Importance of shooting, scene and visualization parameters for subjective tests purpose

Orange Labs, Networks and Carriers
Research & Development

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Context and objective
Context
S-3D systems principle

- **Multiple solutions dedicated to 3D visualization**
  - Anaglyph, active shutters, polarized glasses, etc.
- **Current industrial solutions based on plane images**
  - Conventionnal 2D images (cameras, screen)

Illustration of dissociation between convergence and accommodation

Minimum of 2 views
Objective
To control the perceived depth for testing purpose

- Strong relation between shooting parameters and viewing configuration
  - Shooting parameters: focal length (f), inter-camera baseline (b), convergence distance (d)
  - Visualisation parameters: screen distance (D), screen size (M), inter-ocular distance (B)

Restituted space = f(shooting and scene parameters, visualisation parameters)

- It is essential to model and control the perceived depth to better understand end-users’ opinion about the overall visual experience and related perceptual components
Tools to model and control the perceived depth
Perceived depth

Key concepts

- **Real space**
  - **Scene parameters**
    - Foreground, background and ROI distances
  - **Shooting parameters**
    - Baseline, focal length and convergence distance

- **Restituted space**
  - **Visualisation environment**
    - Viewing distance, screen size and ocular distance
  - **Depth parameters**
    - Foreground, background and ROI distances
    - Dimensions: local depth variations (Dx, Dy, Dz)
    - Shape: roundness of objects (Ds=Dx/Dz)
  - **Comfortable viewing area**
    - Maximum crossed and uncrossed disparities
    - DoF

Diagram:

- Comfortable viewing area?

Values:

- 0.1 diopter
- 0.2 diopter
- 0.3 diopter
- -0.1 diopter
- -0.2 diopter
- -0.3 diopter

Dimensions:

- 11.8 m
- 5.4 m
- 3.5 m
- 2.6 m
- 2 m
- 1.7 m
- 1.3 m
- 0 m
Stereo calculator software
To control depth rendering and to minimize Visual Discomfort

Graphical view of warnings considering HVS features

ROI depth and shape distortions visualization

Scene configuration
Shooting parameters
Viewing environment

Optimization proposals

Depth and shape distortion curves
Stereo calculator software
To control depth rendering and to minimize visual discomfort

- Scene configuration
- Shooting parameters

- Visualization environment

Parameter graphical view

- Background: 5.0000 m
- Region of interest: 3.0000 m
- Convergence distance: 2.6000 m
- Foreground: 2.0000 m
- Focal length: 22.5000 mm
- Inter-camera baseline: 35.0000 mm

Display size: 40" (16:9) 1.0163 m x 0.5720
Display definition: 1920x1080 HD 1080

Viewing distance: 2.6000 m
Interpupil baseline: 65.0100 mm

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Impact of shooting parameters on perceived depth (camera baseline case)
To model and control the depth rendering
Impact of shooting parameters on the final perceived depth

Baseline = 65 mm
Viewing distance = 4.5 H
To model and control the depth rendering
Impact of shooting parameters on the final perceived depth

Baseline = 35 mm
Viewing distance = 4.5 H
To model and control the depth rendering
Impact of shooting parameters on the final perceived depth

Baseline = 85 mm
Viewing distance = 4.5 H
Impact of viewing parameters on perceived depth (viewing distance case)
To model and control the depth rendering
Impact of visualisation parameters on the final perceived depth

Baseline = 65 mm
Viewing distance = 4.5 H
To model and control the depth rendering

Impact of visualisation parameters on the final perceived depth

Baseline = 65 mm
Viewing distance = 3 H
To model and control the depth rendering
Impact of visualisation parameters on the final perceived depth

Baseline = 65 mm
Viewing distance = 6 H
Conclusion
Importance of scene, shooting and visualization parameters

- Perceived depth as well as depth distortions are depending on:
  - Scene parameters: foreground, background and ROI distances
  - Shooting parameters: camera baseline, focal length and convergence distance
  - Visualization parameters: display size, interocular distance and viewing distance

- Exemple: 1mn of arc criteria used in 2D to define the viewing distance will impact depth perception and visual comfort of viewers
  - 6H viewing distance in case of Line Interleave 3D displays (HD screen)
  - 3H viewing distance in case of active shutters (HD screen)

- Proposal: it is essential to provide scene, shooting and visualization parameters
  - To better understand and to analyse viewers’ opinion about the 3D video QoE
  - To compare subjective test results from different studies and/or laboratories
Thank you! Question?