Visibility of Digital Artifacts in 3DTV

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3D@Home Meeting  December 2010
Example of Recent GT Research
No-Reference VQ Algorithm, Commercialized at VQLink
Goals of 3D TV Research

- Understanding visibility of artifacts in 3D (vs 2D)
- Developing an actionable taxonomy of 3D artifacts
- Objective measurement of 3D Video Quality (3DVQ)
- Use of 3DVQ in enhancing QoE in 3DTV
  - Initial Focus on Compression and Network Effects
Testbed Architecture

Software
- Stereoscopic Player (3DTV.at)
- nVidia stereo
- Adobe Creative Suite4 for 3D
  Creating, editing, encoding, transcoding
Content: Initial Database for Research

  - 3D Racing clip as full 3D reference
  - Heidelberg clip for studying isolation
- [www.stereomaker.net/sample/index.html](http://www.stereomaker.net/sample/index.html)
  - Disney, sled and flower clips for compression effects
- [www.youtube.com/watch?v=TV12dCXctCA&fmt=22](https://www.youtube.com/watch?v=TV12dCXctCA&fmt=22)
- [www.youtube.com/watch?v=moINIZuG38E](https://www.youtube.com/watch?v=moINIZuG38E)
- [www.youtube.com/watch?v=3DFizuDjkNQ&playnext from=TL&videos=Ub z52EU4RU](https://www.youtube.com/watch?v=3DFizuDjkNQ&playnext from=TL&videos=Ub z52EU4RU)

- ClearQAM HD captures including Masters Clip
Visibility of artifacts in 3D
Complex, Content-Dependent, Asymmetric
Example of 3D Artifacts: Blockiness

left view is worse...more prominent in video view
Example of 3D Artifacts: Blurriness
this demo better in still..loss of detail in oval area

Left Eye View

Right Eye View
Example of 3D Artifacts: Washed away look
left is better... clear in video view as well

Left Eye View

Right Eye View
Example of 3D Artifacts: Posterization

Easier to see in 3D video view
Examples from FC-3D TV Research Clip
Compression Artifact in 3D FC Example

*Left more jagged in zoom*

Transmitted frame compatible video signal

Re-expanded left eye view (magnified)  Re-expanded right eye view (magnified)
Network Artifact in 3D FC example

Transmitted frame compatible video signal

Re-expanded left eye view

Re-expanded right eye view
Blocked View Artifact in 3D FC Example

Poor filming
Two Program (Isolation) Test

Viewers had to block 1 or 2 eyes, in absence of driver control

Program 1

Program 2

Composite
Questionnaire for Subjective Test
30 Viewers, trained and untrained

• Viewers were asked the following questions
  (A : active shutter display, B: passive polarization display) :
  – Q1. Full 3D clip: Which was better? (A/B)
  – Q2. Did you see a big difference between full 3D vs. Frame Compatible 3D? (Y/N in A,B)
  – Q3. Are (compression) artifacts more or less visible in 3D? (More/Less in A,B)
  – Q4. Are video artifacts more visible in A or B?
  – Q5. Was the 2-Channel demo better in A or B?
  – Q6. How is your desire to buy a 3DTV or 3D computer monitor after the test? (More/Less/Same)
Results: A=Active Shutter, B=Passive Polarization

Q1. Full 3D clip: Which was better? (A/B)
Q2. See a big difference full 3D vs. Frame Compatible? (Y/N)
Q3. Video artifacts more or less visible in 3D? (More/Less)
Q4. Video artifacts more visible in A or B?
Q5. 2-Channel demo better in A or B?
Q6. Desire to buy a 3DTV or 3D computer monitor after demo? (More/Less/Same)
Conclusions from Subjective Test

• Compared to passive polarization, the active shutter display gave
  – Better full 3D
  – More visibility of artifacts
  – Better isolation for independent channel viewing by multiple viewers
  – But still not good enough separation for serious independent channel viewing

• Subjects were nearly evenly split on
  – Desire to buy a 3DTV after demo:
    • 13 more, 12 same, 2 less
  – Seeing difference in Frame Compatible format
    • 16 yes, 14 no

• Detectability of artifacts in 3D vs. 2D
  – 18 said less detectable in 3D
  – 12 said more detectable in 3D
Next steps in 3D TV Research @ GT

- Creation of a more comprehensive 3D TV database with controllable parameters for encoding and distribution
- Systematic study of artifact causes, masking and cross-masking
  - subsampling, compression, interpolation, display
- Research on depth perception and depth artifacts
- Extension of earlier 2D TV research on quantifying 3D TV artifacts
- Enhancement of 3D TV coding beyond frame-compatible coding
  - optimization of multiview and scalable video coding (MVC, SVC)
  - preprocessing, compression, error concealment, enhancement
- Usability studies in single-display multiple programs
- Application in 3D TV and Multiplayer games
- Opportunities for Industry Partnership
Thanks
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References


References (Contd.)

• M. Cowan, “Multiplexing for 3D Distribution”, Video Services Forum Meeting, Atlanta, GA, February 2010

