Streaming Virtual Reality Content

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Outline

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  - Uniform quality mappings
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- Streaming system
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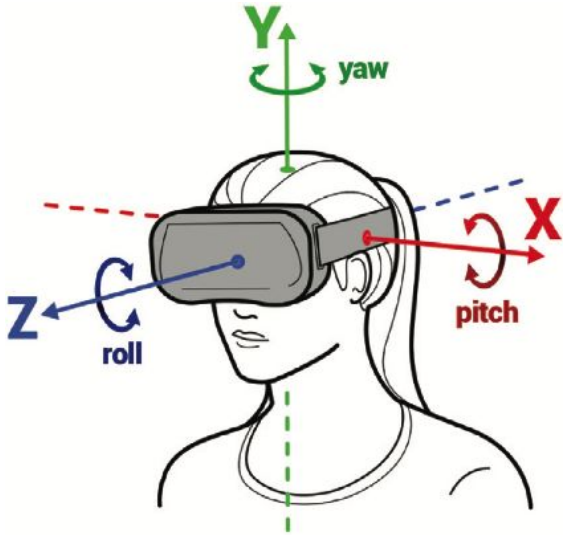
Intorduction

1. This paper briefly talks about virtual reality technology, especially content representation, streaming, and quality assessment
2. Head Mounted Displays (HMDs), such as Oculus Rift, Google Cardboard, Google Daydream, HTC Vive, Sony Playstation VR, and Samsung Gear VR
3. 360-degree camera, such as GoPro Omni, Google Odyssey, Samsung Project Beyond, and Facebook Surround 360
4. Streaming service, such as Facebook and YouTube
5. Cover different aspects related to VR, including projection & tiling & quality assessment.

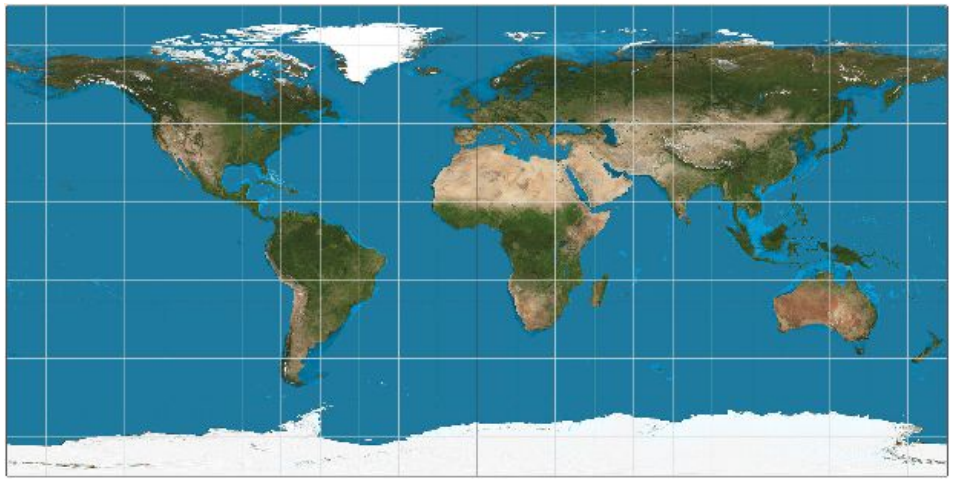


Content representation

- To cover the 360 space, VR videos are typically shot using multiple cameras pointing at different directions
- To Compress the video using standard commercial encoders, we need the video to be in a planar format, that is projection.
- There are two sphere-to-plane mappings,
  a. uniform quality mappings
  b. variable quality mappings

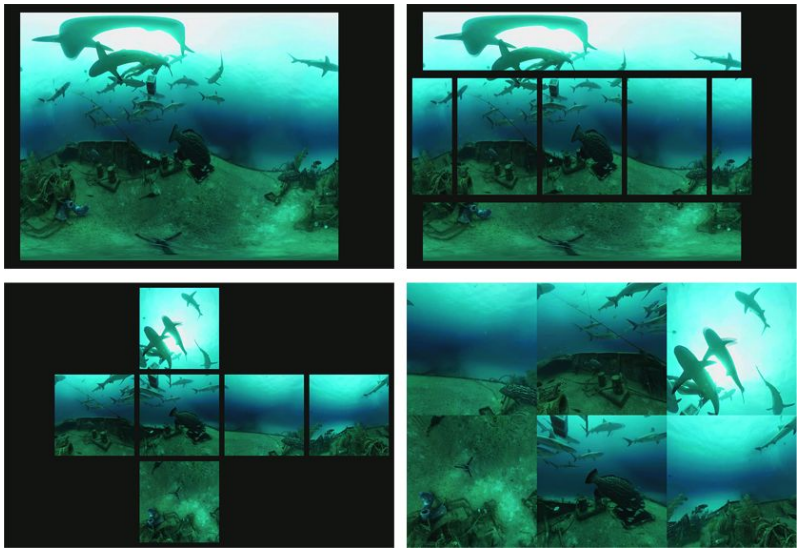
Uniform quality mappings

- equirectangular projection

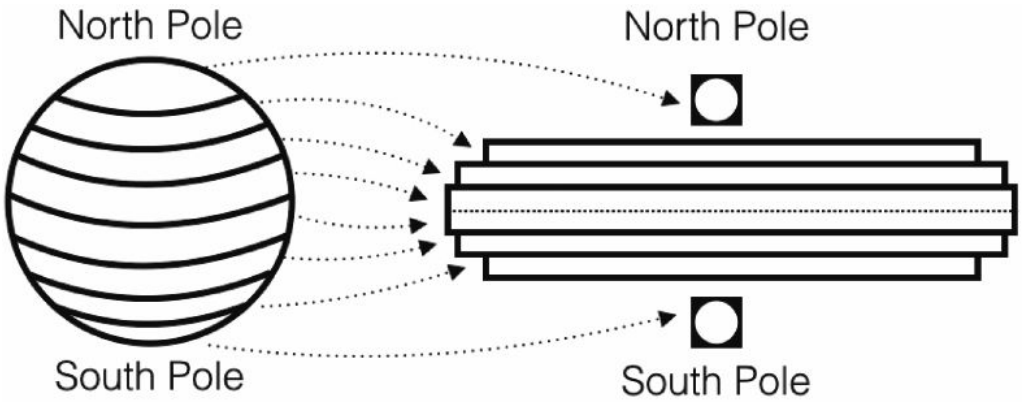


Content representation (cont.)

- Cubemap projection

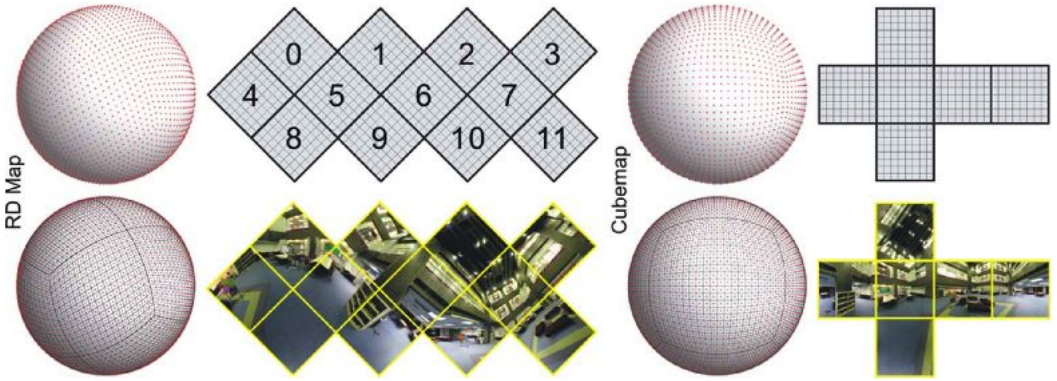


- Tile segmentation scheme



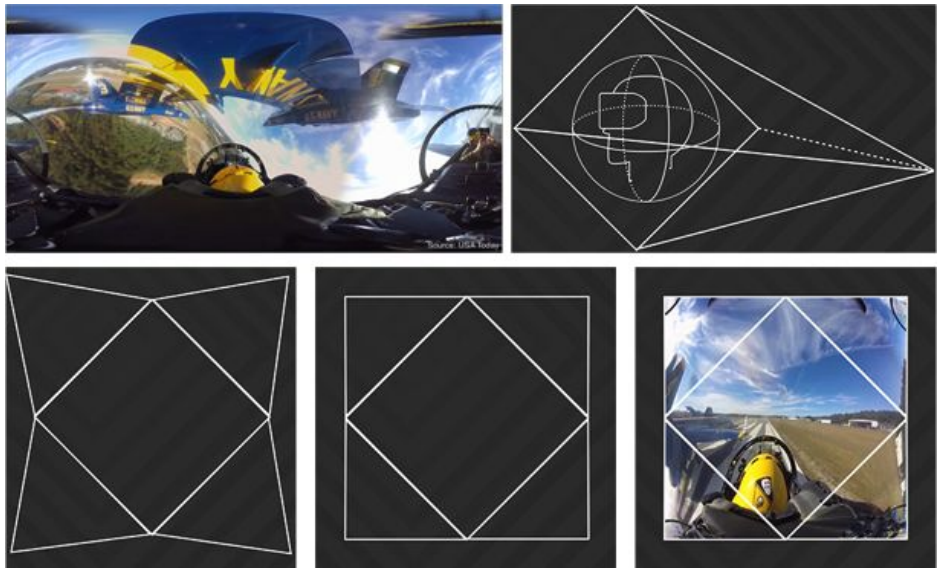
Content representation (cont.)

- Rhombic Dodecahedron Map (RD-map)



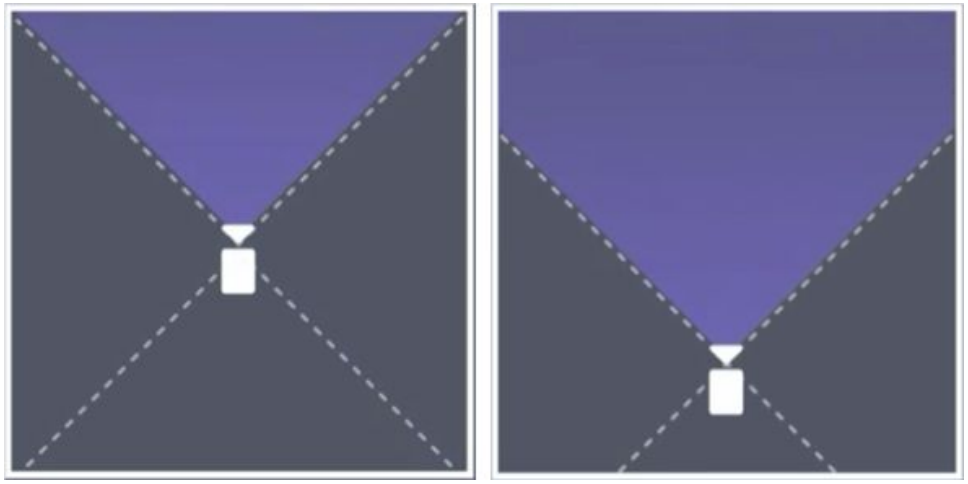
Variable quality mappings

- Pyramid projection



Content representation (cont.)

- Offset-cubemap Projection



Tiled/RoI streaming

- We only stream RoI with high quality while minimizing the quality of the rest of the video and saving the user bandwidth
- Region of Interest (ROI)

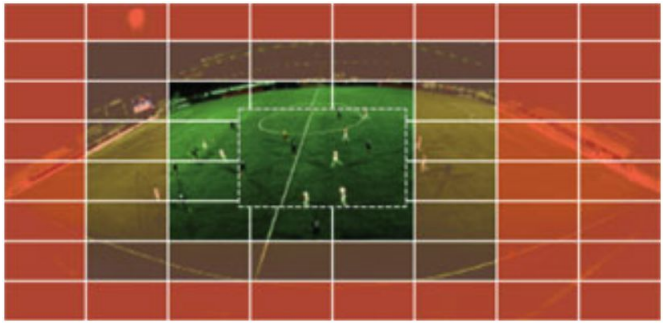
- There are some challenges,
  - Encoding performance
  - Stitching / blending problem
  - Frequency of adaptation
  - Different user profiles

Tiled/RoI streaming (cont.)

- To support tiled streaming, D'Acunto et al. [26] make use of the MPEG-DASH Spatial Relationship Description (SRD) [32] extensions to support tiled streaming.
- To mix tile resolutions, Wang et al. [23] studied the effect of mixing tile resolutions on the quality perceived by the users
- One of the challenges is having multiple decoders at the client side to decode each independent tile, Sanchez et al. [31] addressed this challenge to support devices having a single hardware decoder
- De Praeter [24] takes these problems by sending each user a personalized view of the video

Streaming systems

- Partial delivery systems
  - Inoue et al. [34] propose a tile-based adaptive rate adaptation system using H.264 multiple view MVC standard, each tile in the video is encoded at multiple bitrates
- Full delivery systems
  - Gaddam et al. [29] developed a streaming system for panoramic videos based on tiling methods, they exploit 4 tiling schemes in their system



Pyramid

- Predictive systems
  - Qian et al. [13] stream only the visible portion of the video based on head movement prediction

Quality assessment

- To evaluate the quality of VR content

- Yu et al. [36] investigate how to assess the quality of 360 videos under different projections and evaluate their coding efficiency

- Zakharchenko et al. [37] propose an objective quality estimation method for spherical videos

Conclusion

1. Different ways to represent spherical content to 2D plane in a compatible way with standard encoders.
2. Different solution for streaming high resolution videos under limited bandwidth
3. Show recent attempts for VR streaming systems
4. Multiple models that can be used to asses the QoE for a VR streaming system