

# Considerations on FTV quality assessment

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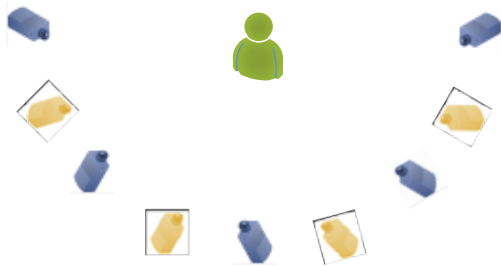
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# Presentation scheme

- Introduction to Free View-point Video
- Some current approaches
- Evaluation of an (unknown) system
- Test contents: scenarios, trajectories, and baselines
- Test methodology: paired comparison and absolute category rating
- Results and discussion
- Conclusions (lessons learnt)

# What is Free View-point Video?

- Interactive selection of the viewpoint and direction within a range
- Virtual views are generated from the data of physical camera viewpoints
- Scene 3D geometry
  - Depth data
  - Depth cameras
- (Very) High computational load



# What is Free View-point Video?



# Different FVV approaches

- *4DReplay* →

- Professional cameras
- Non real time
- Dense camera configuration



- Intel *freeD* Technology →

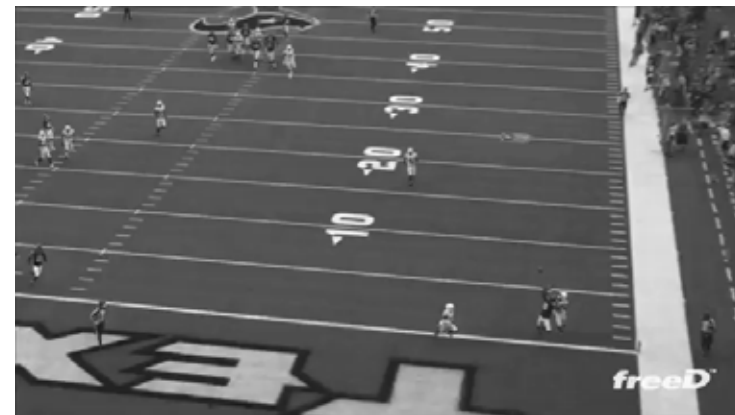
- Professional cameras
- Non real time
- Velocity/Perception tricks



# (Unknown) System to be analyzed

- (Unknown) System properties:
  - Real time operation
  - Free navigation – Real interaction
  - Unpredictability of synthesized trajectories
- Research questions:
  - How the subjective quality of synthesized view trajectories is evaluated? (*objective of this talk*)
  - How the quality of immersiveness / interaction is evaluated? (*not here*)
- System evaluation (Synthesis) versus Content evaluation (Camera dependent)

## Velocity/Perception tricks



## (Unknown) System to be analyzed

- Content assessment → Well established procedures
- System evaluation → Many undefined options
  - Camera setting: array/linear, number, baseline(s), ...
  - Camera video quality: optics, frame-rate, spatial resolution, ...
  - Transmission effects (mainly bit-rate limitation)
  - User interaction
  - ...
- **Need for the definition of a reproducible testing scheme**  
→ **scenario and procedure**

# Test contents

- Set of videos (RAW videos) where a virtual camera travels along a dense path of virtual viewpoints generated using the same set of reference cameras  
→ the camera path is the key element for the quality assessment
- Test contents should contain:
  - Different scenarios with different levels of complexity
  - Different trajectories for the virtual camera: swing, step in/out, still (at least)
  - Different baseline distances between reference cameras to study the impact of camera array density on subjective quality:
    - all cameras - ½ cameras (double baseline) - ¼ cameras (quadruple baseline)

**contents** = *scenarios* × *trajectories* × *baselines*



# Test contents - Scenarios

## Simple



- Few objects in the scene
- Slow/No movement

## Medium



- More objects in the scene
- Movement
- Occlusions

## Complex



- Scene plenty of objects
- Movement
- Multiple occlusions

# Test contents - Trajectories

**Swing**



**Step In/Out**



**Still**



# Test content – Baseline increase

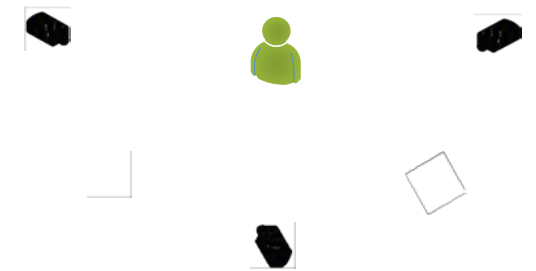
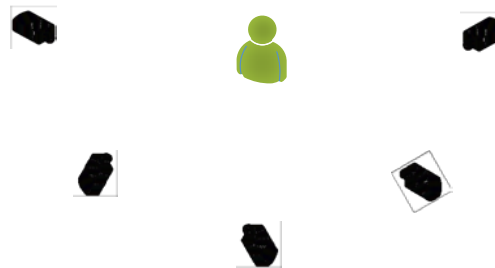
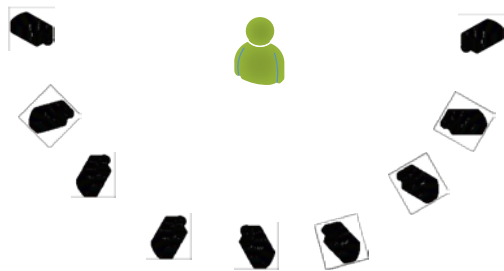
All Cameras



½ Cameras: Double baseline



¼ Cameras: Quadruple baseline

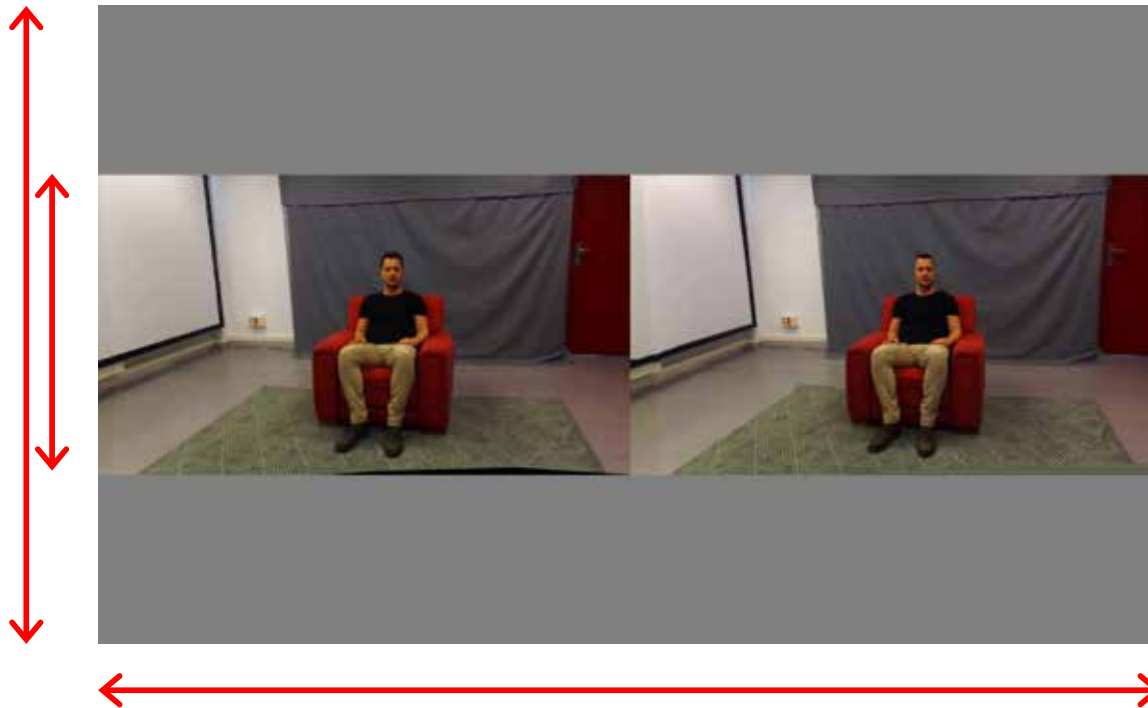


# Test methodology

- Objectives:
  - Comparative analysis of synthesis algorithm with SoA methods
  - Analysis of synthesis quality in an absolute quality range
- Two tests:
  - Paired Comparison versus VSRS (MPEG reference software)
    - Comparison with SoA synthesis algorithms
  - Absolute Category Rating with Hidden Reference
    - Quantitative quality assessment

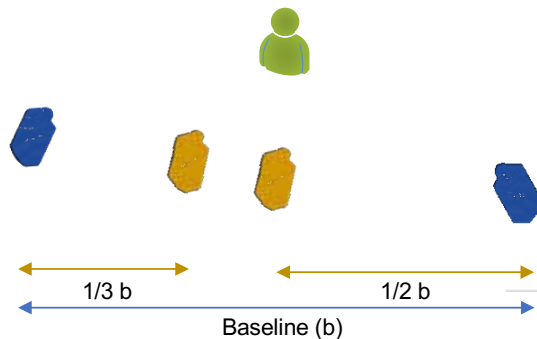
# Test methodology – Paired comparison

- Compare synthesis algorithm with a reference (MPEG-VSRS)
- Simultaneous comparison



## Test methodology – Absolute Category Rating

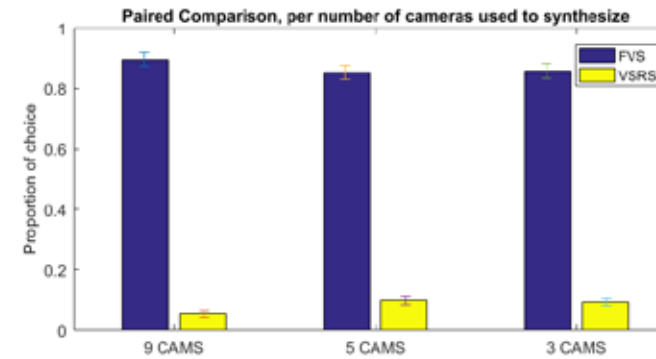
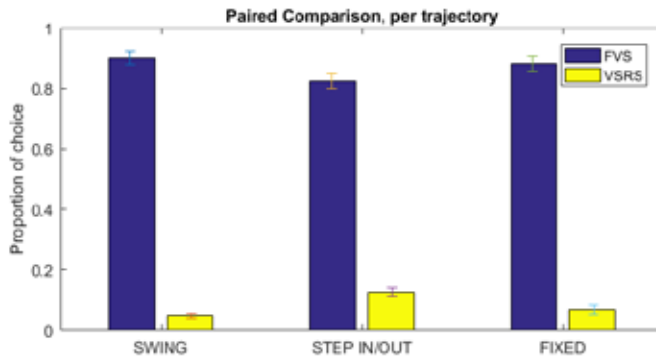
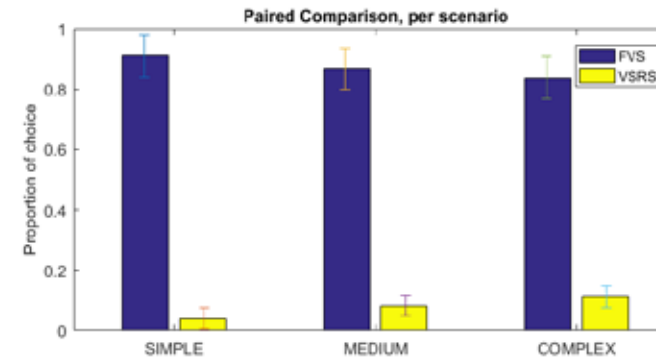
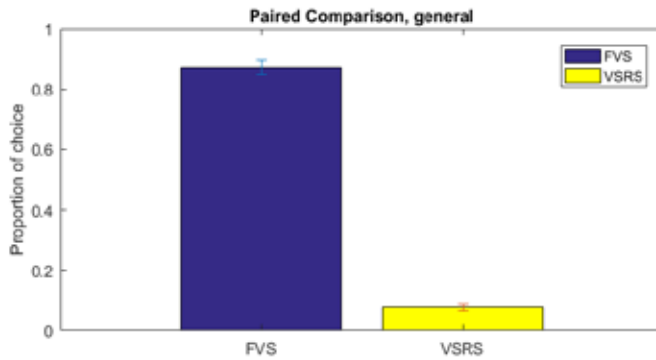
- Analysis of synthesis quality in an absolute quality range
- Show fixed virtual viewpoints:
  - Allows the inclusion of a reference camera as a hidden reference
  - Evaluate quality in different virtual relative positions:
    - Half-way between two closest reference cameras
    - Closer to one of the two reference cameras



# Environment & Equipment

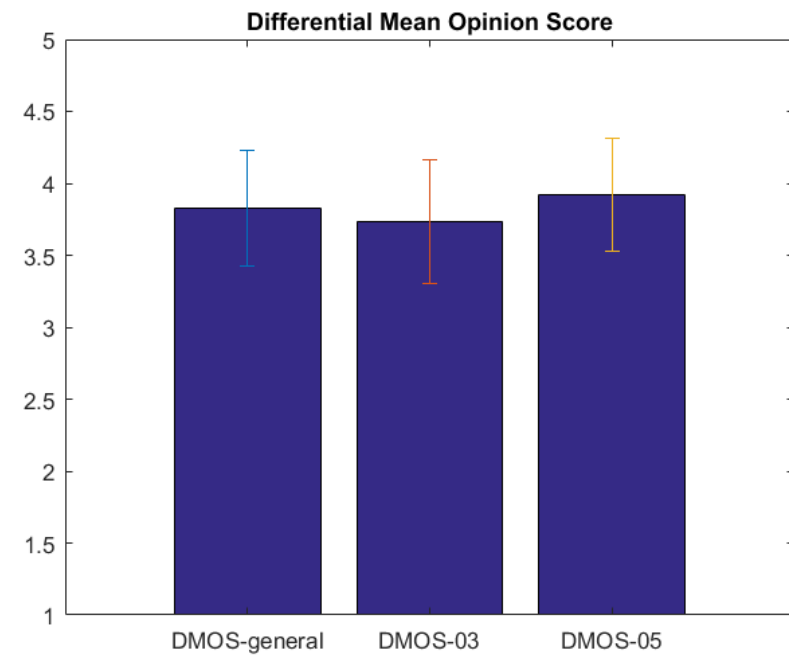
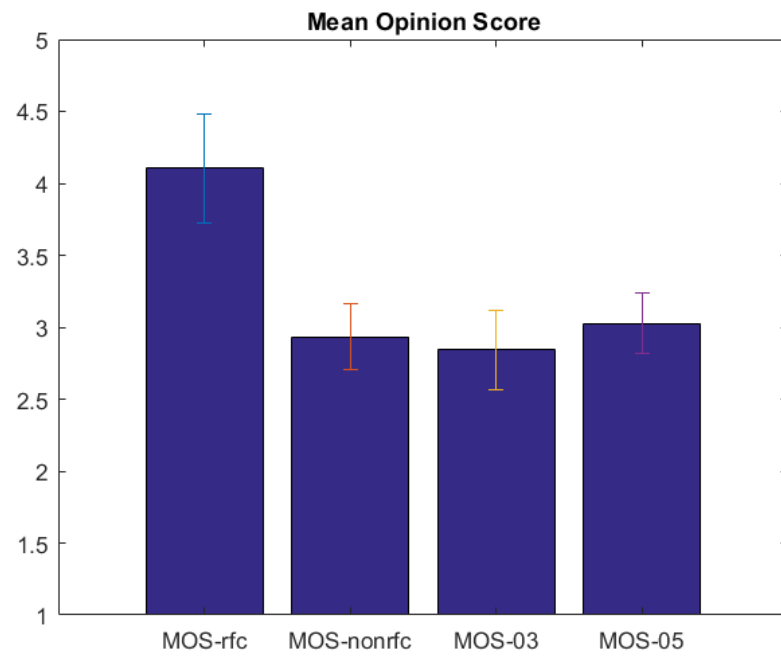
- Ambient lighting conditions controlled to avoid disturbing reflections
- Paired Comparison:
  - Evaluation on a UHD display
  - Distance to visible video: 6H ... *attention to figures!*
- Absolute Category Rating:
  - Evaluation on different devices: fixed display and mobile device
  - Distance to the fixed display: 3H
  - Distance to the mobile device: comfortable for the user

# Results – Paired comparison





# Results – Absolute Category Rating



## Conclusions (lessons learnt)

- FTV techniques should be evaluated on a pre-specified reproducible camera setting:
  - Comparison with an state of the art reference technique (pair comparison)
  - Evaluation of the synthesis quality (quality range)
- Aspects that should be defined in the analysis, due to their influence in synthesis quality:
  - Camera setting (arrangement and density)
  - Virtual view trajectory
  - Lack of reference for some/all virtual view positions
- Video assessment using a combination of tests included in international standards: ITU-T P.913, ITU-T P.910, ITU-R BT.500
  - Paired Comparison: validation of the new technique
  - Absolute Category Rating with Hidden reference: quantitative quality assessment

# Conclusions

- FTV quality assessment requires the identification and normalization of the System Operating Parameters (FTV\_SOP) to conduct a meaningful system evaluation
- Assessment of video synthesis quality requires two parallel/simultaneous evaluations

# Considerations on FTV quality assessment

## Questions – Discussion – Debate - ...

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