Real-time View Synthesis for Virtual Reality and Light Field displays

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Aquisition, Synthesis & Rendering in XR

Camera arrays, plenoptic & GLC cameras

XR, light field displays & holograms

DERS

DIBR: Depth Image-Based Rendering

RVS

3DoF+ 6DoF
MPEG-I immersive media formats

3D Graphics
3D meshes + 2D textures

Light Fields
Multiview + Depth, DIBR

Point Clouds
Octree + modified Video Codec

2020-2022

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Brussels 3DLicorneA project
Acquisition: moving camera (X,Y,Z translations)

Acquisitions along green and blue planes = ULB_Unicorn (in MPEG-I)
Video Acquisition & View Synthesis

15 x 4k Black Magic Cameras

How ??
Synthesis

- Depth map
- Point Cloud
- Camera View
- Virtual View
- Blended
- Hole filling from Camera 1 re-projection
- Triangles between pixel triplets to help hole filling
- Camera 0 Left re-projection
- Camera 0 view
- Right re-projection
RVS 3.1: Reference View Synthesizer

N Input views with associated depth maps
Challenge: Depth estimation

DERS: Depth Estimation Reference Software
Virtual Reality with 4-views RVS
Virtual Reality: 4-views RVS on ULB_Unicorn
Light Field display: 72 output views, Holografika @VUB
Light Field display:
72 output views, Holografika @VUB

72 viewpoints for horizontal parallax
Hologram 4-views RVS
Hologram Photogrammetry: 500 input pictures!

Fur objects (goat, sheep) at the left have been removed from the hologram, because of bad quality in photogrammetry
Comparisons

4-views RVS

8-views RVS

Ref

Holograms

RVS
Comparisons

Photogrammetry (500 pic.)

4-views RVS
RVS: 360 Dataset Museum, perfect depth map
RVS: Dataset Fencing, moderate depth quality
Conclusions

• View Synthesis RVS is mature for 3DoF+/6DoF XR
• Real-time RVS on GPU
• Depth Estimation DERS still requires some attention
• How to define quality for Light Field displays and Holography? (no ref for PSNR, SSIM, etc)
Reference software

http://mpegx.int-evry.fr/software/MPEG/Explorations/6DoF/DERS.git

http://mpegx.int-evry.fr/software/MPEG/Explorations/3DoFplus/RVS/tree/v3.1
Video Point Cloud Coding (V-PCC)

Lossy coding = 20 Mbps
Lossless w/o attributes (geometry only) = 40 – 66 Mbps (1.5 bpv)
Lossless (all attributes) = 200 – 400 Mbps (10 bpv)
Geometry = 15 - 20%, Color = 70 - 84%, Patches = 1 - 10% of total bitrate
Point Cloud Coding: Quality vs. Bitrate

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Augmented Reality with Point Clouds

6DoF with possibility to turn around the objects/persons

http://research.microsoft.com/hoportoation

https://www.3ders.org/articles/20180305-russians-take-ar-selfies-with-40-ft-vladimir-putin.html

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