

# HoloVizio

*The world first glasses-free 3D cinema system*

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[www.holografika.com](http://www.holografika.com)

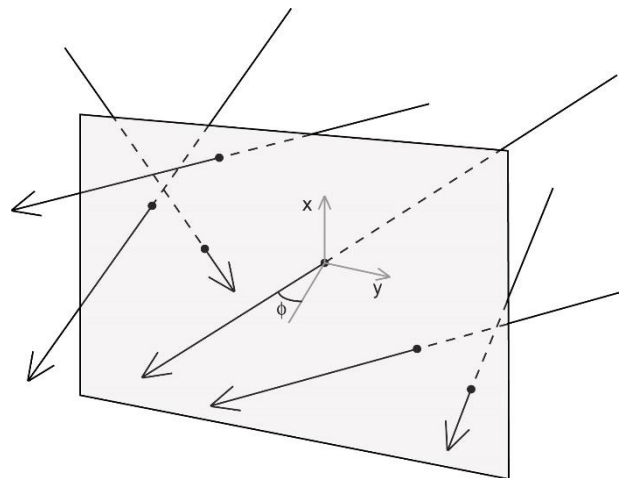
# 3D Displaying basic rules

- The goal of displaying is to provide perfect representation of real/syntetic scenes
  - life-like view
  - the ultimate display will be like a window...
- True 3D displaying - reconstructing the **light-field** as present in the natural view
  - producing light beams with the same parameters the human perception is capable to process: direction, position, intensity, color (*but polarization, phase*)
  - „...Let the display work, not the brain...”



# Light Field

- General representation of 3D information that considers a 3D scene as the collection of light rays that are emitted or reflected from 3D scene points. (M. Levoy, and P. Hanrahan, "Light Field Rendering", 1996.)
- The visible light beams are described with respect to a reference surface (screen) using the light beams' intersection with the surface and angle.
- The LF is defined as a function of position (2 parameters) and direction (2 parameters):  $L(x,y,[z],\Theta,\Phi)$

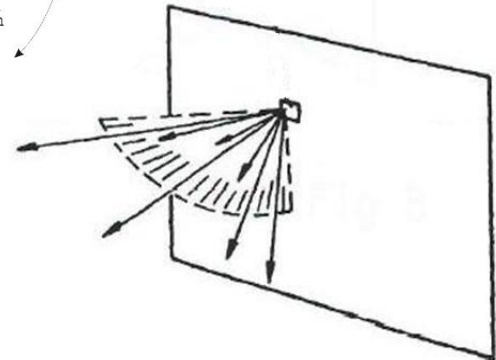
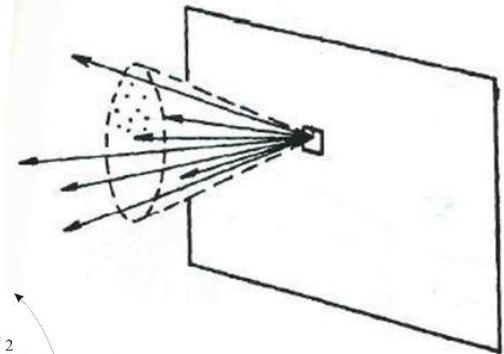
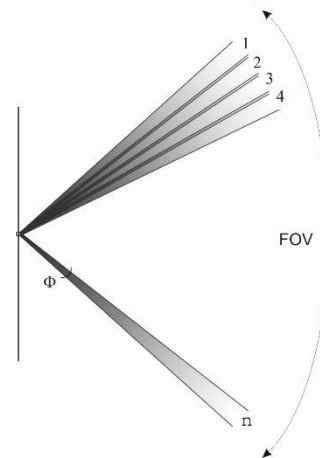


# 3D Displaying basic rules

- Additional independent variant to X, Y :  $\Phi$ 
  - emission range - FOV
  - number of independent beams in the range – Angular resolution ( $\phi$ ) determining FOD

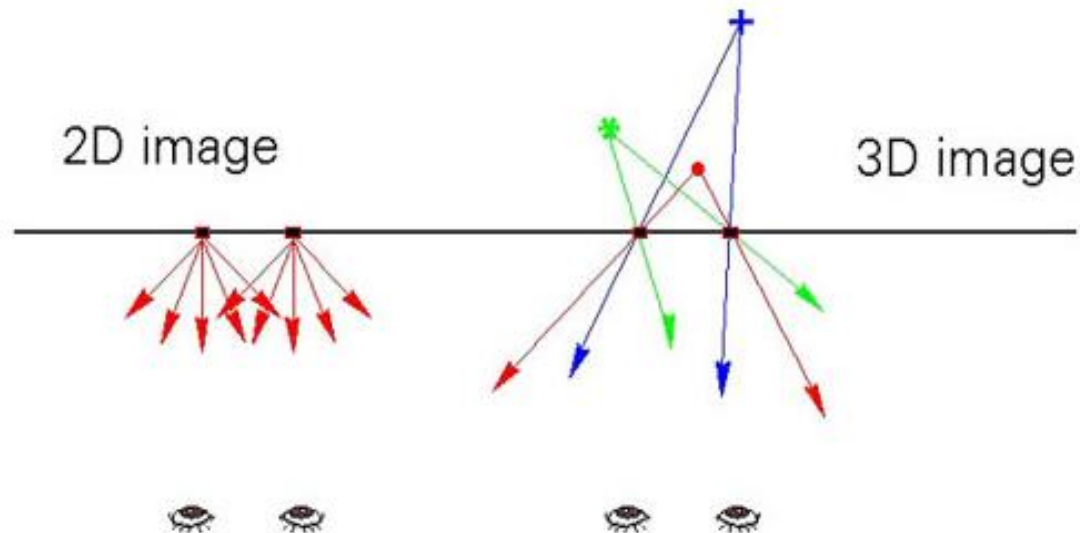
$$\text{FOV} / n = \phi$$

- Vertical / horizontal parallax
  - reducing the number of beams by omitting the vertical parallax
  - systems with different horizontal and vertical angular resolution – HOP systems



# 3D Displaying basic rules

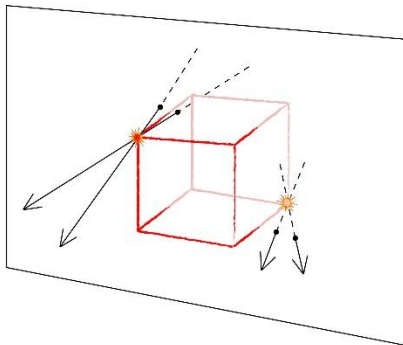
- Direction selective light emission
  - common for all systems having a screen, conforming with current displaying conventions (also for the outer surface of volumetric systems)
- General approach: to create a light emitting surface, where we are able to emit different light beams from each point in a controlled way - defining the output



# Objective – subjective displaying

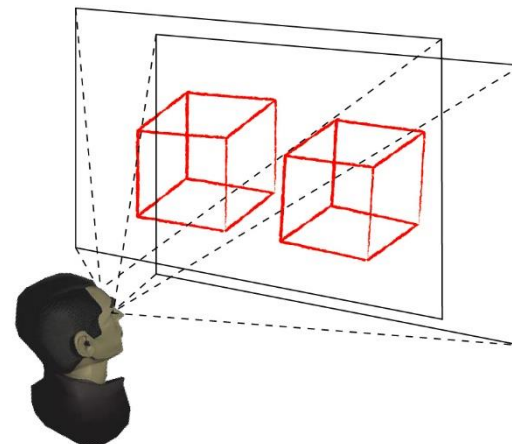
## Light field

- 3D scene centric
- Viewer independent, spatial positions addressed, no contradictions
- Unlimited number of freely moving viewers by nature
- Continuous and correct parallax in the FOV
- FOD function of the angular resolution
- Inherent 3D approach



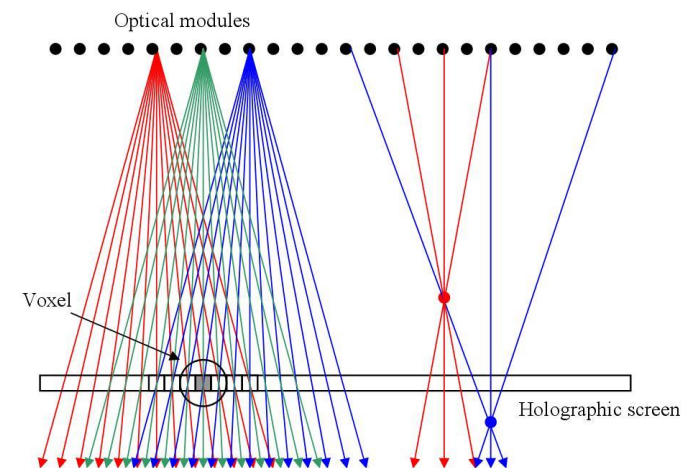
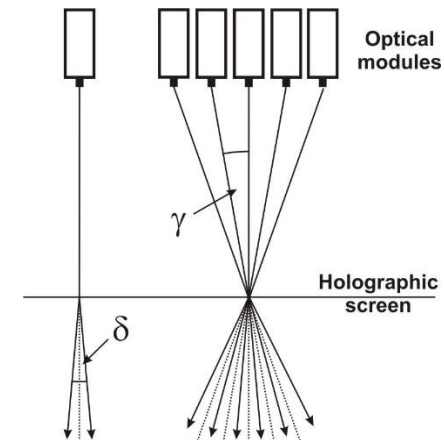
## View based

- Viewer centric
- Viewer position dependent view, contradictions – health risks
- Single viewer, or positioning (sweet point), or tracking
- jumpy character (borders btw discrete views) or limited FOV, invalid zones
- in the practice flat layered demos only
- Philosophically coming from 2D



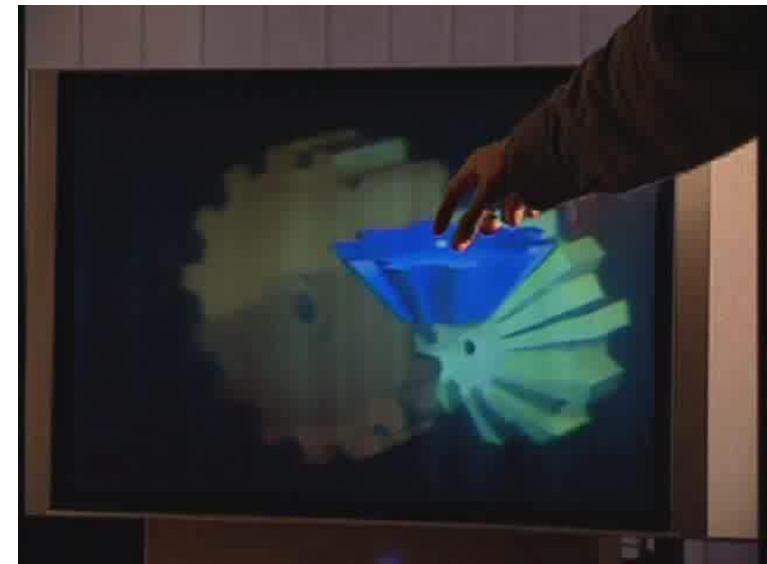
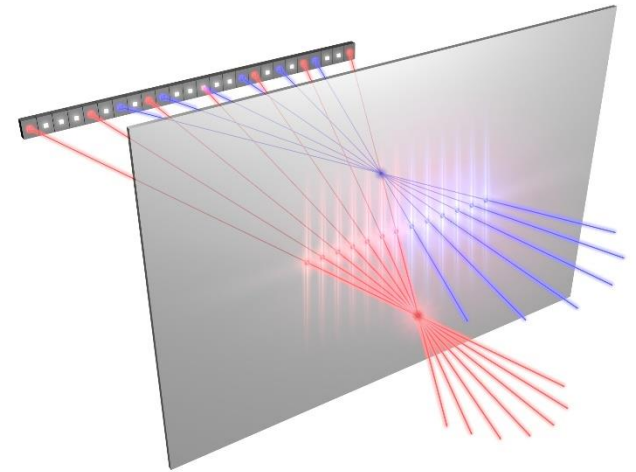
# HoloVizio system

- Optical modules
  - project light beams to hit the points of a screen with multiple beams under various angles of incidence
- Holographic screen
  - direction selective property
  - the screen diffusion angle  $\delta$  is equal to the angle  $\gamma$  between the neighboring modules
- Emission angle geometry determined
  - no optical road-blocks like at Fresnel, or lenticular lenses



# HoloVizio system

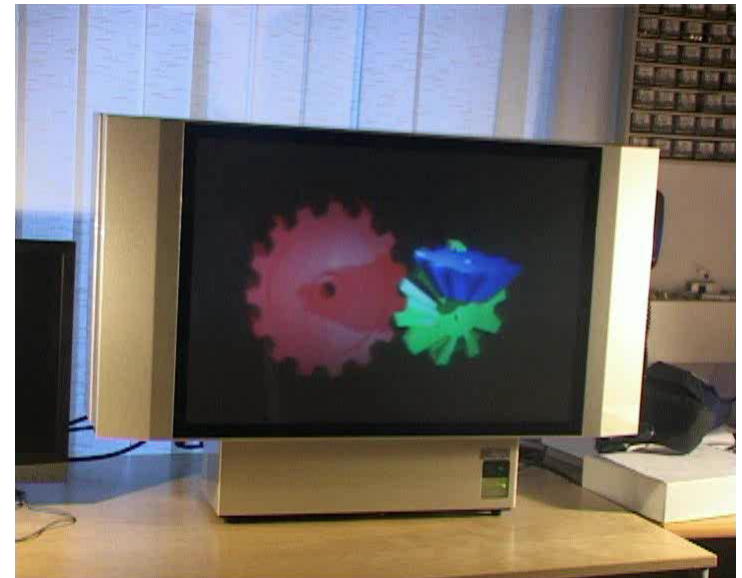
- Light field reconstruction instead of views, specific distributed image organization
  - the projected module image not a 2D view of the final 3D image
  - each view of the 3D image comes from more modules
  - continuous motion parallax - no discrete border between views





# HoloVizio displays

- The HoloVizio monitors
  - **HoloVizio 128 WD, WLD**  
10 Mpixel, 32" (16:9)
  - 50 degrees FOV
  - angular resolution 0.8 degrees
  - 2D equivalent image resolution 512x320
  - up to 4 DVI inputs



# HoloVizio displays

- The large-scale HoloVizio systems
  - **HoloVizio 640RC, 720 RC**  
50 Mpixel, 72", (16:9)
  - 50–70 degrees FOV
  - angular resolution 0.9 degrees
  - 2D equivalent image resolution  
1344x768
  - Dual Gigabit Ethernet input
  - Control system+PC based render cluster



# HoloVizio displays

- The digital signage HoloVizio kiosk system
  - **HoloVizio 240P**  
11,5 Mpixel, 45" standing format
  - 40 degrees FOV
  - 2D equivalent image resolution  
600 x 800
  - LED colors
  - Gigabit Ethernet input
  - Control system + 3 PC
  - Easily adaptable for various installations



Make  
**CROWD**  
with  
HoloVizio 3D display!

CeBIT 2009

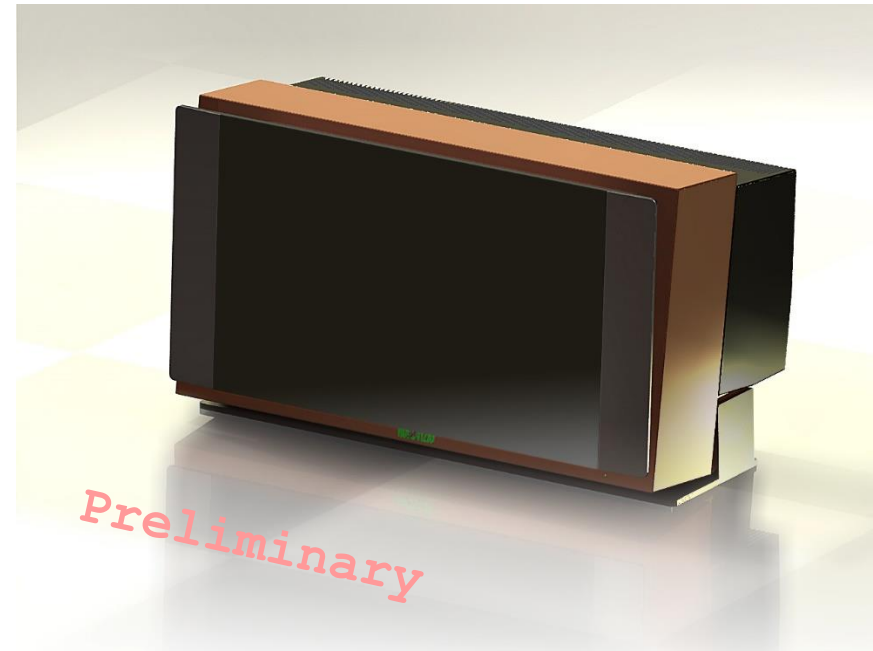
# HoloVizio displays

- The open architecture HoloVizio monitor
  - **HoloVizio 64WLT**  
60 Mpixel, 43" (16:9)
  - 50 degrees FOV
  - 2D equivalent image resolution  
1280 x 768 (WXGA)
  - LED colors
  - 9 mm screen thickness
  - Multiple DVI inputs



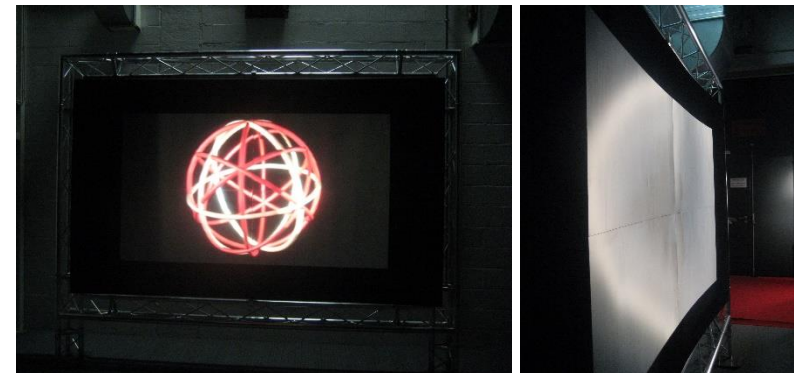
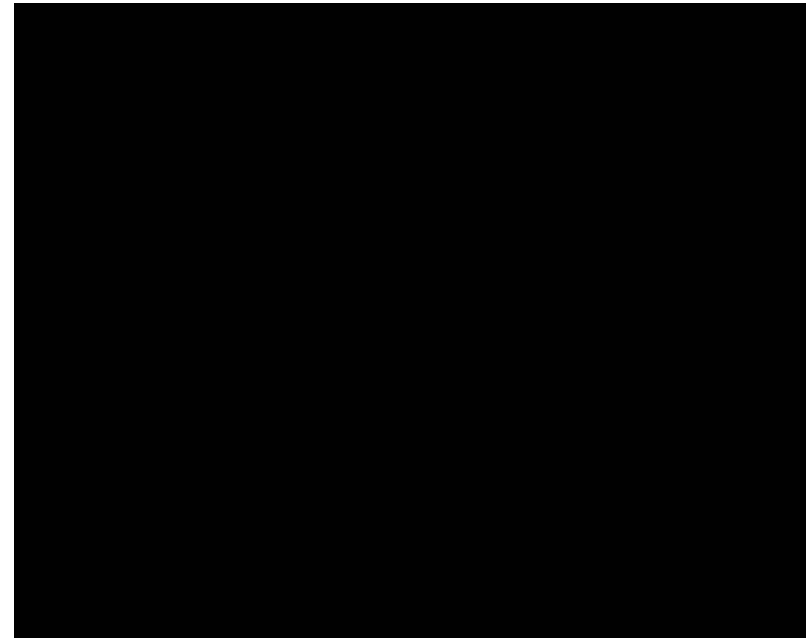
# HoloVizio displays

- The full angle HoloVizio monitor
  - **HoloVizio 80WLT**
    - 78 Mpixel, 30" (16:10)
    - 180 degrees FOV
    - total freedom 3D experinece, no invalid zones, no repeated views
  - 2D equivalent image resolution 1280 x 768 (WXGA)
  - LED colors
  - Multiple DVI inputs



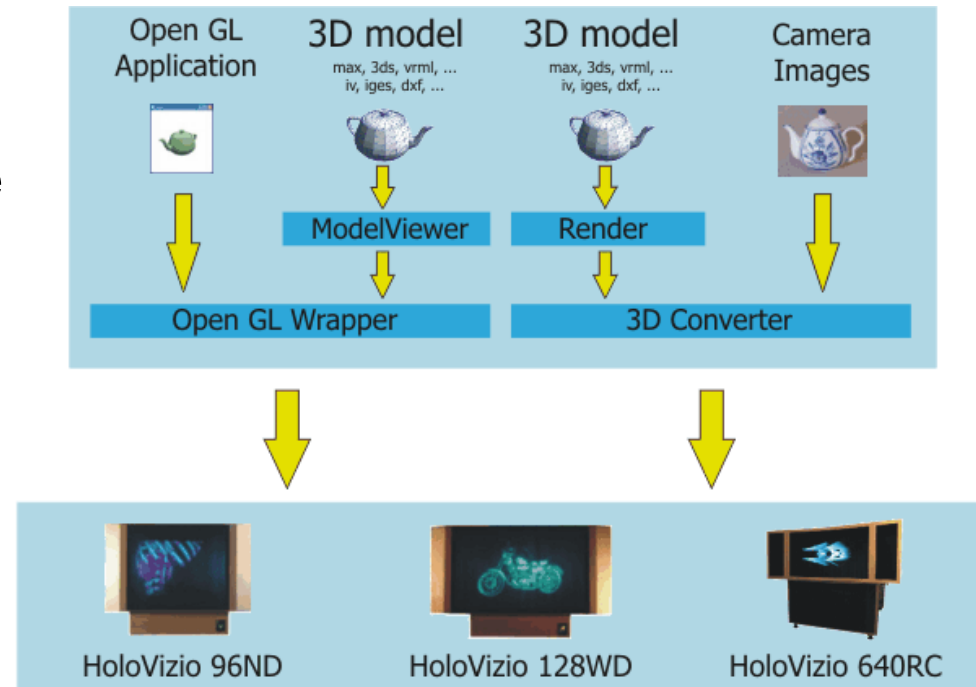
# HoloVizio displays

- The world first glasses-free 3D cinema system
  - **HoloVizio C80**
    - 3,5 m dia reflective HoloScreen (140")
    - no glasses, no optical contradiction
    - LED based 3D projection unit
    - exceptional 1500 Cd/m<sup>2</sup> brightness
    - 40 degrees FOV
    - 2D compatible
    - Fitting cinema rooms, 3D simulators



# HoloVizio software system

- Integrate existing applications
  - OpenGL Wrapper
- Display 3D models in Real-time
  - ModelViewer (OpenGL Wrapper)
- Display pre-rendered 3D models/scenes
  - rendering - converting to 3D
- Display real-life 3D scenes
  - capturing - converting to 3D





# 3D Light Field Content

## 3D scene representations

- Model based (geometry aware)
- Image based
  - 3D image / video input formats
    - Large number of image streams (~100)
      - „Hi-fi”
    - Fewer image streams (9-21)
      - interpolation, extrapolation
      - quality vs. real time
  - Few image streams + depth streams
    - fast, real-time rendering



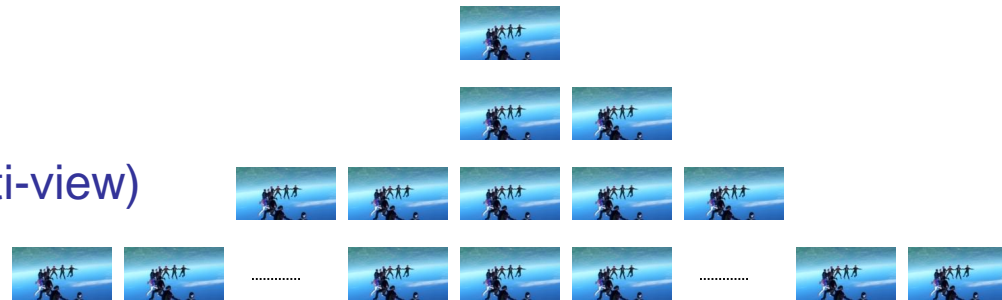


# 3D Light Field Content

## 3D scene representation

- Scalability

- 2D
- 2 View (stereo)
- Narrow angle (few-view, multi-view)
- Wide angle (Light Field)

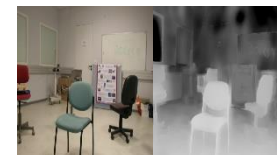


- Compatibility

- 2D
- conversion into various 3D formats

- Formats

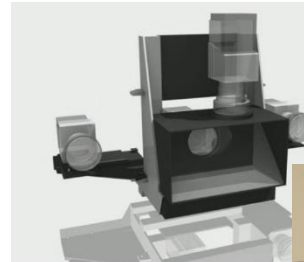
- L&R streams - frame compatible formats
- Image(s) + depth map(s) (MVD)
- Multiview coding (MVC)





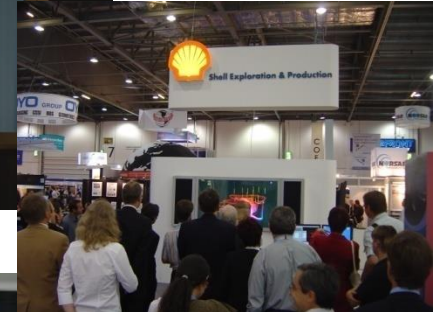
# 3D Light Field Content - Acquisition

- Computer generated animation – *solved*
  - Just rendering time, avoid 2D after effects, etc.
- Live scene acquisition
  - if user expectation is wide FOV at the display side, at the acquisition you have to collect information from the same range
  - wide base-line camera arrangements
    - Free-viewpoint TV
  - TV programs - talk shows, studio arrangements - can be solved by multiple cameras or camera arrays
  - 3D cinema - film shooting equipment to be developed
- 3D/3D conversion
  - stereo pairs into multiview



# Professional applications

- Oil&gas – exploration, geological data visualization → **no-glasses, true 3D tool**
- Medical – surgical planning → **authentic visualization**
- Museums, Edutainment, Entertainment, Theme parks → **real 3D, interactions**
- Military, Security, Simulation, Air traffic control **enhanced information content**
- Event rental → **visually striking appearance**
- Scientific visualization, VR → **precise displaying of large 3D datasets**
- CAD – automotive, molecular → **collaborative use**
- 3D Telepresence → **realistic feeling of presence, direction selective communication in multiplayer scenarios, eye contact**





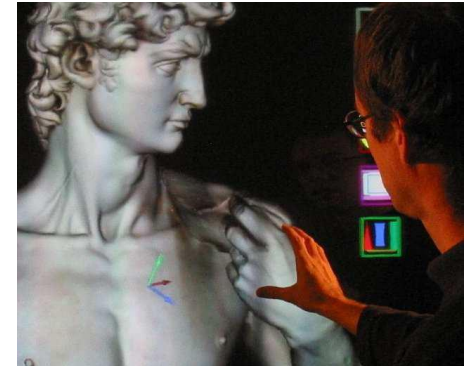
# Medical applications

- CT, MR, PET, US image-based diagnostics
- Operation planning
- Remote surgery
- Education
- Medical simulators



# Virtual museums

- Changing times:
  - interactive exhibits to attract more visitors
  - life-like 3D impressions, realistic interactions
  - protect valuable treasures
  - multiplication of exhibit capability
  - 3D content:
  - AR with supplementary information (edutainment)
  - interactive applications
  - storytelling



# Virtual museums

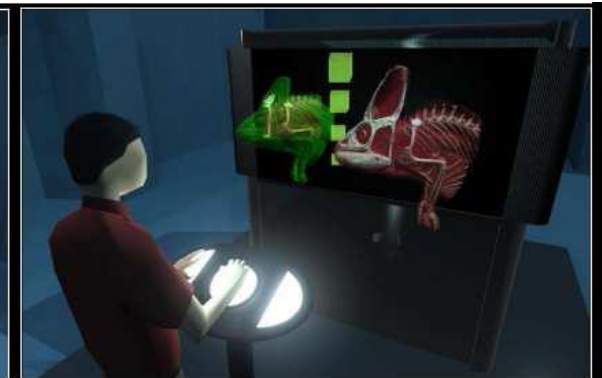
- Interaction tools



*Touchscreen.*



*Close view.*



*Physical devices.*



*Gesture detection system.*



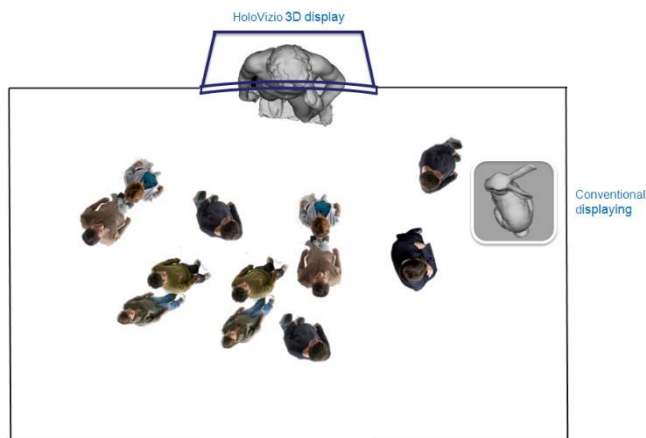
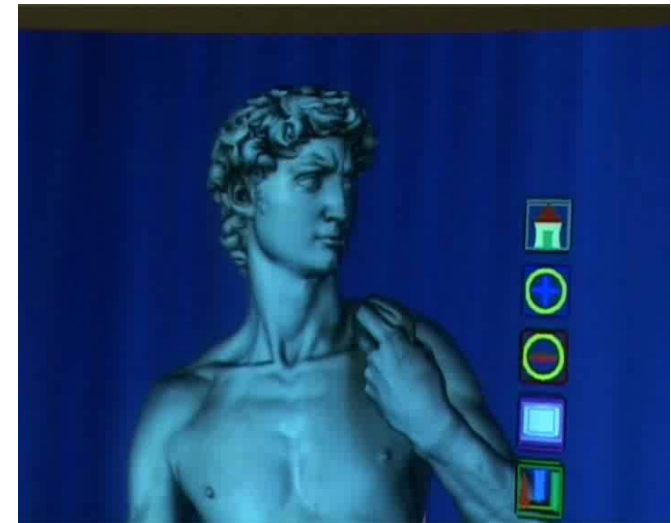
*Voice detection.*



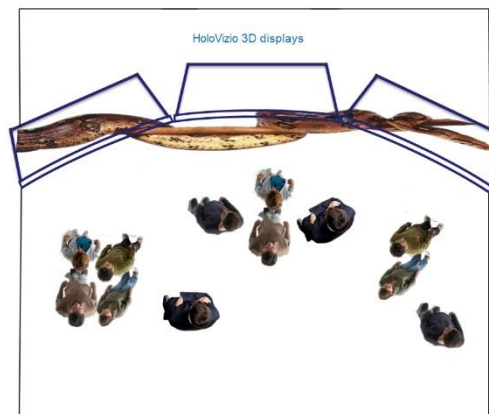
*Tracking system.*

# Virtual museums

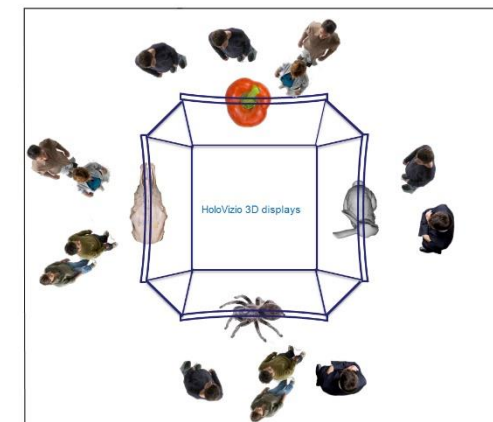
- Free viewpoint system
  - no limits for visitors
- Flexible arrangements
  - individual, island, immersive display blocks



3D display in combination with conventional display



3D display in wall configuration for panoramic 3D view

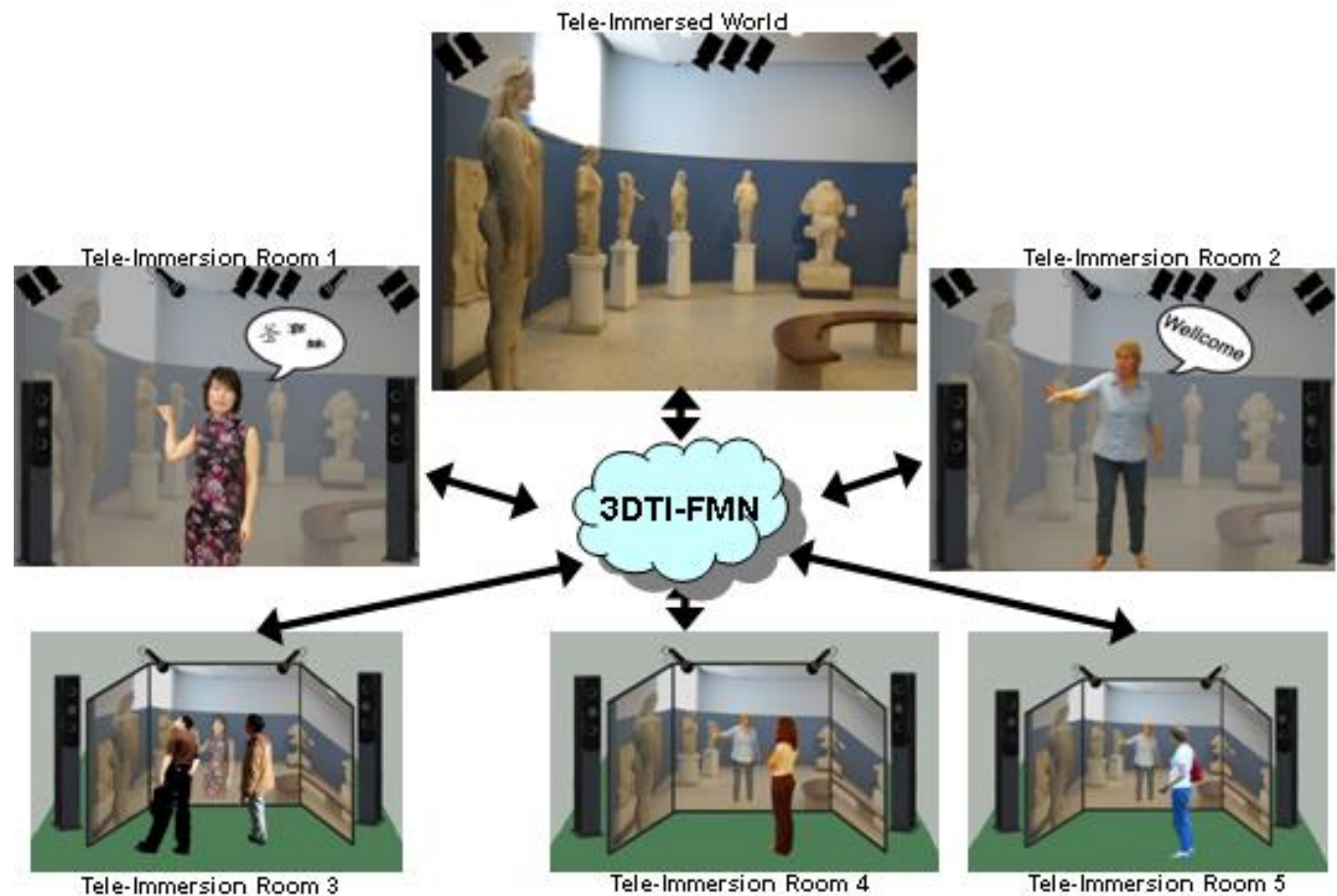


3D display in island configuration showing separated items



# Virtual museums

- Tele-Immersion concept



# Theme-parks

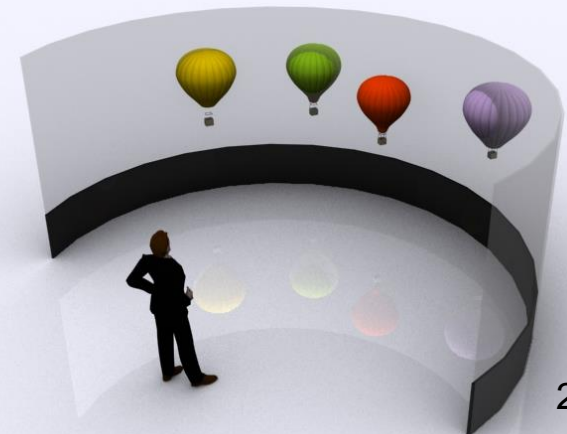
- Immersive systems
  - towards Gigapixel displays
  - 3D, revival for projection technologies, pixel/\$ rate
  - Large-scale 3D visualization
    - CAVE systems' market



Be there in 3D!

Telepresence with  
HoloVizio 3D display

2009



# Theme-parks

- Theme park technologies
  - 3D attractions to stimulate people
  - interactivity to be involved
  - immersive, life-like adventures
  - attraction preparation phase queuing entertainment
- 3D Virtual aquarium
  - edutainment
  - combinative content
  - cost-effective
  - technologically feasible
- Other potential projects



# Thank you



## Questions?

[www.holografika.com](http://www.holografika.com)