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Art and Magic Research

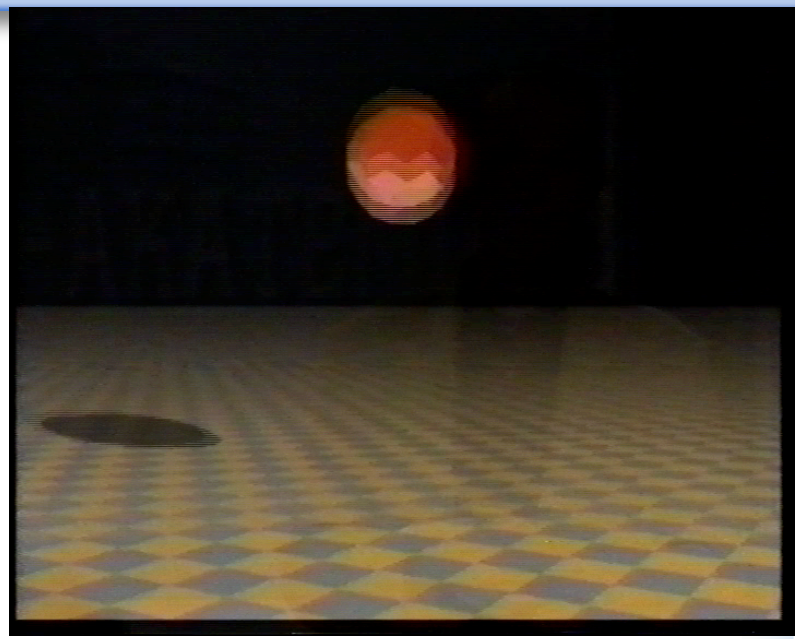
technology for
sound, motion and
interactive installations

"Any sufficiently advanced technology is indistinguishable from magic."
Arthur C. Clarke

Department of Media Technology

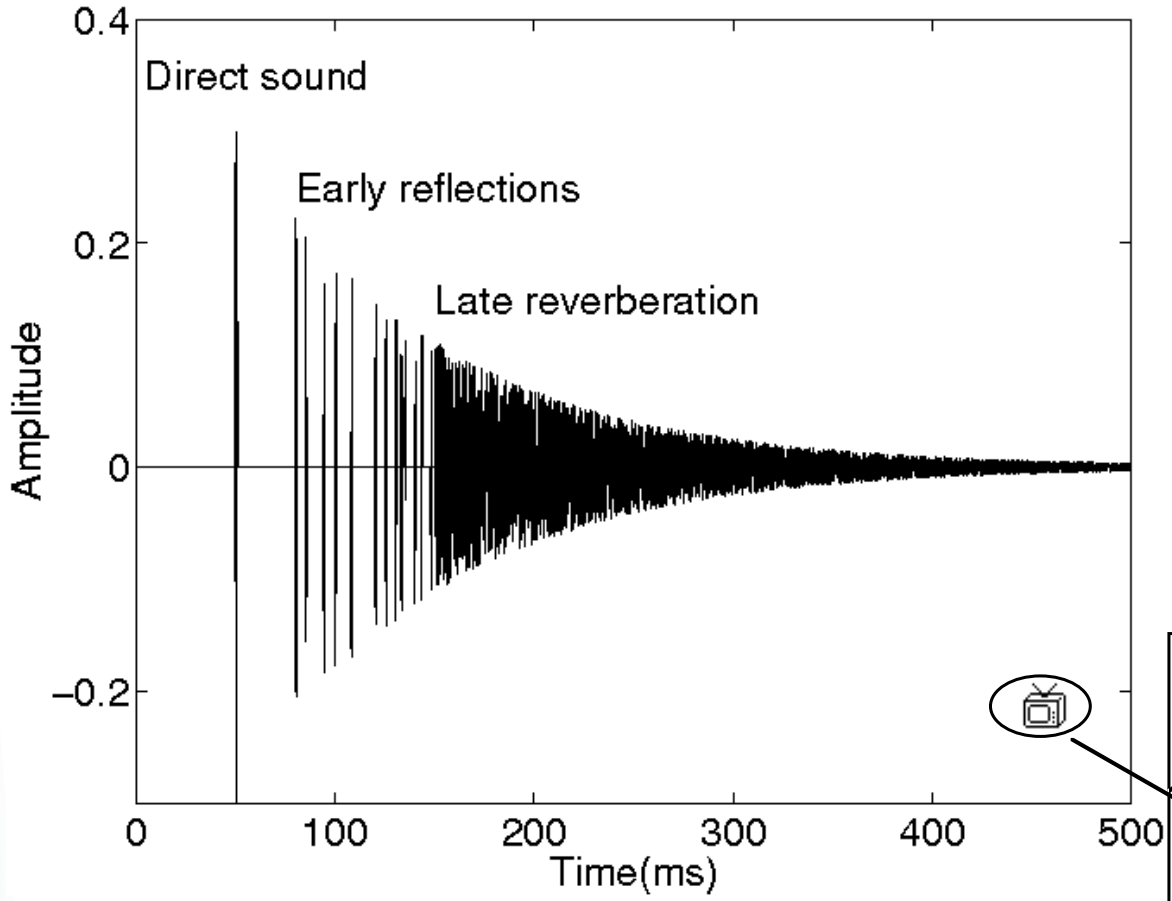
- founded in 2008, combining two related units
  - Laboratory of Media technology
  - Telecommunications software and multimedia laboratory
- research groups and professorships
  - visual media (Oittinen)
  - multimedia and networked media (Vuorimaa)
  - semantic web (Hyvönen)
  - **graphics, virtual reality and interactive systems**
    - **virtual acoustics (Savioja)**
    - **interaction technology (Takala)**
- http://www.tml.tkk.fi/Research/projects.php

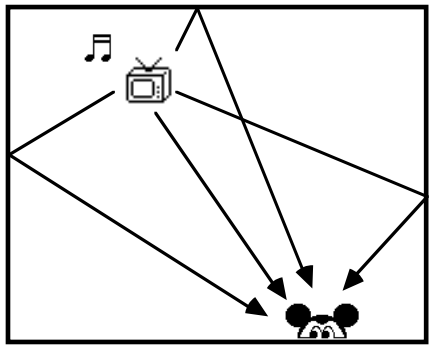
Sound rendering (1992)

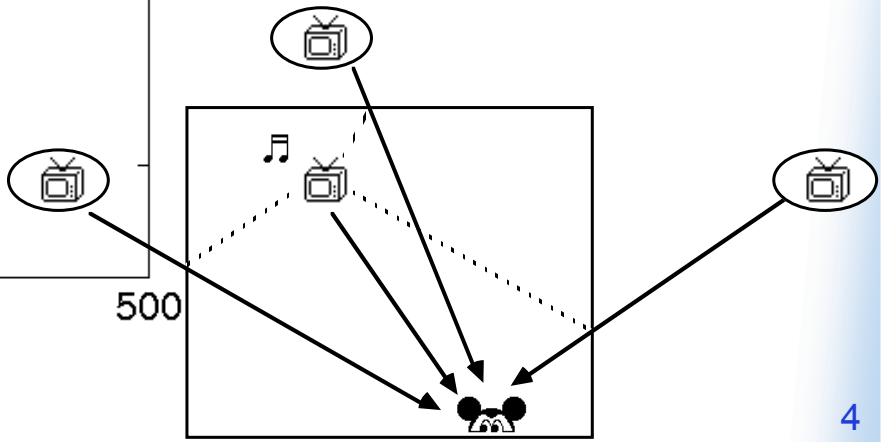


- computational model drives both animation and sound
- bouncing balls
  - each collision initiates a sound
  - force determines amplitude
  - arbitrary sound samples
- walls around an ambulance
  - reflected sound when the source is visible
  - direct sound disappears when the source is occluded
- driving car
  - amplitude changes inversely to distance
  - changing delay causes Doppler effect

Modeling room acoustics





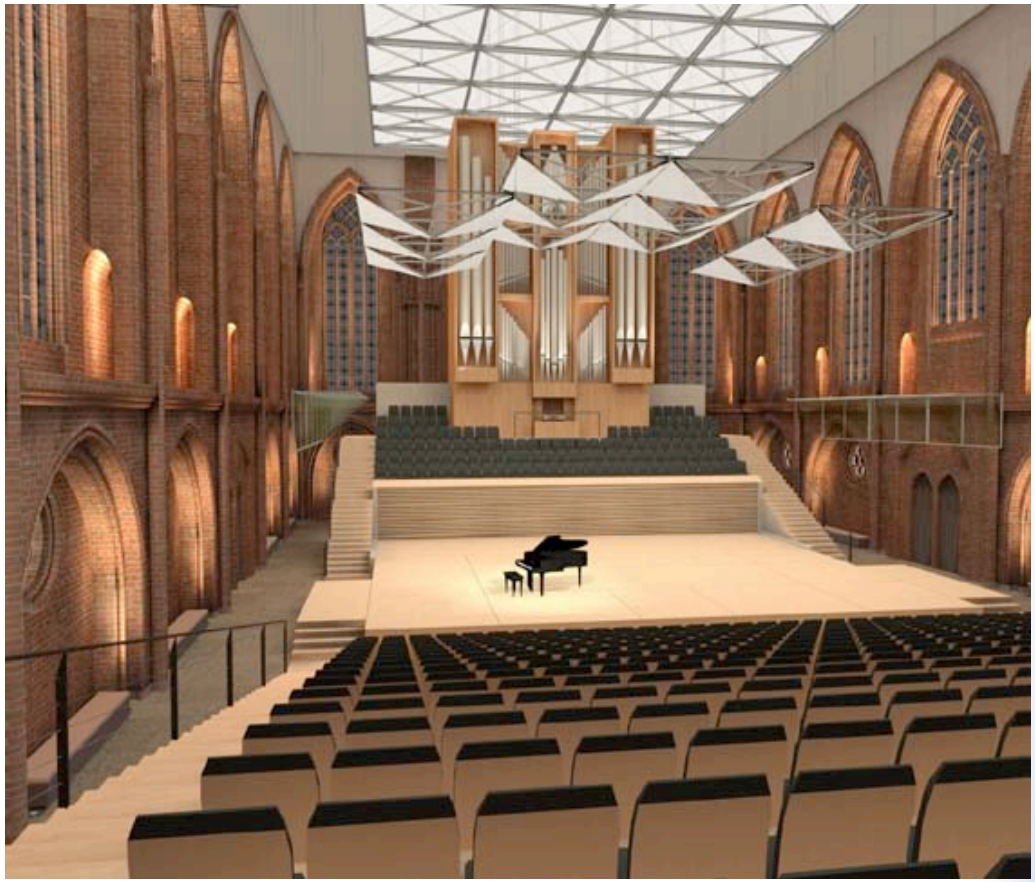


Marienkirche (1998)

- concert hall designed for a renovated church in Neubrandenburg, Germany
- music recorded “dry” in a studio

video sample:

- lobby: recording as such
- hall: sound rendered to a moving camera



DIVA virtual orchestra (1997)

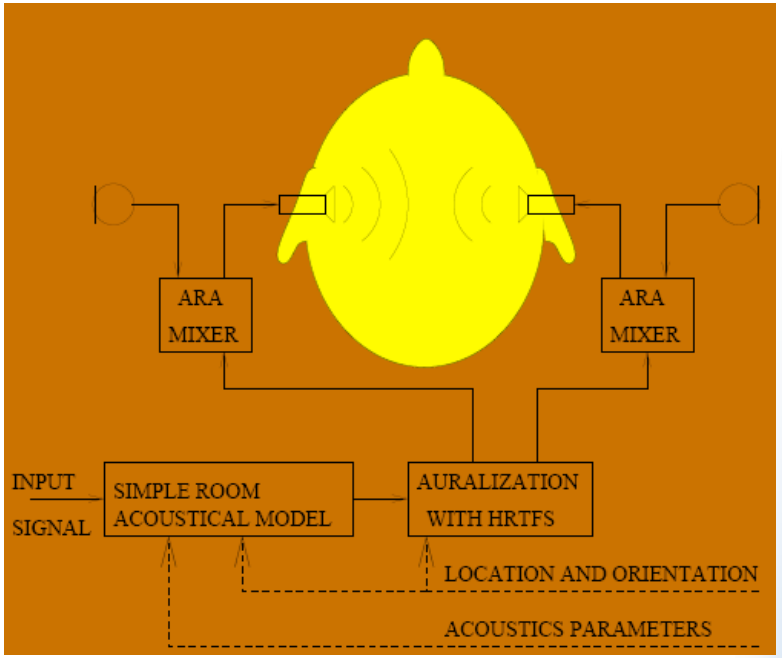
- animated musicians playing MIDI encoded music
  - automatically computed grips on the instruments
  - physically based sound synthesis

- sound reverberated according to virtual concert hall
- music conducted with a baton
  - neural networks trained to follow the motion
  - mapping from motion samples to relative timing between beats
- also recognition of conductor's emotional intent
- performance at Siggraph'97 Electric Garden

- **video sample…**

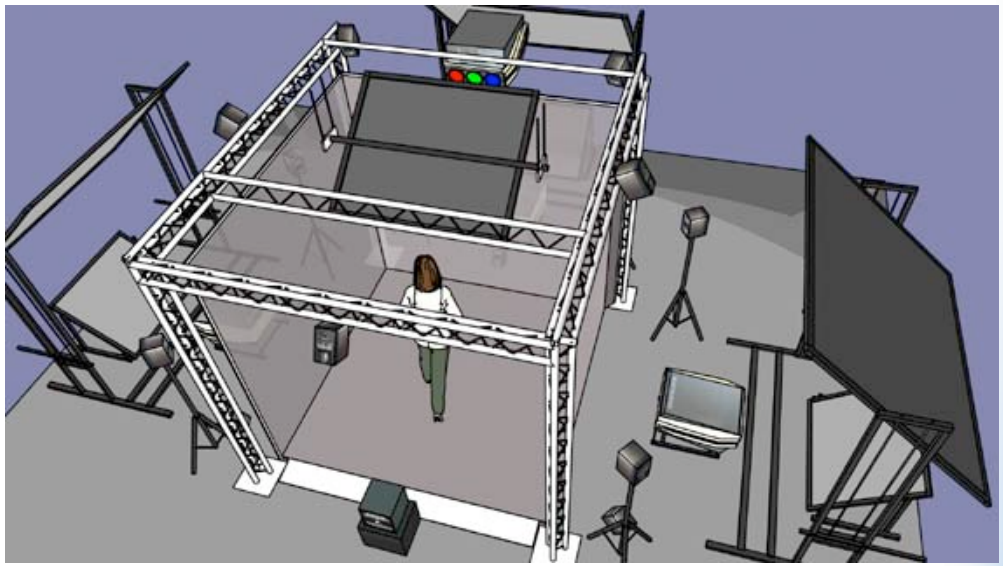
Virtual/augmented audio
(joint work with TKK/Acoustics)

- Mobile and augmented reality in audio
  - Binaural IP-telephone
  - Binaural audio networking
  - Location-based audio
  - Warnings
  - Navigation aids
  - Virtual tourist guides
  - Auditory traffic signs
  - etc.



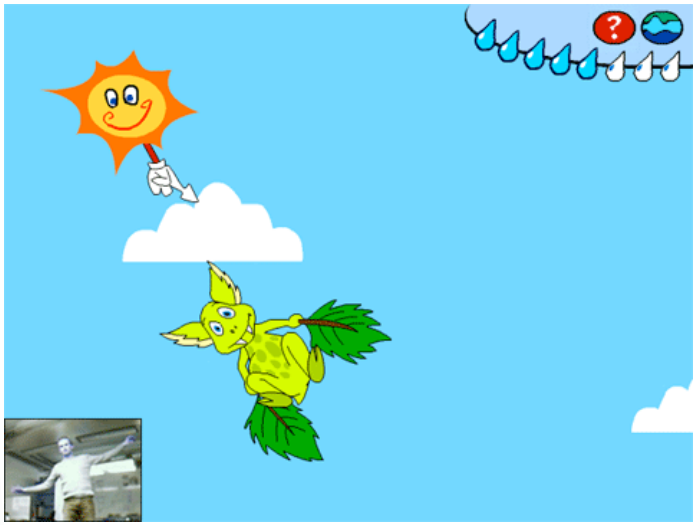
Experimental Virtual Environment EVE (1997–2007)

- CAVE-like installation
  - 3D images on three back-projected walls and the floor
  - magnetic motion tracking device
  - wand and data gloves
  - 16 loudspeakers for 3D audio
- applications
  - scientific visualization
  - architecture and building services
  - entertainment and art
  - http://eve.hut.fi/



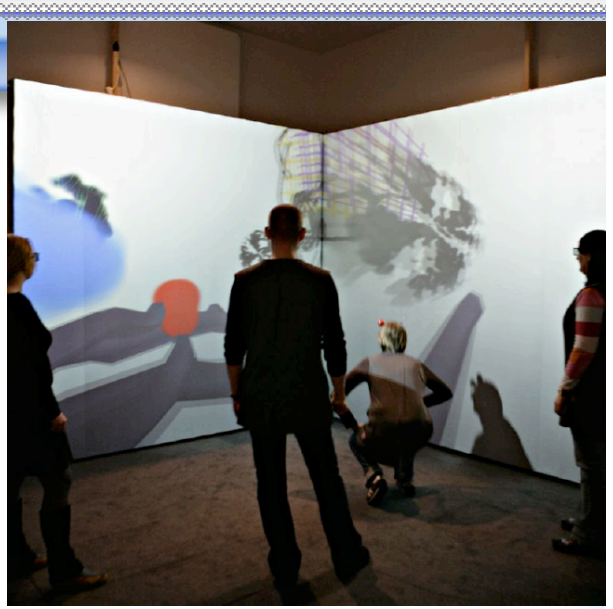
Motion-based entertainment and games

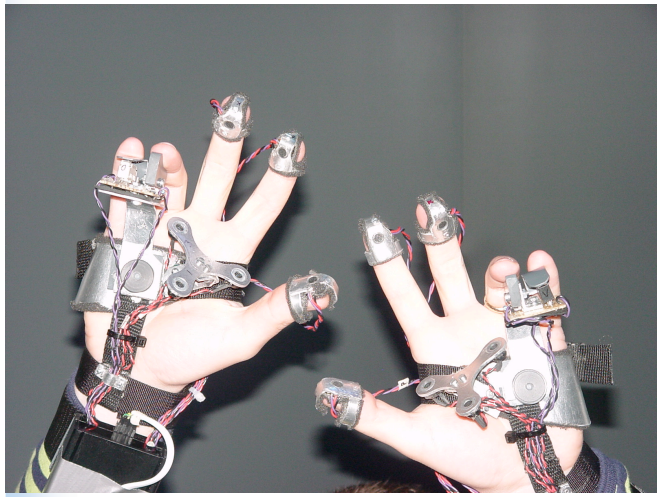
- hand gestures and sound effects
  - virtual aquarium
  - virtual snow fight
- camera based tracking of full body movements
  - games for children
  - Kick Ass Kung-Fu



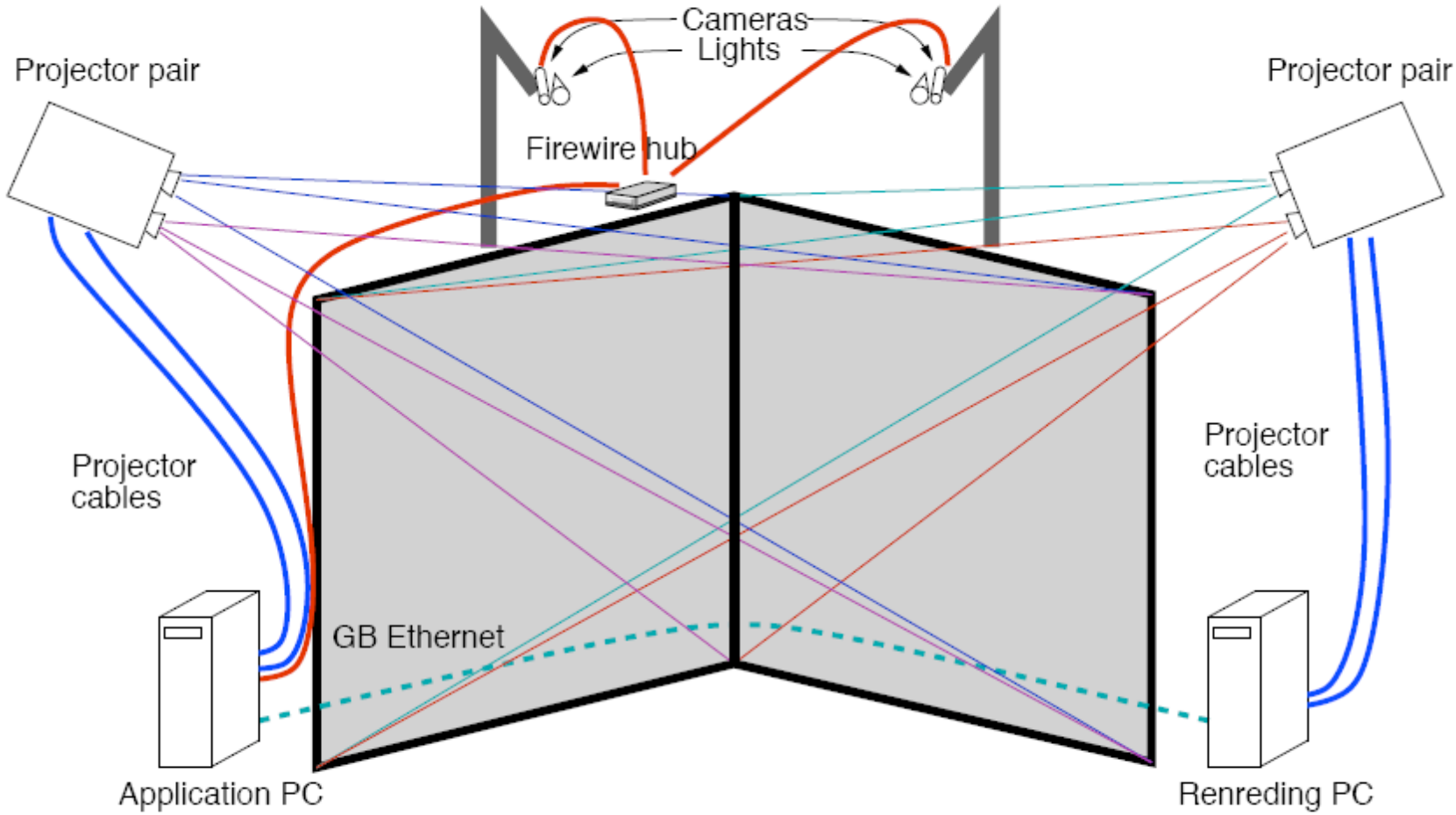
Fine Motor Interaction Methods for Immersive Free-Hand Expression

- drawing in the air
  - a new art medium
  - exhibition at the Kiasma museum of modern art (2005)





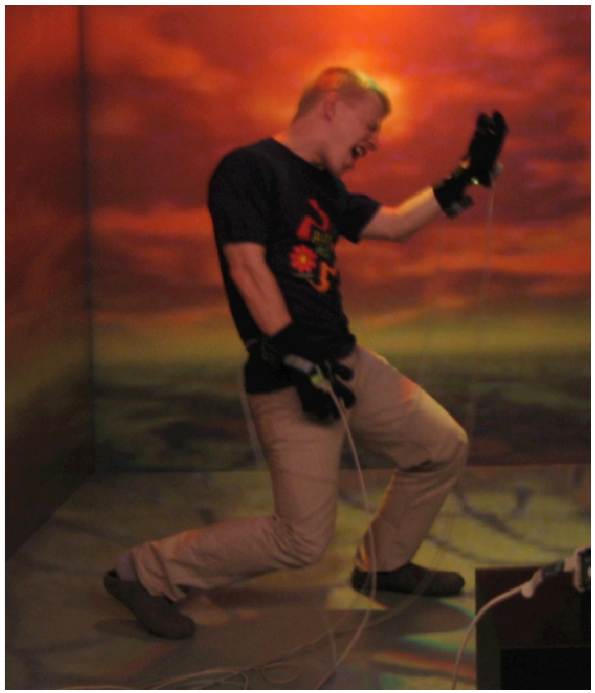
Upponurkka: a cheap two-wall display



Virtual instruments

- new user interfaces for synthesized sound
- started with ALMA project (EU) 2002–2004
- more degrees of freedom than with a keyboard
- mappings to control parameters of physically based synthesis algorithms
- free configurability
  – build your instrument

- examples
  - xylophone
  - drum plate
  - virtual air guitar
    http://airguitar.tml.hut.fi/



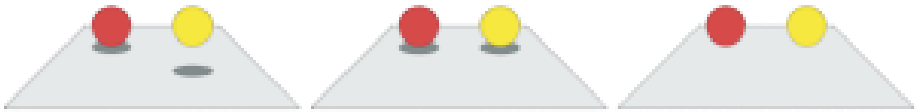
Virtual opera (2005)

- joint project with Sibelius Academy opera class students singing arias
  - digital visual and acoustic effects
- virtual 2D/3D sets in the background
  - animation partly controlled by music (MIDI piano) and singers' motion
- singing voice reverberated in 3D
  - artificial acoustics by 24 loudspeakers
- implemented using PD
  - events controlled with laptop during performance

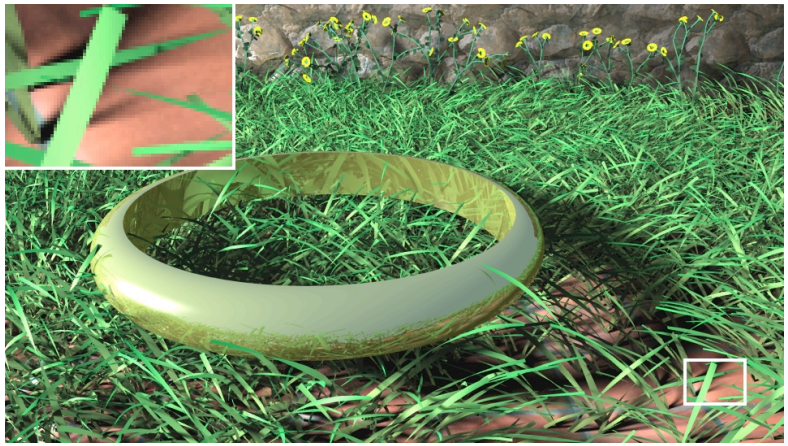
- **new productions in 2008**
  - cooperation with SibA and HIIT

Computer graphics

- Shadows are needed for realistic rendering
- Visibility and shadows are two sides of the same coin



- For truly photo-realistic images global illumination is required



SIGGRAPH 2005 **Proceedings Cover**

What next?

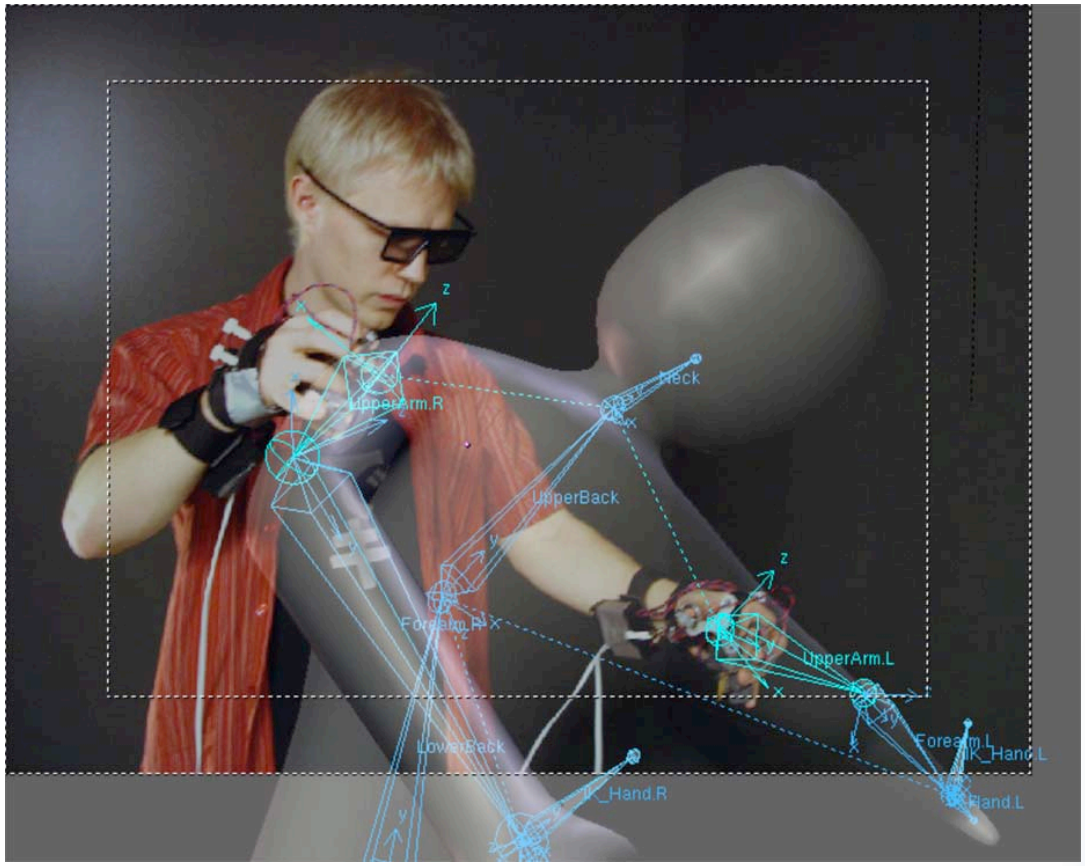
- embodied interaction
  - gesture recognition technology
  - applications in games and sports
  - low cost installations
- augmented reality (AR)
  - matching virtual to real environment (position, lighting…)
  - multimodal interaction (visual, audio, gestures)
- user experience
  - joint research with psychologists, neuroscientist, and usability experts, for understanding emotions, etc.
  - applications in games and design
- growing cooperation with artists/designers
  - University of Art and Design

Current projects (1)

- emotion research (affective computing)
  - two-way communication with facial expressions
  - recording brain responses with fMRI
  - narrative development of feelings
  - eye tracking as a means of communication

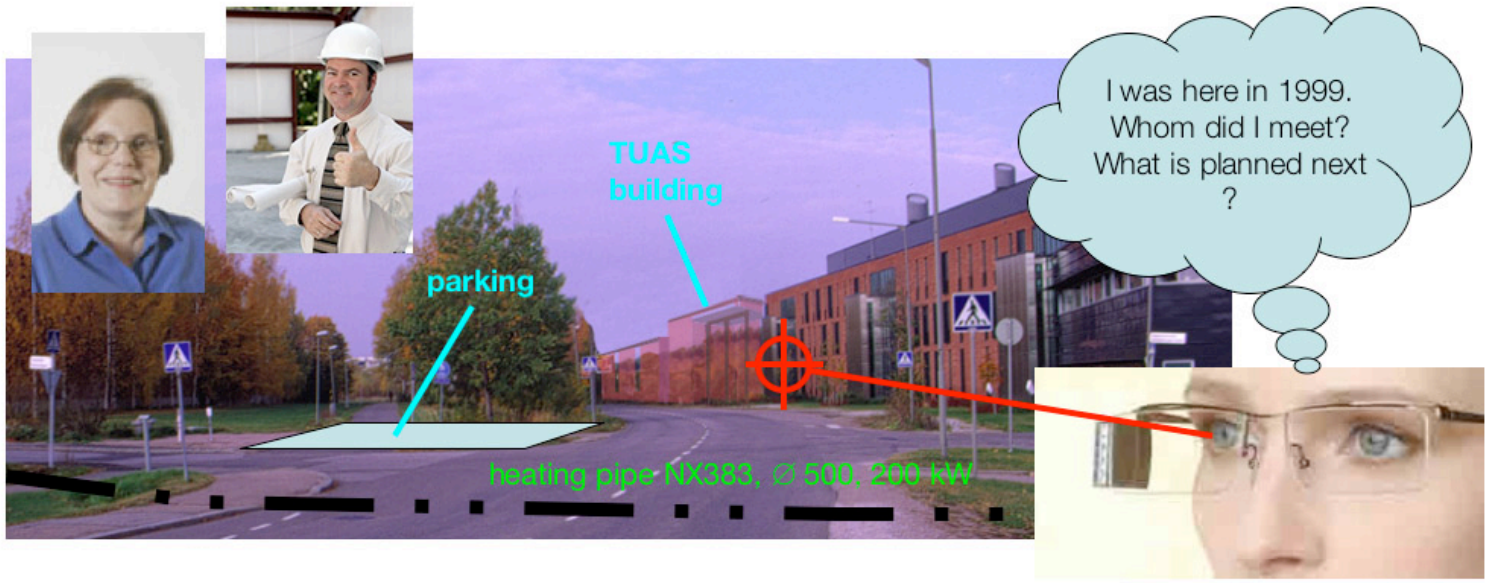
Current projects (2)

- **HandsOn**: connecting a CAD system with 3D immersive display and wireless hand-tracking



Current projects (3)

- **UI-ART**: visual and auditory augmented reality in urban environments
  - recognition and identification of 3D environment
  - eye tracking for detecting attention
  - associative access to public data, and personal memories



Thank you.