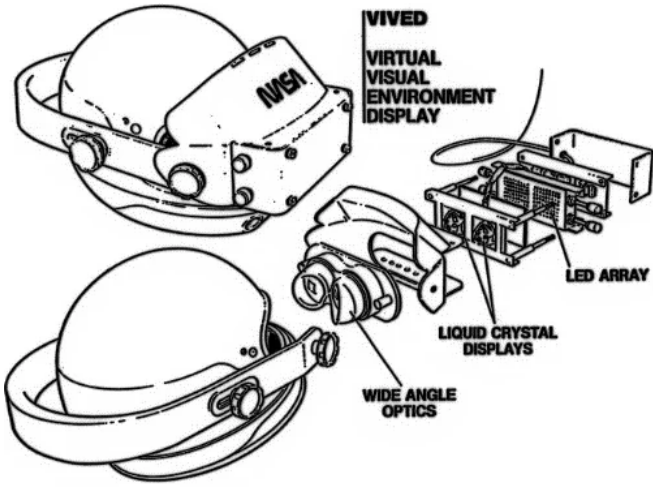
Gloves and head movement

Integrated interfaces

Display, tracking and interaction



Aerospace head-mounted displays



NASA’s VIVED research system

COURSE NOTES

Military and aerospace research helped integrate displays, tracking and control interfaces. NASA’s VIVED work illustrates the convergence of these technologies into a recognisable immersive system. Development depended on collaboration across graphics, sensing, human factors and application domains.

NASA’s virtual-environment research



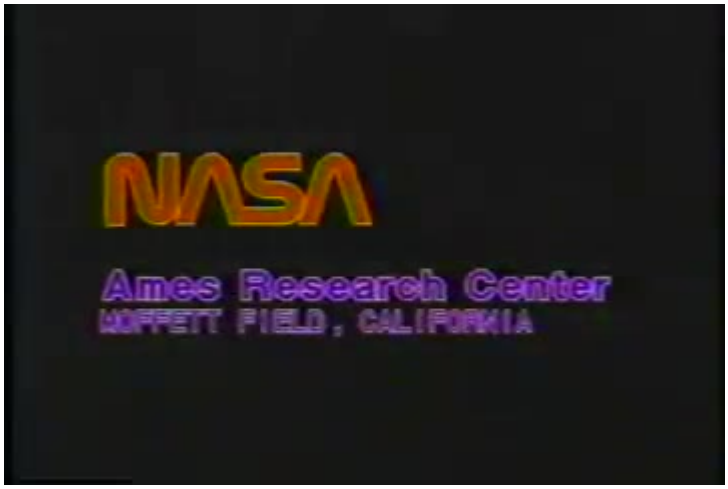
NASA head-mounted display research

COURSE NOTES

The NASA Ames demonstration brings together sensing, visual display and interaction in a single environment. The important relationship is between the participant’s movement and the simulated response. Head-related viewing and instrumented actions make the environment responsive, rather than simply presenting a recorded scene. The system illustrates the integration required to close the perception–action loop.

2.3 Interactive simulation

NASA Ames archive



NASA Ames archive

Watch the video ↗

COURSE NOTES

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Part 4 of 5

2.4

Research and commercial systems

COURSE NOTES

VPL’s work connects head-mounted viewing with instrumented interaction. The participant is represented through measured movements rather than only through commands entered at a keyboard. Jaron Lanier and Thomas Zimmerman helped bring these interfaces into commercial and cultural discussions of VR. The development concerns both the devices and the ambition to act and communicate within shared simulated worlds.

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2.4 Research and commercial systems

VPL and instrumented interaction

Data gloves

Capture aspects of hand movement

Commercial systems

Dedicated hardware and software

Public language

“Virtual reality” enters wider circulation



VPL and early commercial VR interfaces

COURSE NOTES

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The CAVE

Room-scale projection

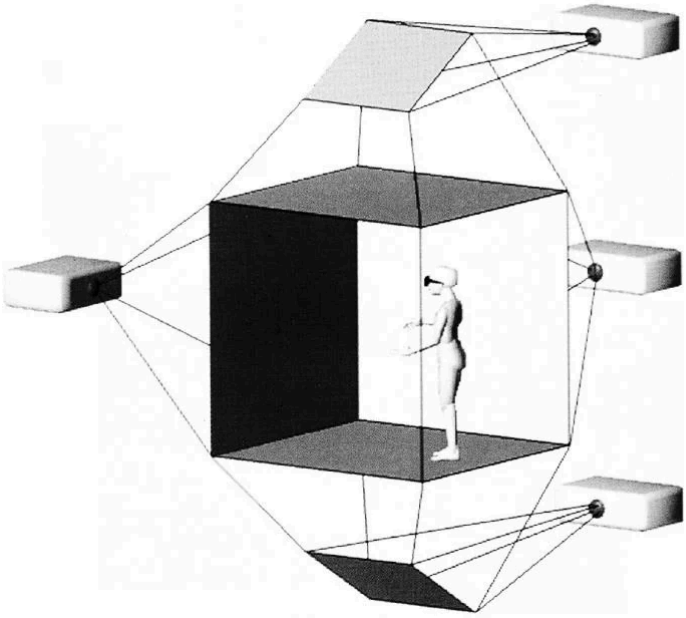
A surrounding visual environment

Tracked viewpoint

Images adapt to the observer

Visible physical body

A different relation to the room



The CAVE projection arrangement

COURSE NOTES

The CAVE exemplifies an alternative to head-mounted displays. Its images depend on the tracked viewer, and a single stereo pair does not provide correct perspective for an arbitrary number of independently moving users. Discuss shared physical space, peripheral vision, installation cost and interaction opportunities.

Immersive projection demonstration



Immersive projection demonstration

Watch the video ↗

COURSE NOTES

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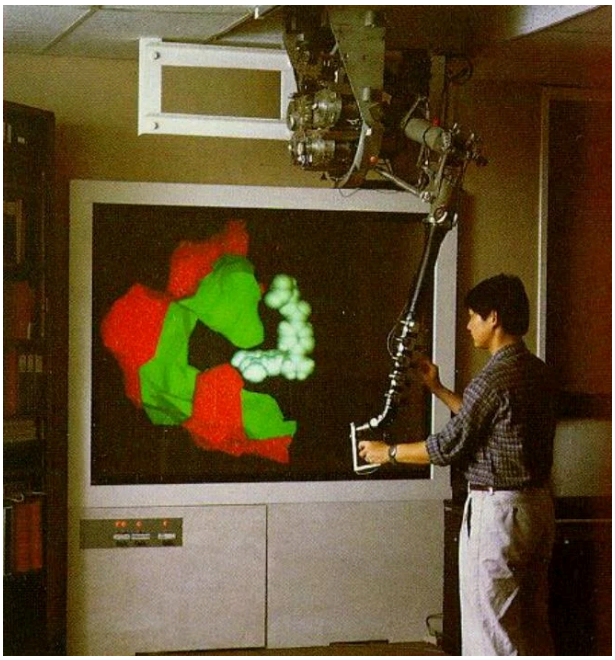
Haptic and auditory research

GROPE

Force feedback for molecular interaction

Spatial audio

Sound sources tied to the virtual world



GROPE: early force-feedback research

COURSE NOTES

Early force-feedback research explored the manipulation of structures that are difficult to understand visually. Spatial audio work added sound sources that remained located in the world as the head moved. These histories show that VR developed as a multisensory field, even when public narratives focus on displays.

Early consumer systems

Arcades

Dedicated experiences and installations

Home products

Games and experimental peripherals

Constraints

Cost, tracking, content and comfort



Examples from the early consumer wave

COURSE NOTES

The comparison groups arcade systems, consumer headsets and game peripherals as an early commercial wave. Their capabilities were unequal. Commercial difficulty cannot be explained by a single technical parameter: cost, useful content, usability and uncomfortable experiences all mattered.

2.4 Research and commercial systems

Early commercial hardware



Sega VR



Early immersive game imagery



Virtuality arcade installation



An early consumer headset and controller

> Different products exposed different parts of the action–perception loop

COURSE NOTES

Early commercial systems explored different combinations of headsets, controllers and dedicated installations. Their usefulness depended on the interaction they supported, the available content and the conditions of use. A system suited to a short arcade session did not necessarily suit prolonged work at home. Tracking, comfort, cost and ease of installation all shaped adoption.

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Part 5 of 5

2.5

Diffusion and recurring questions

COURSE NOTES

Expectations can rise faster than reliable applications and everyday use. The hype-cycle diagram offers a way to discuss that gap; it is not a law predicting a fixed trajectory for every technology. Adoption depends on the relationship between promised benefits, actual performance, cost and useful activities. Visibility in the media and sustained use are different indicators.

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2.5 Diffusion and recurring questions

Expectations and adoption

Research promise

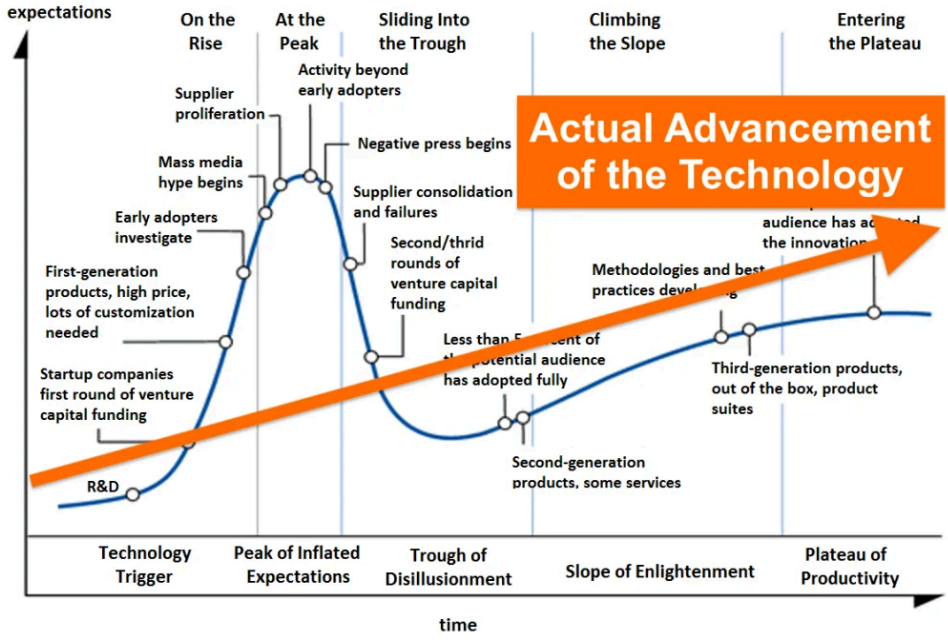
What a system might enable

Product experience

What users can actually do

Adoption

Value in a particular context



The hype cycle as a discussion model

COURSE NOTES

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The 2010s consumer wave

Personal displays

Consumer headset development

Tracked spaces

Room-scale head and hand movement

Mobile and standalone

Different computing arrangements



Consumer headset generation



Early standalone headset examples

COURSE NOTES

The consumer wave of the 2010s brought together several architectures: a headset connected to an external computer, a smartphone used for display and computation, and a standalone headset. These arrangements distribute computation, tracking and input differently. Portability, available computing power, installation requirements and supported interactions vary with that distribution.

Shared immersive architecture

Naexus

A large panoramic installation

Coraulis

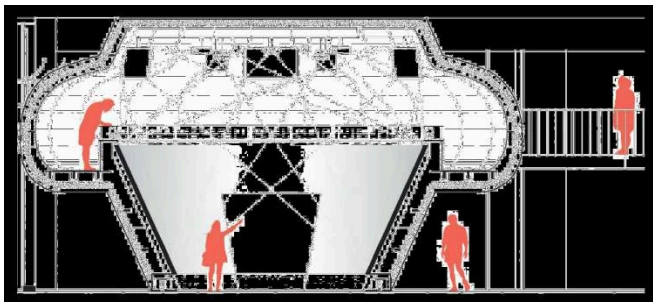
A collective immersive space

Design question

Who shares the viewpoint and the room?



Naexus



Coraulis: structure and immersive space

COURSE NOTES

An immersive installation is also an architectural arrangement. Circulation, visibility, sound and relations between spectators shape the experience. A physically shared room gives participants access to one another's bodies and actions; a networked virtual world connects participants through representations and shared digital state. Sharing a location and sharing a simulated world are different properties.

Fiction and expectations

A represented world

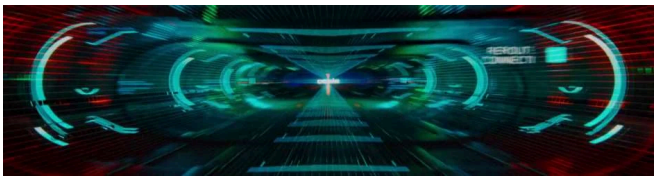
The boundary as a narrative device

A virtual identity

Another body or social role

A return

The physical setting remains relevant



Ready Player One



The Thirteenth Floor

COURSE NOTES

Pleasantville, The Matrix, Ready Player One, The Lawnmower Man, Total Recall, The Thirteenth Floor and The Wizard of Oz explore boundaries between experienced worlds. Their stories raise questions about identity, control and the ability to enter or leave an environment. These fictional situations shape expectations of VR, while implemented systems remain constrained by their interfaces, computation and physical setting.

Consumer VR: computing and tracking arrangements



Oculus-era consumer headset



Headset, controllers and external infrastructure



Smartphone-based viewing



A standalone headset example

> Display, tracking and computation are separate design choices

COURSE NOTES

A headset is only one part of the system. Computation may be embedded or external; tracking may rely on external infrastructure or sensors carried by the device. Controllers add another set of measurements and actions. These arrangements determine where the system can be used and how much setup it requires, independently of the headset's outward appearance.

Interactive-system milestones

Period	Example	Main contribution
1960s	Head tracking and generated imagery	An image linked to a moving observer
1980s	NASA and VPL systems	Integrated displays and bodily input
1992	The CAVE	Immersive projection as an alternative
2010s	Consumer and standalone systems	New combinations of cost, tracking and computing

Sutherland archive at the Computer History Museum ↗

COURSE NOTES

The chronology relates major developments in simulation, tracking and interactive display. Sutherland's tracked head-mounted display dates to 1968. The timeline groups related systems into periods rather than claiming a single invention or a uniform commercial success.

The later consumer wave includes several computing and tracking arrangements.