The office of the future

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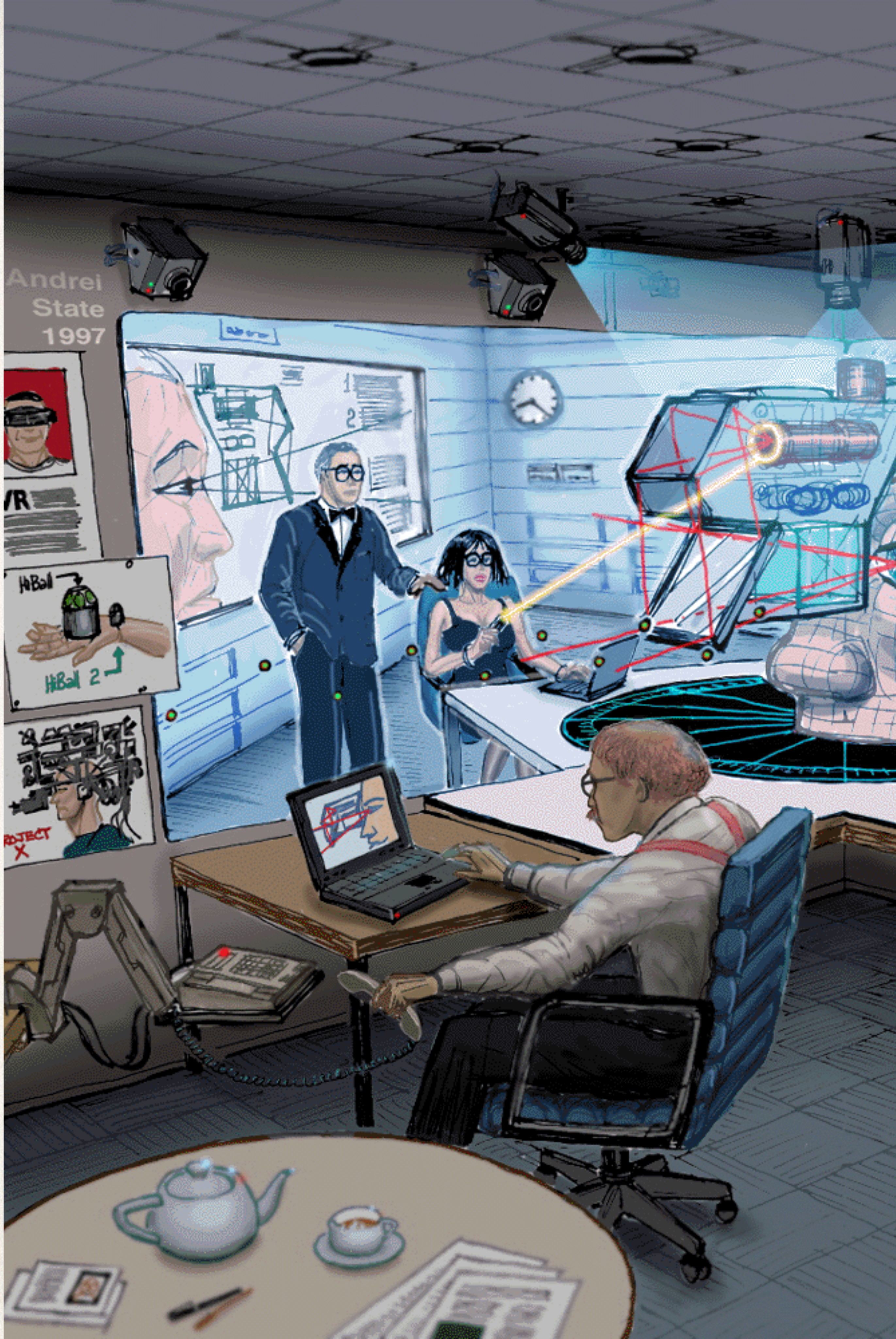
R. Raskar, G. Welch, M. Cutts, A. Lake, L. Stesin, and H. Fuchs, “**The office of the future: A unified approach to image-based modeling and spatially immersive displays,**” in Proceedings of the 25th annual conference on Computer graphics and interactive techniques, 1998, pp. 179–188.

key vision: office of the future

- shared collaboration (telepresence)
- immersive virtual environment
- through-the-window paradigm
- freedom of movement (natural interaction)
- spatially immersive displays



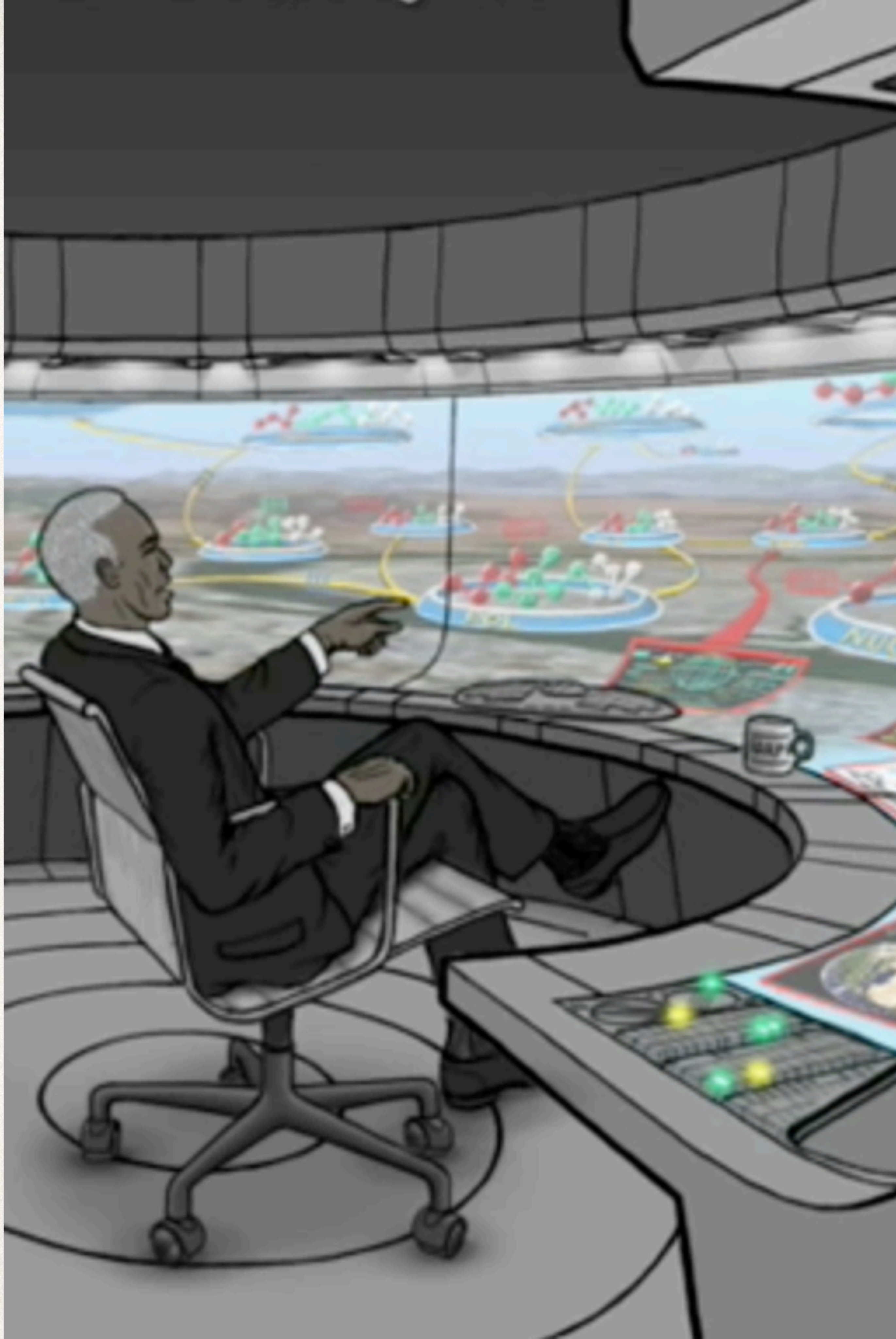
kick off ideas

- image-based reconstruction of the remote office
- use imperceptible lights to extract a 3D scene
- usage of several cameras
- autocalibrate designated display surfaces

setup

methods & tools

- spatially immersive displays
- dynamic image-based modeling
- imperceptible structured light
- rendering & display
- tracking



spatially immersive displays

- get the display off of the user's head
- telepresence
- 3d projection technology
- projectors synchronously shuttered along with screens
- virtual environment

excursion - CAVE

Surround-Screen Projection-Based Virtual Reality: The Design and Implementation of the CAVE, SIGGRAPH, 1993

- difference to CAVE: projected onto the general display surfaces
- reduced to 1 per wall
- limitations:
    - no intensity blending
    - no capture of geometry of environment

dynamic image-based modeling

- goal: capturing models of environment
- requirements: high accuracy, high update rates, non-intrusiveness
- depth extraction
  - video camera & projector (in a pair)
  - vertical bars: create binary images using adaptive thresholding

dynamic image-based modeling

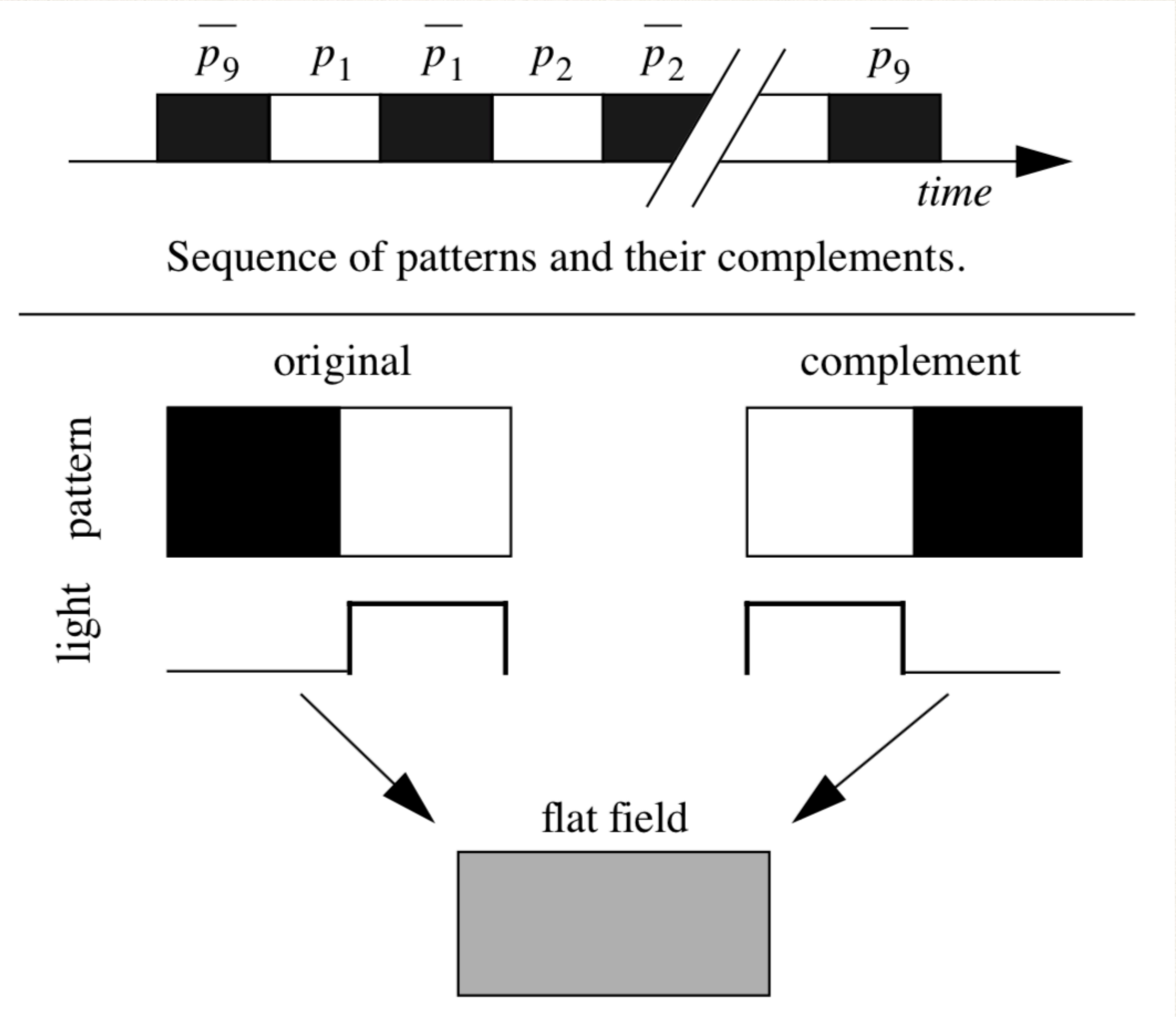
- vertical bar projection
- trilinear interpolation
  - compute intersection
  - image based model
- binary coded structured light

dynamic image-based modeling

- challenges (binary coded structured light)
  - speed vs. accuracy tradeoff: usage of camera-projector pair
  - calibration for two separate devices for depth extraction
- checkerboard pattern for calibration
  - calibrate camera by finding pattern on flat surface
  - calibrate projector to flat surface
  - relationship between camera and projector

imperceptible structured light

- problem with structured light: flashing binary pattern
- combination of time-division multiplexing & light cancellation techniques
  - hide patterns with light weight projections
  - projection of a flat field or white light



pattern and complement are visually integrated over time, the result is the appearance of a flat field, or “white” light.

text can only be seen with a synchronized camera

initial image projected on the wall, imperceptible image is captured and displayed on the monitor

rendering and display

- images should look correct to observer
- specific algorithm
- two pass approach for rendering and displaying
    - render the 3d scene from the observers viewpoint
    - project the stored image from users viewpoint onto the polygonal model of display surface

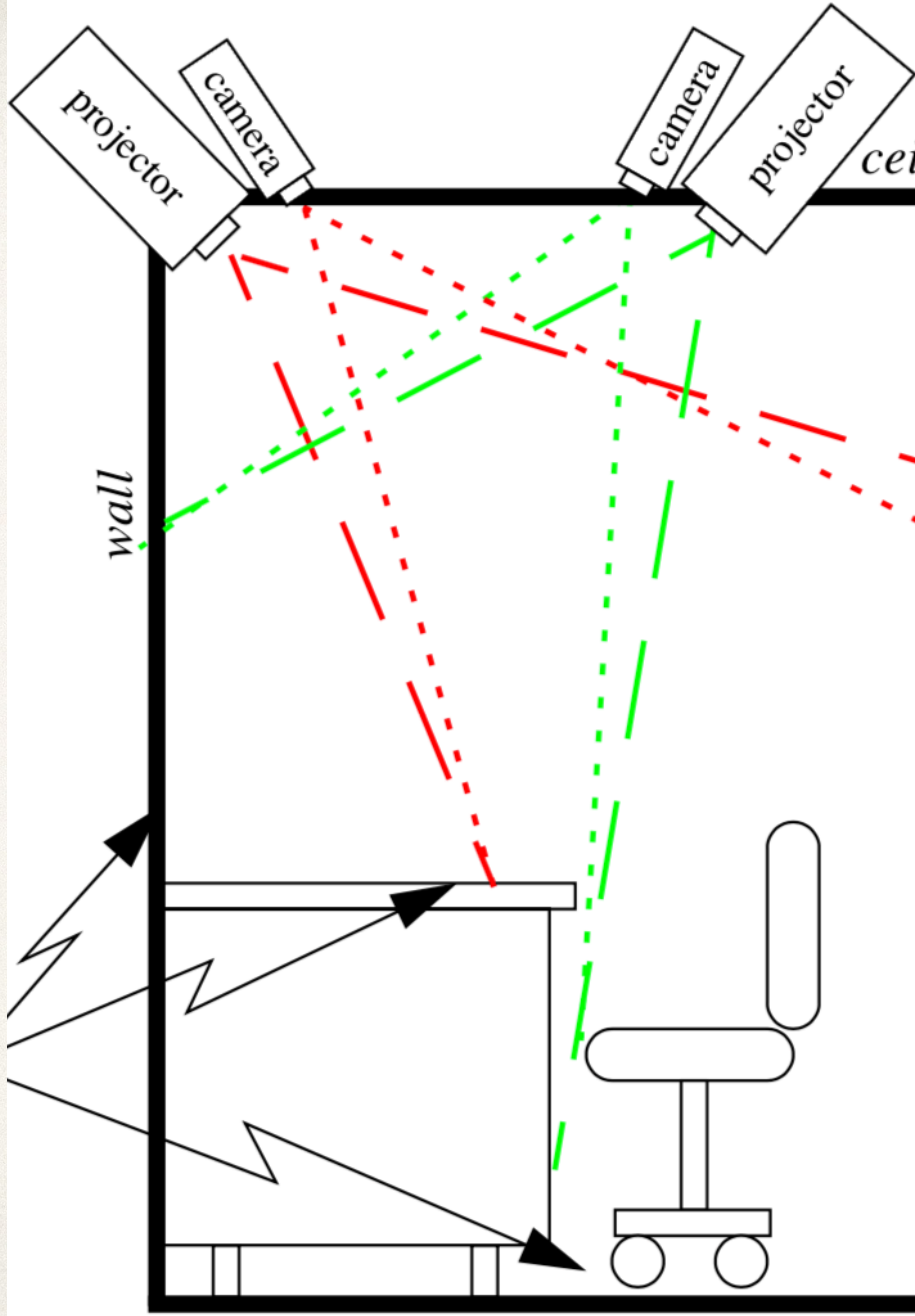
display surface is rendered from projectors viewpoint and show the correct image

rendering and display

- complete display surface coverage (multiple projectors)
- requirements
  - position of user
  - reasonable FOV
  - assumption: no radial distortion
  - work on: speed / parallelisation / latency

tracking

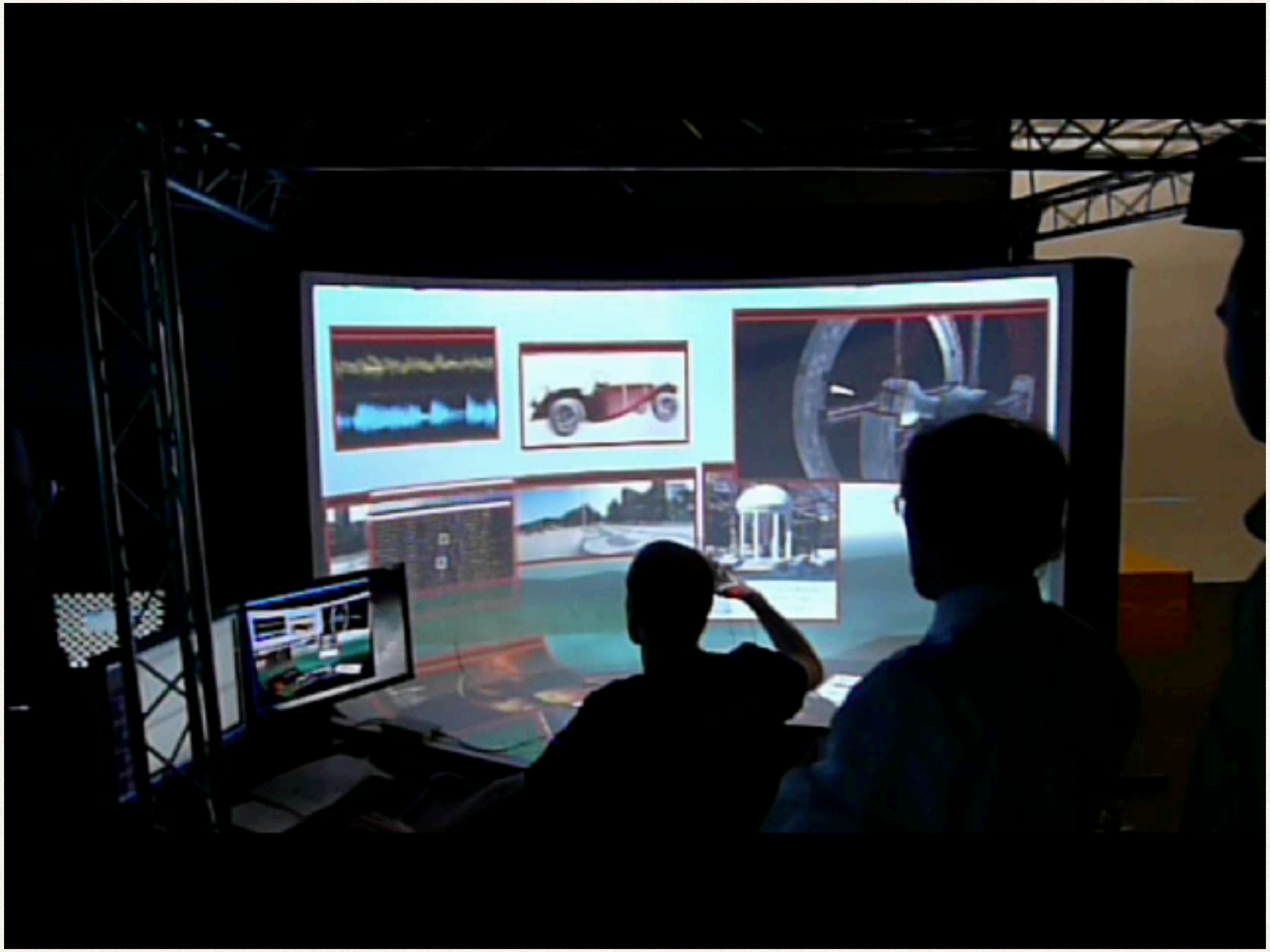
- 3d virtualisation environment
- stereoscopic viewing
- viewers location via magnetic head tracking
- autocalibrate the display surfaces
- geometrically and photometrically correct viewpoint



conclusion

- novel semi-immersive display (office environment)
- acquire geometry of irregular surfaces
- modify rendering to allow projection onto that irregular surface
- method of injecting structured light that is imperceptible

video - demos



thank you