LIGHT-FIELDS: PHOTOREALISTIC REPRESENTATION OF REAL-WORLD SCENES WITH 6 DEGREES OF FREEDOM

Principles, potentials and remaining challenges

Joachim Keinert

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AGENDA

- Motivation
- The light-field technology
- Light-fields for video
- Light-fields for still scenes
- Conclusion

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Images are everywhere

https://de.wikipedia.org/wiki/Datei:Metro_Kino_Wien_innen.jpg
https://de.wikipedia.org/wiki/Datei:Notre_Dame_on_fire_15042019-1_(cropped).jpg

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Benefits of light-fields
2D images miss interactivity

- 2D images are flat

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Benefits of light-fields
Motion parallax as depth cue

- Allows for different perspectives
- Motion parallax is a strong depth cue
- Allows to walk in a 3D scene

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Motivation

6DoF content for new display formats

Virtual Reality

Augmented Reality

Multiview displays

https://sk.wikipedia.org/wiki/S%C3%BAbor:LCD_generic_tv.jpg

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Motivation
Photorealistic 3D content for editing

- Virtual backgrounds and objects

https://commons.wikimedia.org/wiki/File:Bahubali_With_Prabhas.jpg

- Manipulation (i.e. relighting)

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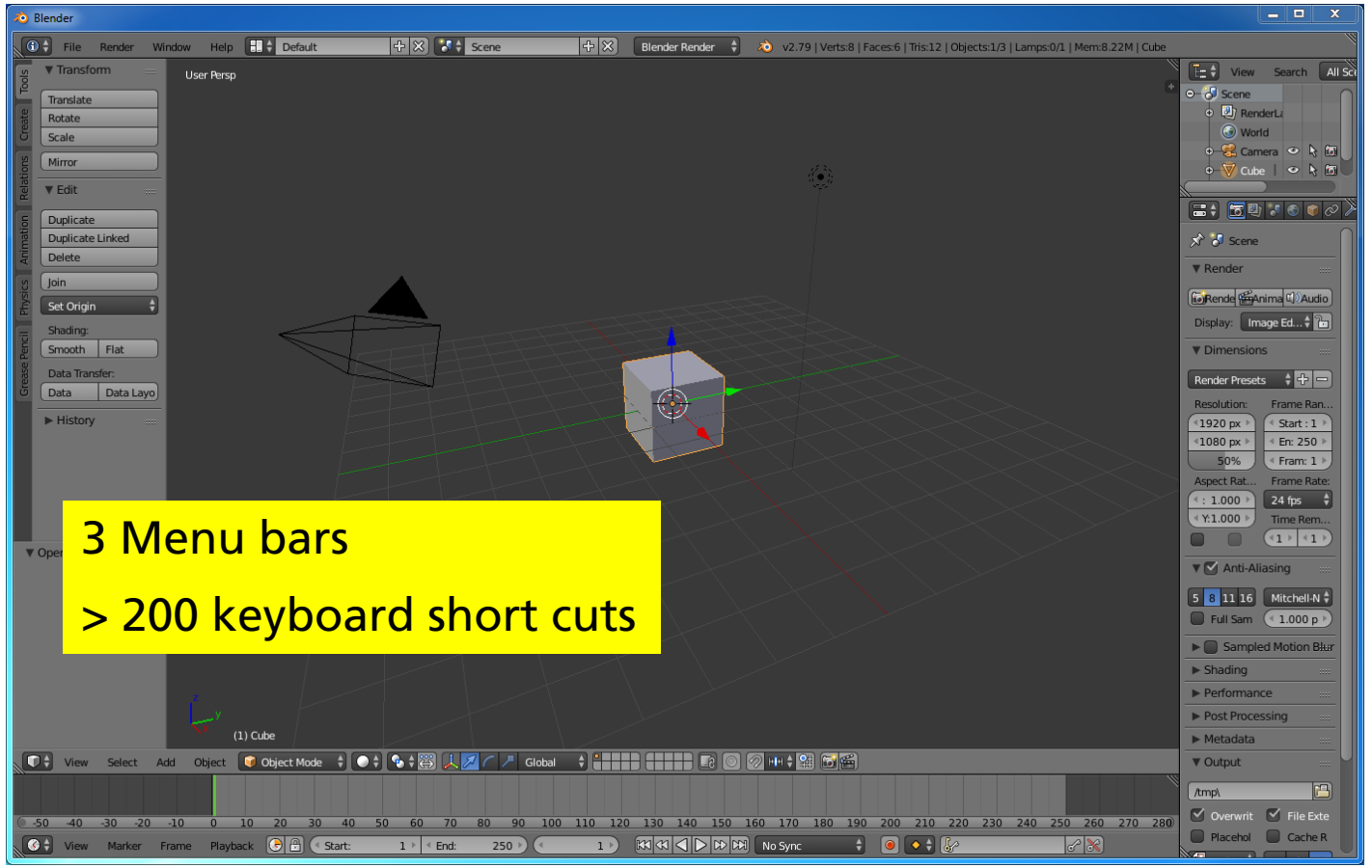
Challenge

Content production still difficult



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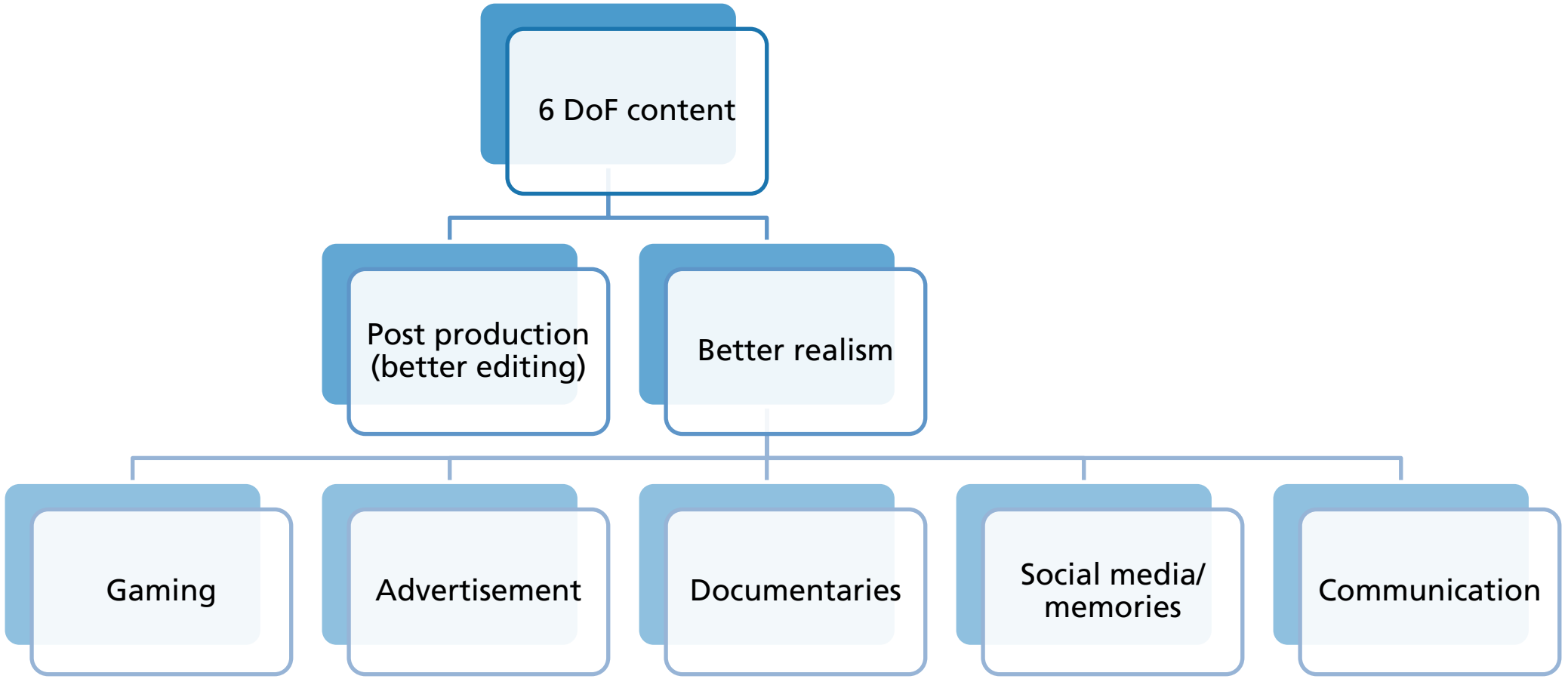
Applications



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Applications
Photorealistic objects in gaming

- Computer games in known cities
  - Combines leisure with stimulation of tourism
- Have realistic objects in computer games
- Melting movie and gaming genres

https://de.wikipedia.org/wiki/Datei:Nuremberg_Wei%C3%9Fgerbergasse.jpg

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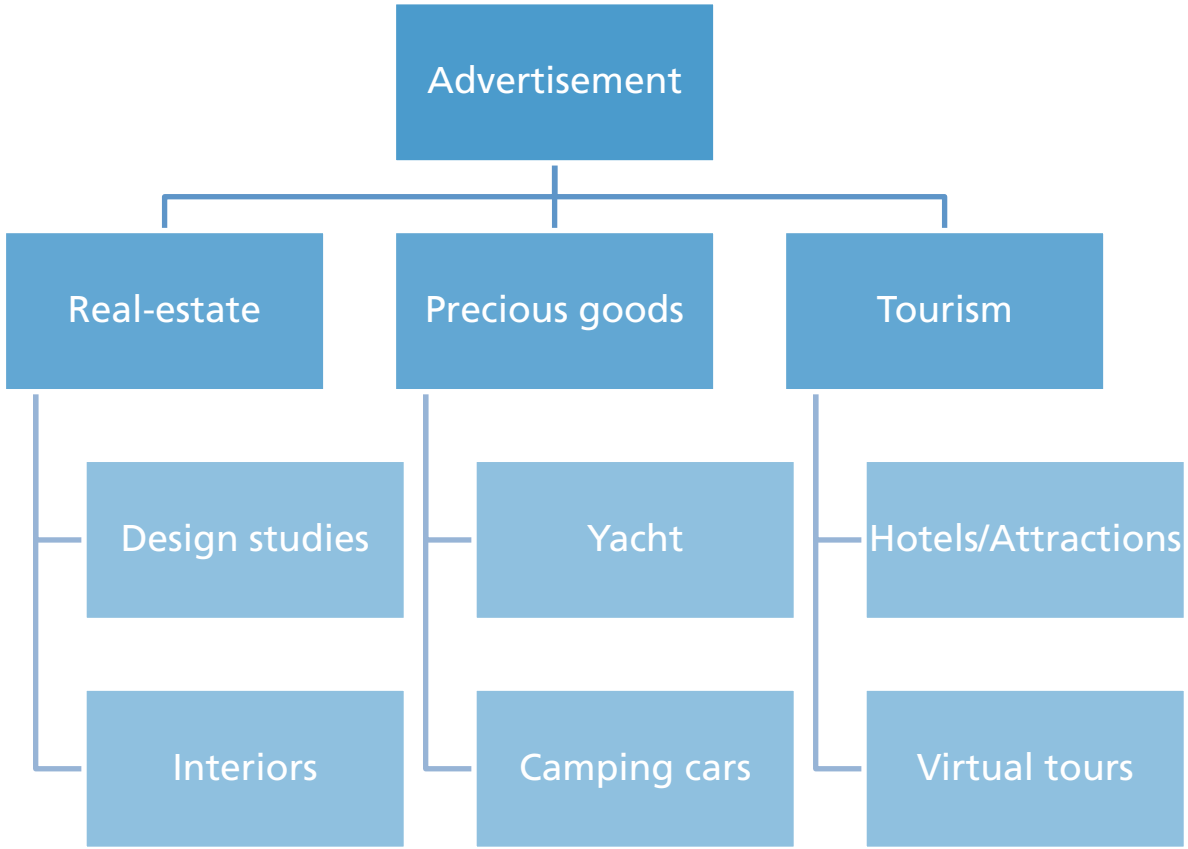
Applications
Advertisement

- Explore object, environment
- Choose speed
- Focus on points of interest
- Better spatial feeling



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The vision
True spatial experience for everyone

- Capture and watch objects from multiple perspectives
- Allow exploration by movement
  - That’s what we do in reality
- Document real happenings
  - Record instead of modelling
- High realism
  - Reflections, refractions, …

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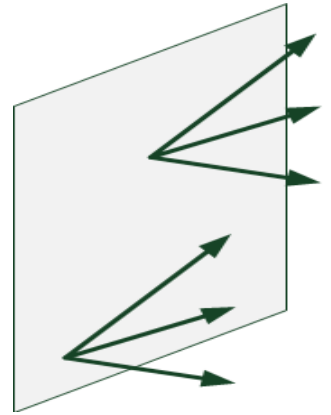
Introduction of light-fields
Definition



- Captures all rays traversing a surface (use of multiple cameras)
- Perfect capture of all perspectives for an object

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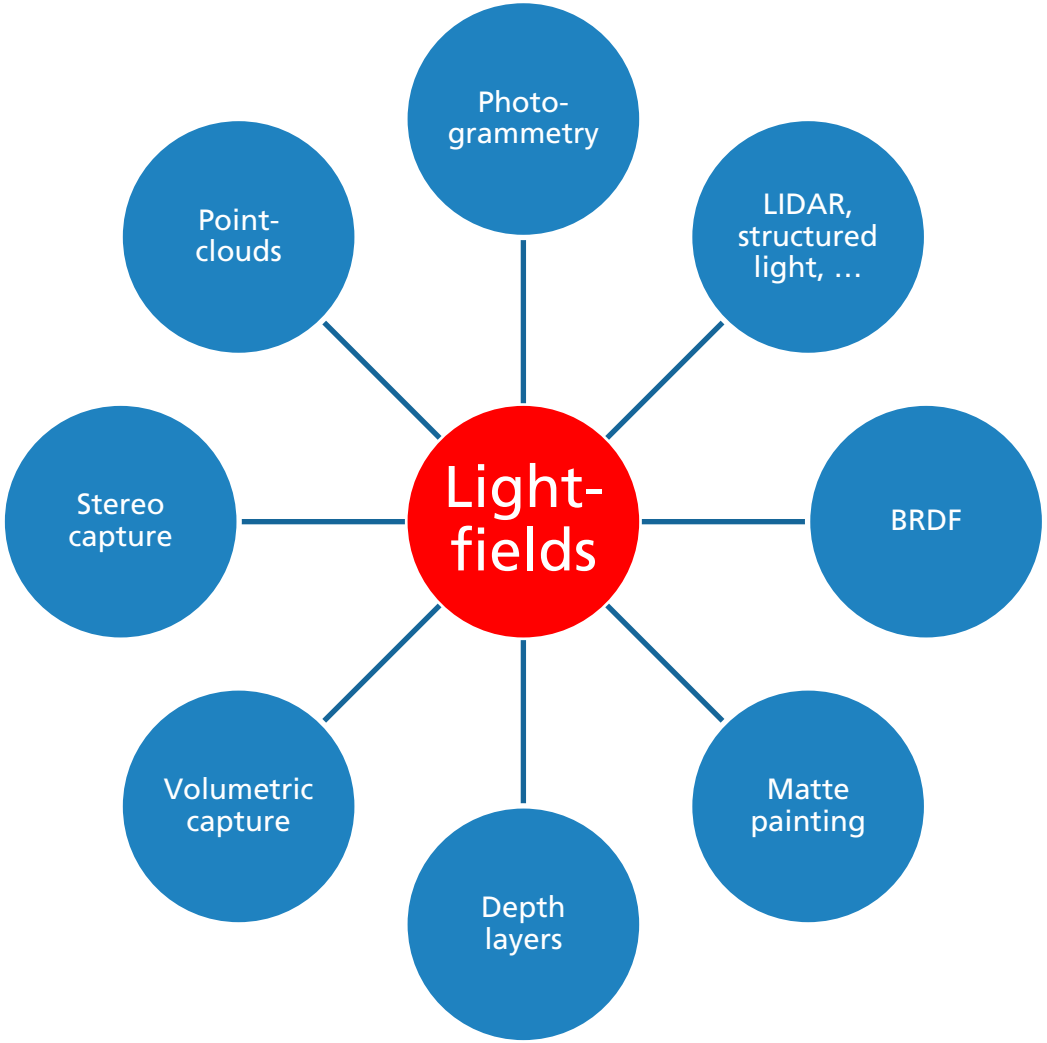
Related technologies for light-field acquisition

Unique selling points of light-fields

- Large number of perspectives
  - Better handling of occlusions
  - Better reproduction of view dependent effects
  - Better disparity maps
- Faithful reproduction of reality (photorealism)
- Maintenance of captured quality
- No geometric simplifications (no direct need of a 3D mesh)



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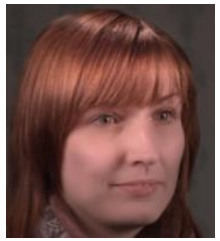
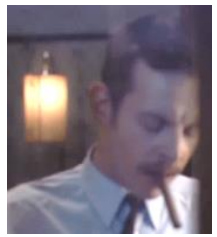
Realception®

Light-field for videos

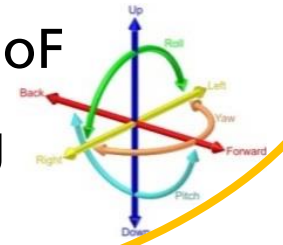


relighting

refocus



3DoF+/6DoF rendering



depth based effects

Fraunhofer IIS light-field algorithms and plugins

Multi-camera capture

NUKE®

Post production software

UNREAL ENGINE

Game engines

HMD

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Goal

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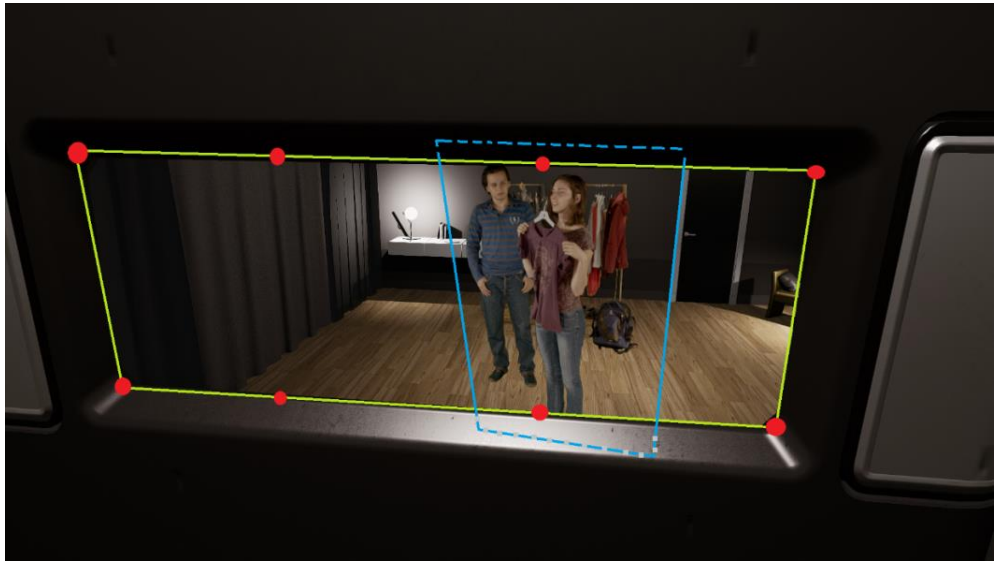
Application
Looking through a window

- Window size corresponds to array size
- Avoids any extrapolation
  - Higher rendering quality



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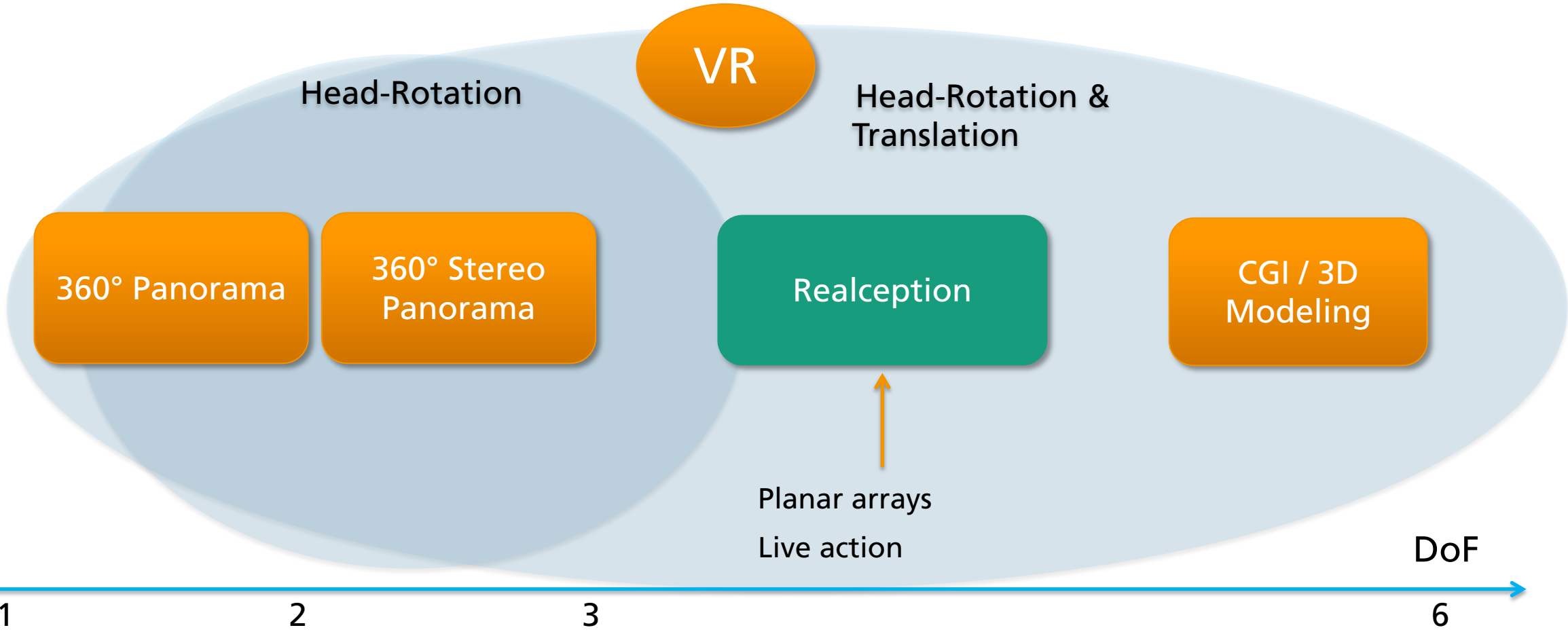
Example scenario
Virtual Reality



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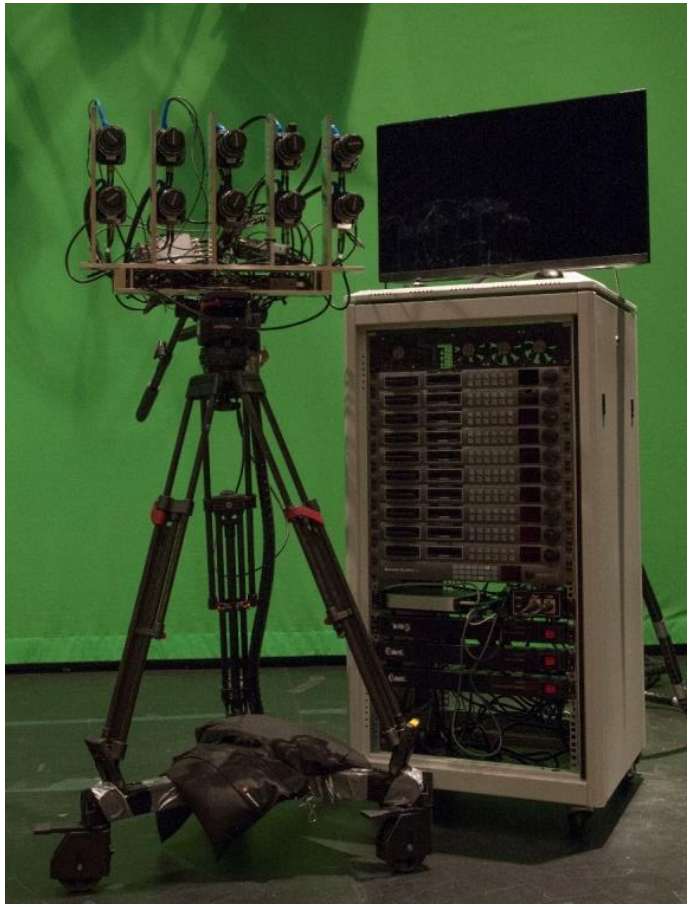
Workflow



- Capture
- Calibration (Nuke)
- Disparity Estimation (Nuke)
- Compositing (Unreal)
- Rendering (Unreal)

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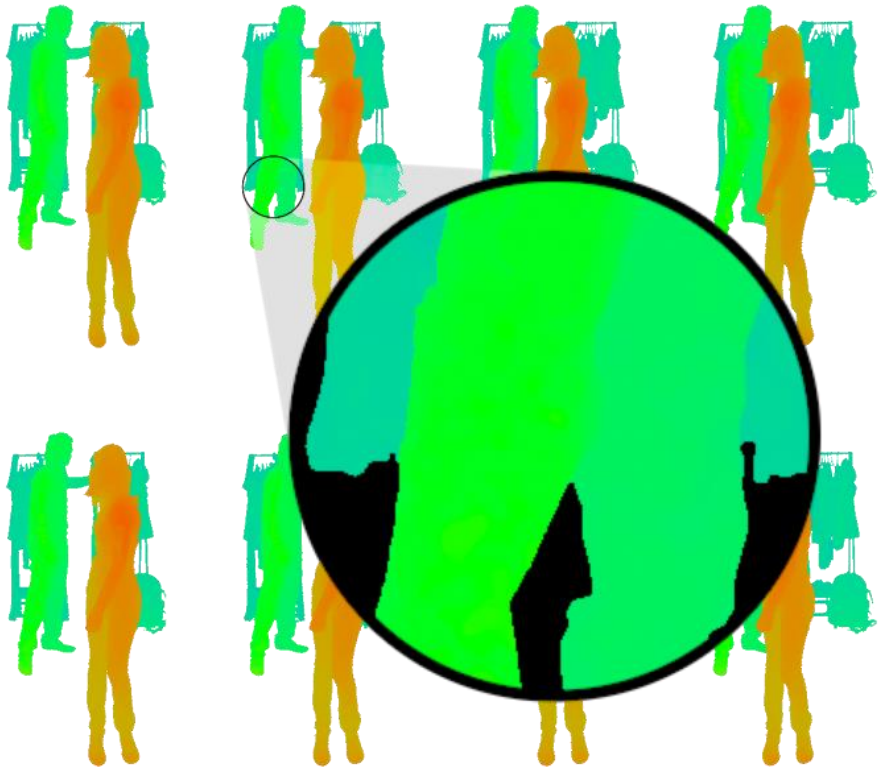

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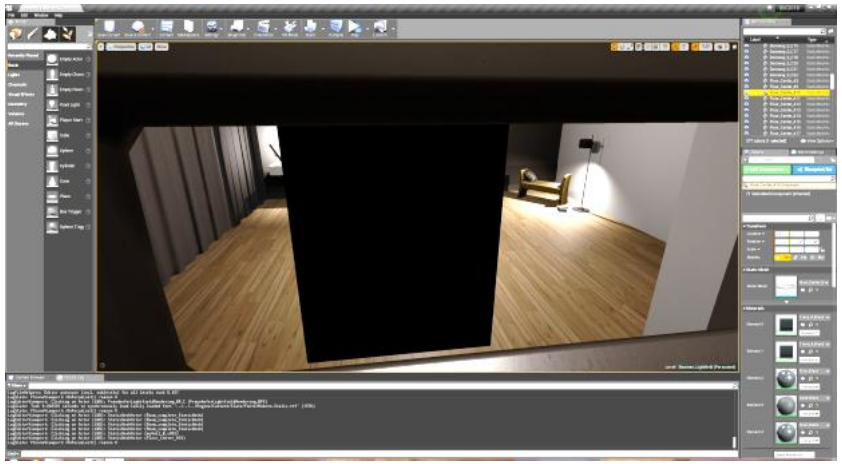

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Workflow

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Result

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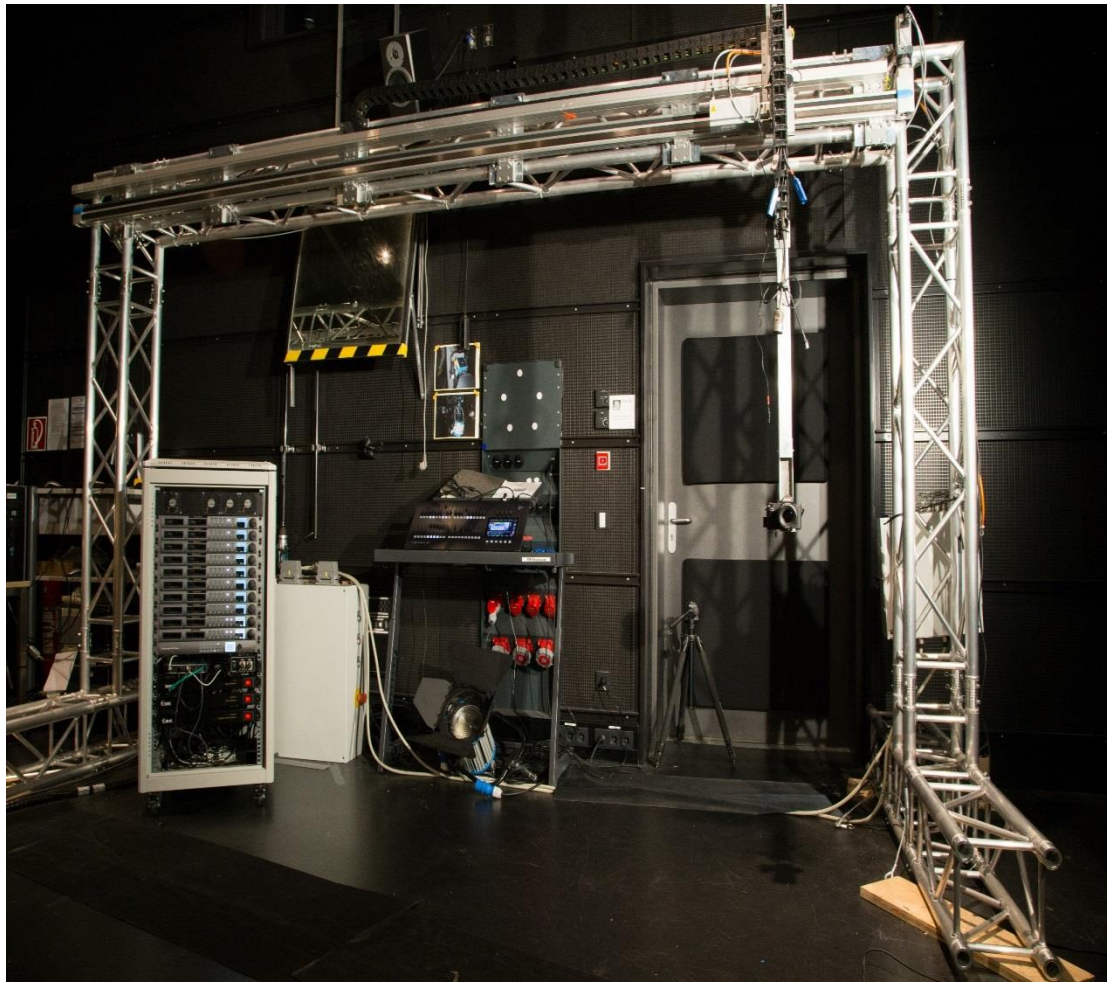
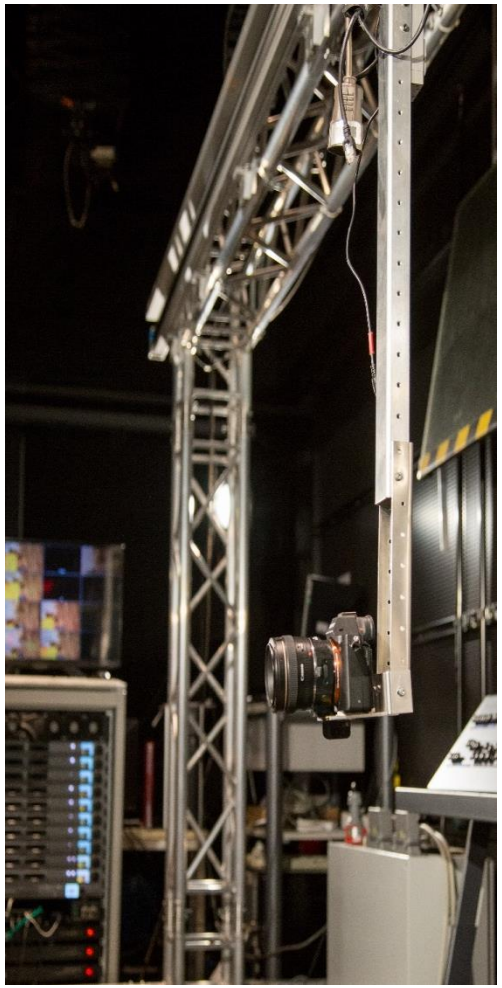
Static scenes
Light-field acquisition - Gantry





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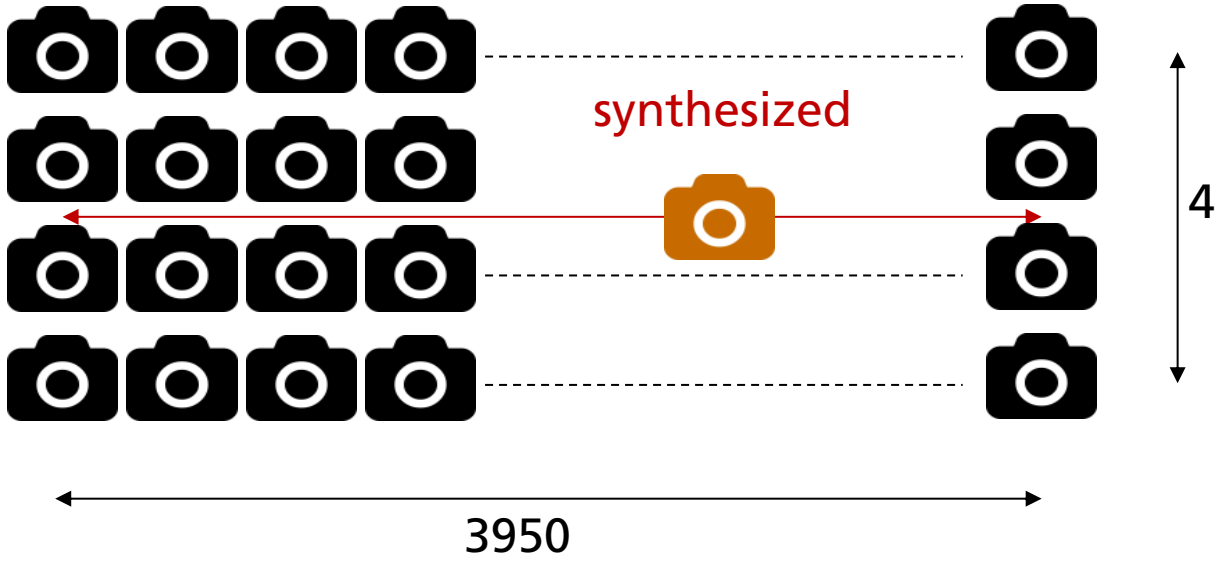
Dense light-field scanning
Camera setup

- Dense light-field scanning using a translation stage
- Base line: 1mm



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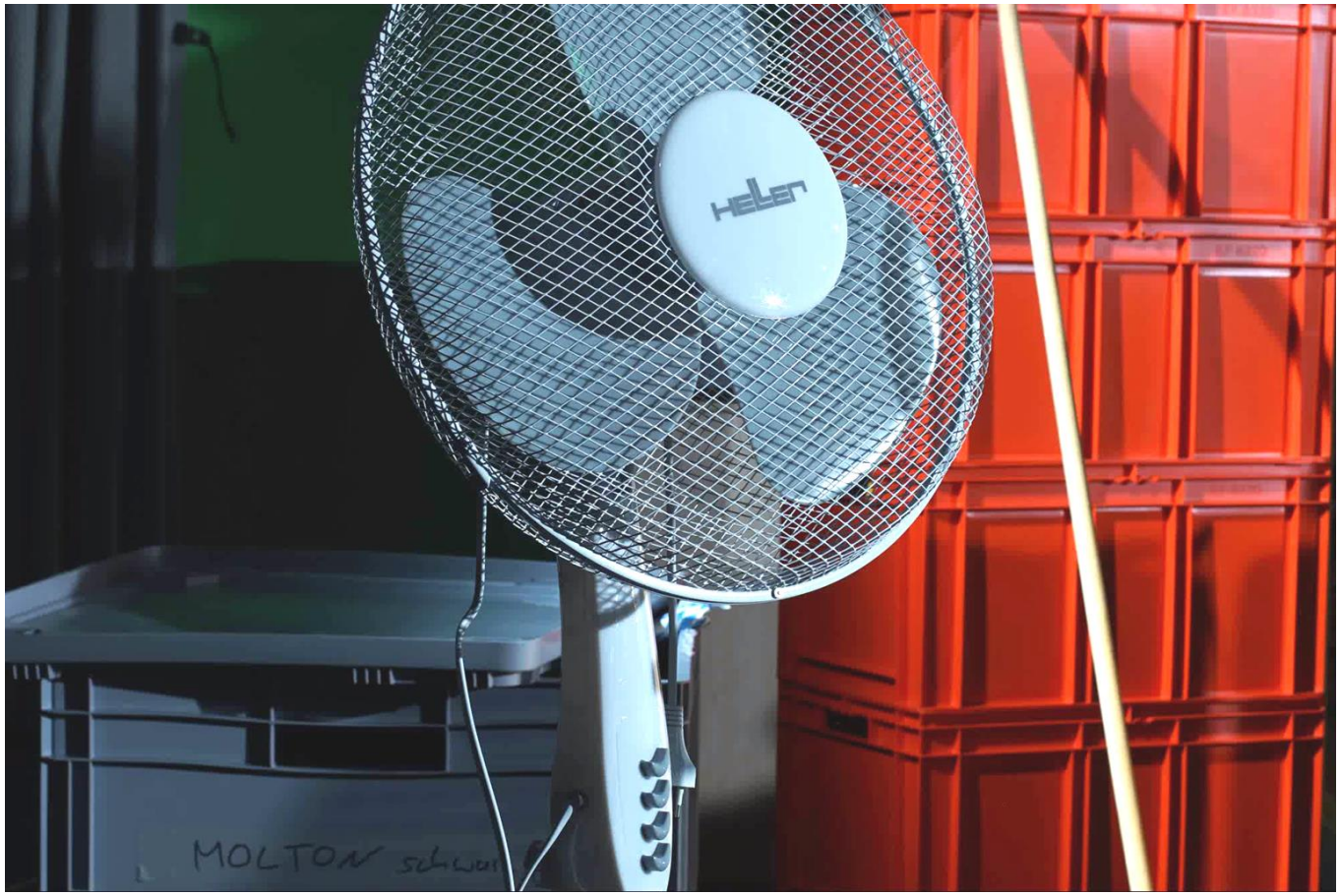
Dense light-field scanning
Original sequence



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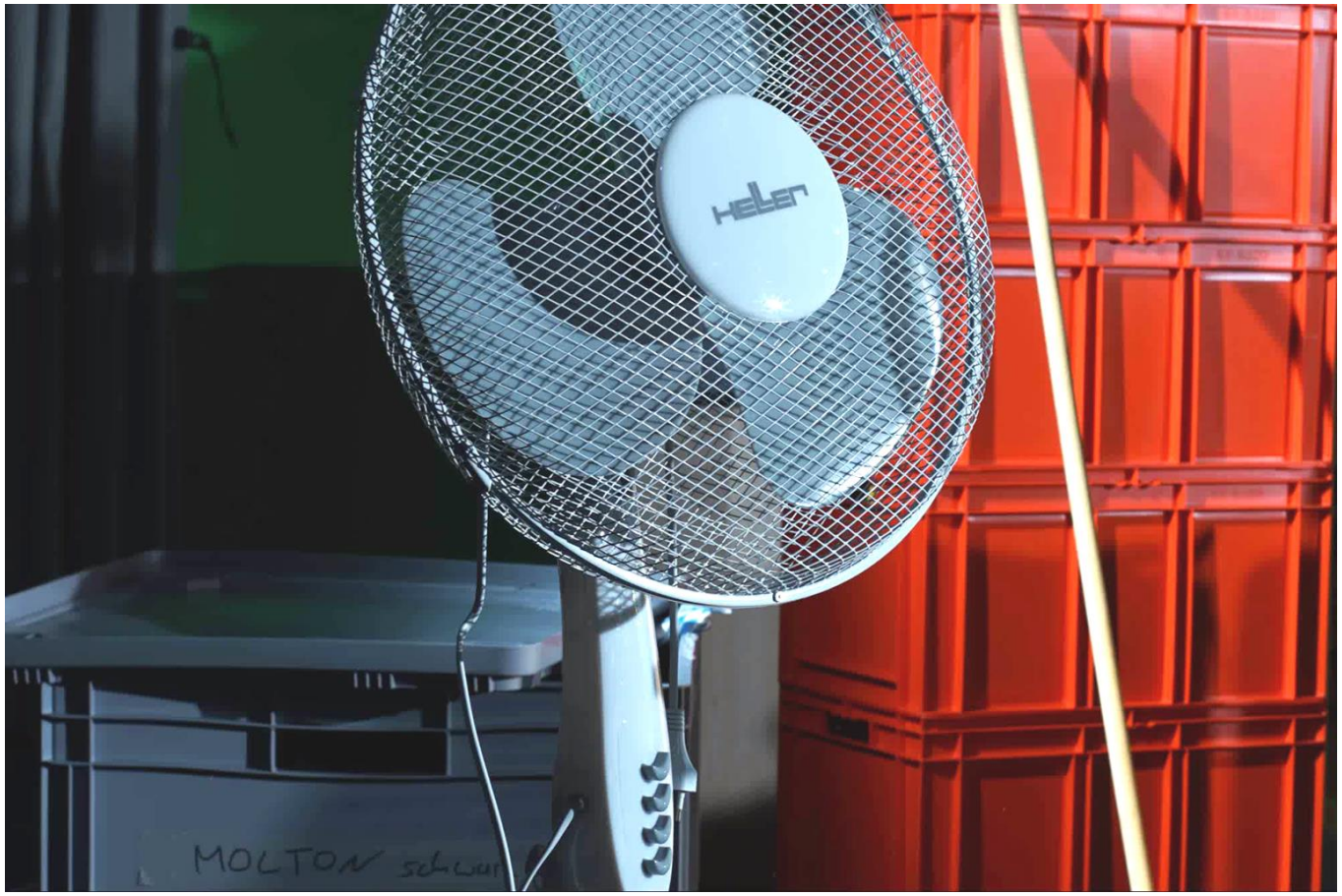
Dense light-field scanning
Rendered sequence



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Summary

- Light-fields allow photorealistic capture and reproduction of scenes for 6DoF applications
- Main benefits are high sampling quality and photorealism
- Various tradeoffs between capture efforts, scene complexity and rendering quality

- Integration into todays workflow still a research task that needs joint efforts

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Thank you for your attention!

Any Questions?

Joachim.Keinert@iis.fraunhofer.de

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