Group Partitioning Method for Viewport-dependent MPEG Immersive Video Streaming

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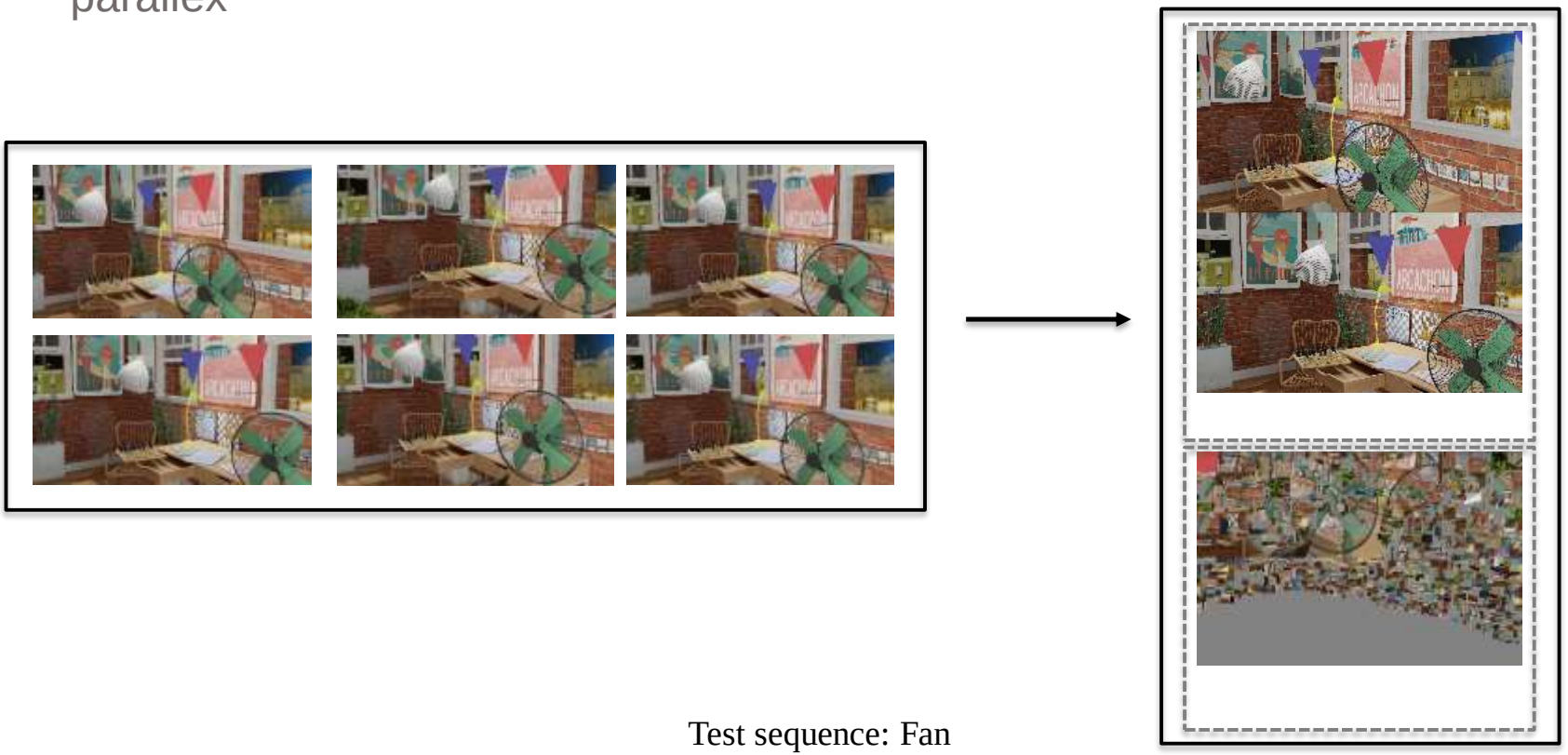
Background

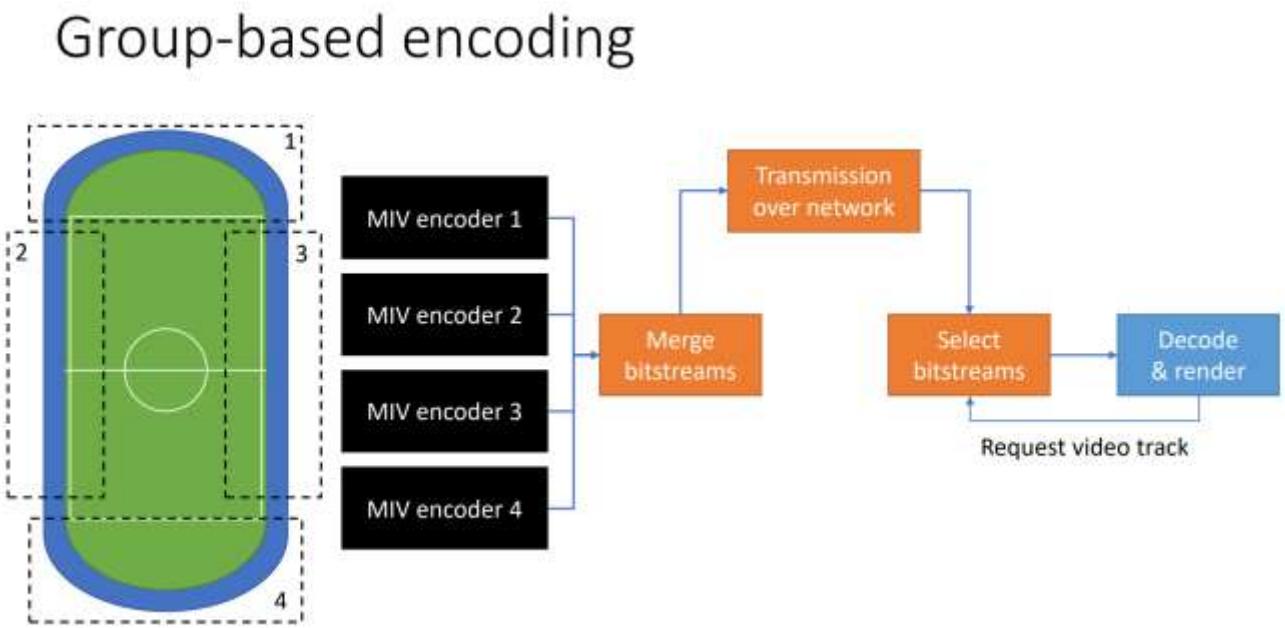
- Test model for MPEG immersive video (TMIV)
  - Multi-view processing for DIBR(Depth Image-based Rendering) technique
  - **Basic view** contains complete view information
  - **Patch (Additional view)** contains side information for occlusion, motion parallex



Test sequence: Fan

Grouping for 6DoF Sequence

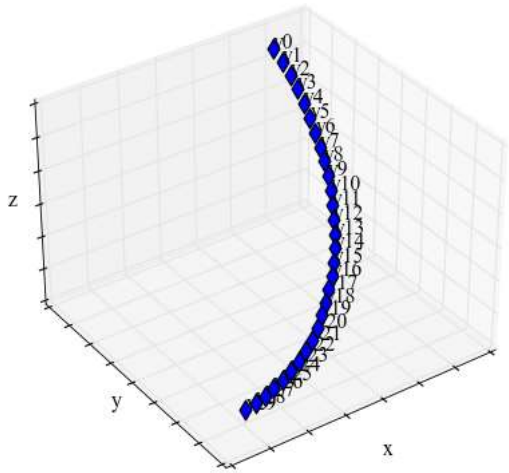
- Group-based MIV
  - The MIV standard enables video codecs to handle multiple inputs through the inter-view redundancy removal process
  - Group-based MIV for partial access (e.g., Viewport-dependent streaming)



Source: ISO/IEC SC29 WG4, http://mpegx.int-evry.fr/software/MPEG/MIV/RS/TM1/-/issues/670#note_63449

Experimental Condition

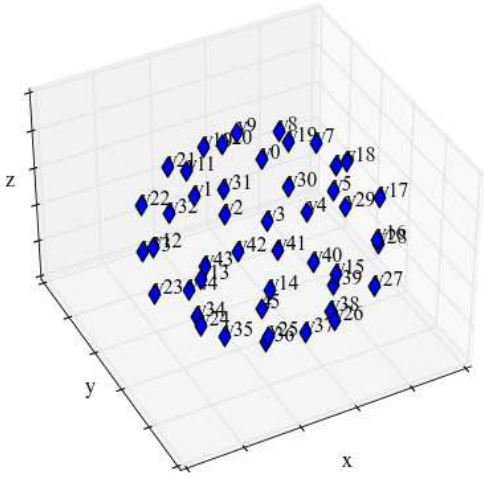
- Test Material
  - CBA Basketball
  - Natural Content (NC) videos consisting of 30 cameras, each perspective of 2048x1088 perspective views



Camera Visualization
'CBA Basketball'

Experimental Condition (-Cont'd)

- Test Material
  - Guitarist
  - Natural Content (NC) videos consisting of 46 cameras, each perspective of 2048x2048 ERP views



Camera Visualization
'Guitarist'

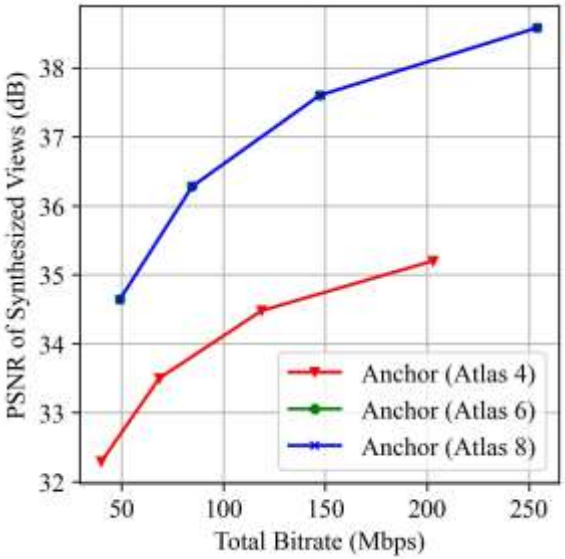
Experimental Condition (-Cont'd)

- Experimental Conditions (Atlas Generation)
  - MIV anchor and group-based method comparison
  - (atlas4 vs. group2) / (atlas6 vs. group3) / (atlas8 vs. group4)
  - The total number of basic views is the same ("maxBasicViewFraction": 0.5)
  - The maximum resolution of one atlas is fixed ("maxLumaPictureSize" : 8912896)
  - Comparison conditions, "maxAtlases": 4 (group=2) / 6 (group=3) / 8 (group=4)

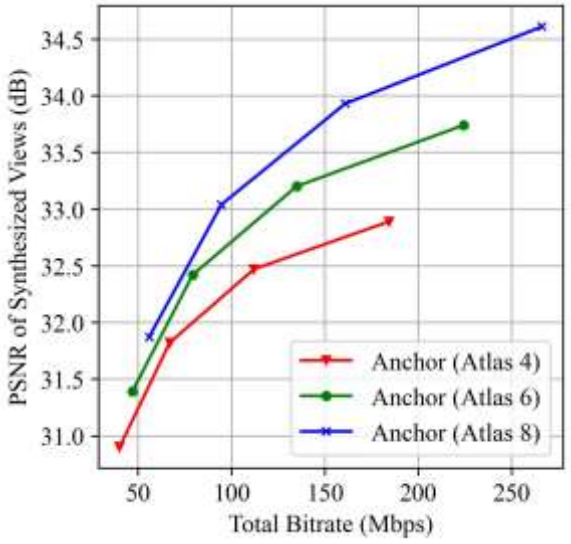
Basketball group=2
(Atlas=4)

Experimental Results

- Experimental Results
  - TMIV 11.1 + HM 16.16, Atlas(4/6/8) vs Group(2/3/4), 17frame (atlas4 vs. group2) / (atlas6 vs. group3) / (atlas8 vs. group4)
  - tex QP={20,25,30,35}, geo QP={5,10,15,20}
  - Rate-distortion (RD) curves – bitrate in X-axis, quality in Y-axis
  - Bjontegaard-delta rate (BD-rate): performance evaluation on bitrate saving
  - In the case of basketball, there is no change in performance even if the number of atlas increases to 6 (saturation)



RD-curves of Basketball (Atlas4,6,8)



RD-curves of Guitarist (Atlas4,6,8)

Experimental Results (-Cont'd)

- Experimental Results
  - **CBA Basketball group-overhead**
  - Fewer groups cause more overhead, but as the number of groups increases, it is observed that the improvement in restoration quality exceeds overhead

Basketball
(Atlas4 vs Group2)

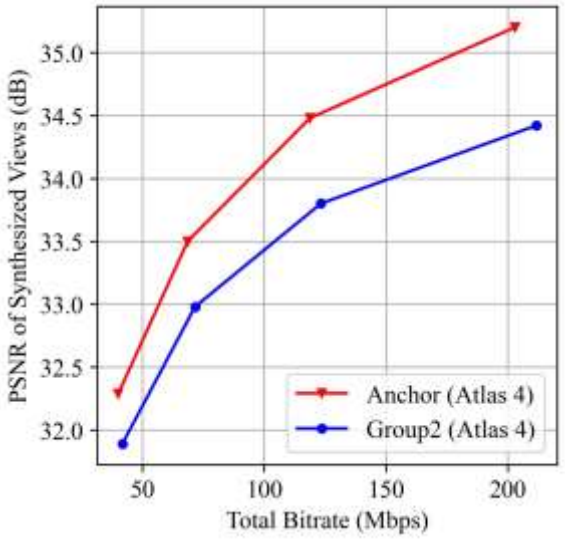
Y-PSNR BD-rate (%)
44.17%

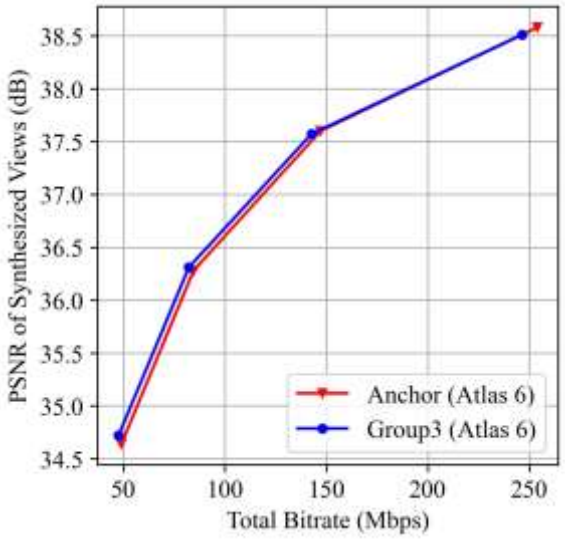
Basketball
(Atlas6 vs Group3)

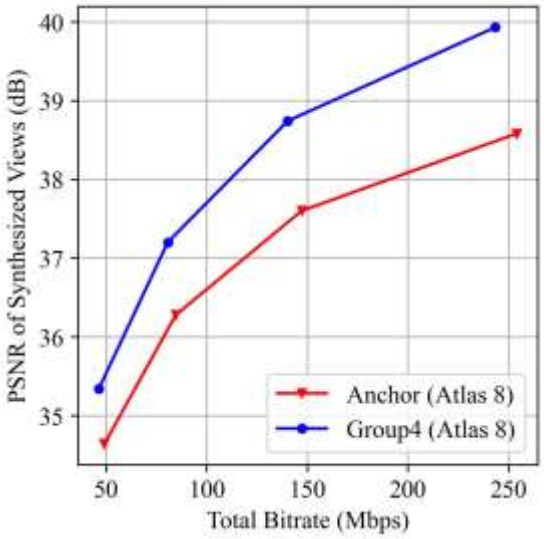
Y-PSNR BD-rate (%)
-2.96%

Basketball
(Atlas8 vs Group4)

Y-PSNR BD-rate (%)
-34.29%





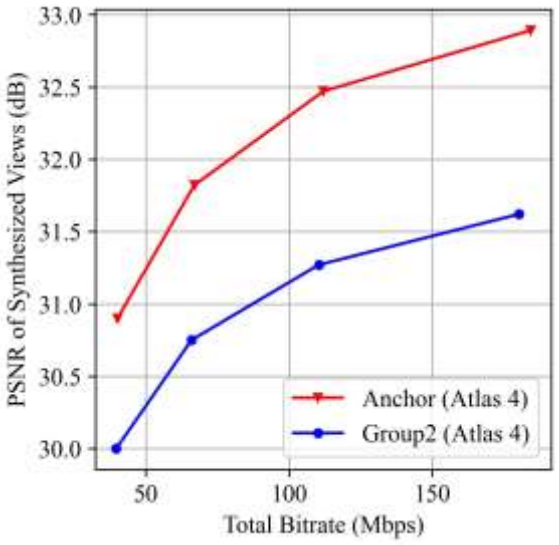


Experimental Results (-Cont'd)

- Experimental Results
  - **Guitarist group-overhead**
  - Fewer groups cause more overhead, but as the number of groups increases, it is observed that the improvement in restoration quality exceeds overhead

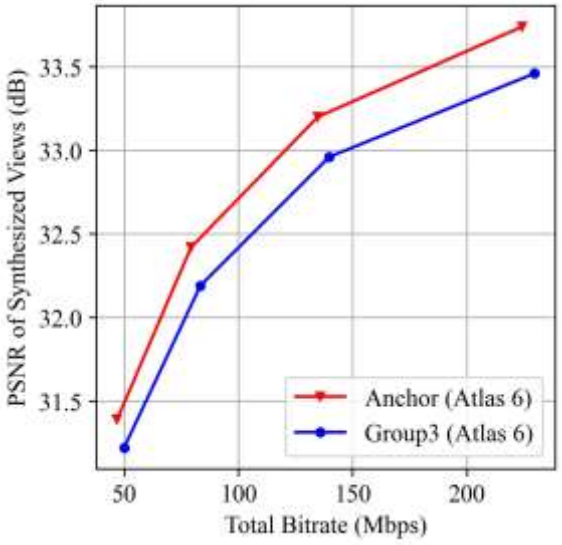
Guitarist
(Atlas4 vs Group2)

Y-PSNR BD-rate (%)
132.75%



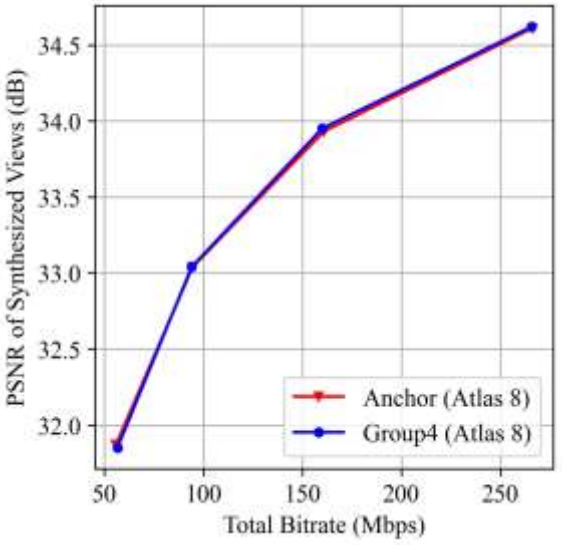
Guitarist
(Atlas6 vs Group3)

Y-PSNR BD-rate (%)
21.74%



Guitarist
(Atlas8 vs Group4)

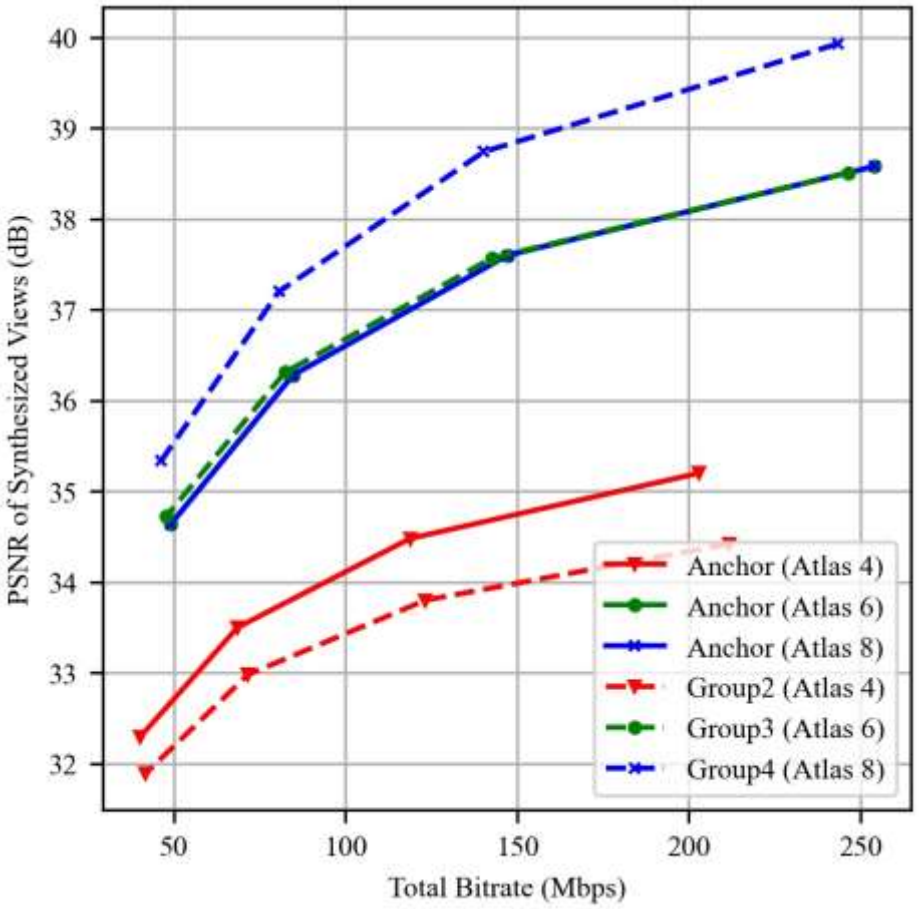
Y-PSNR BD-rate (%)
-0.42%



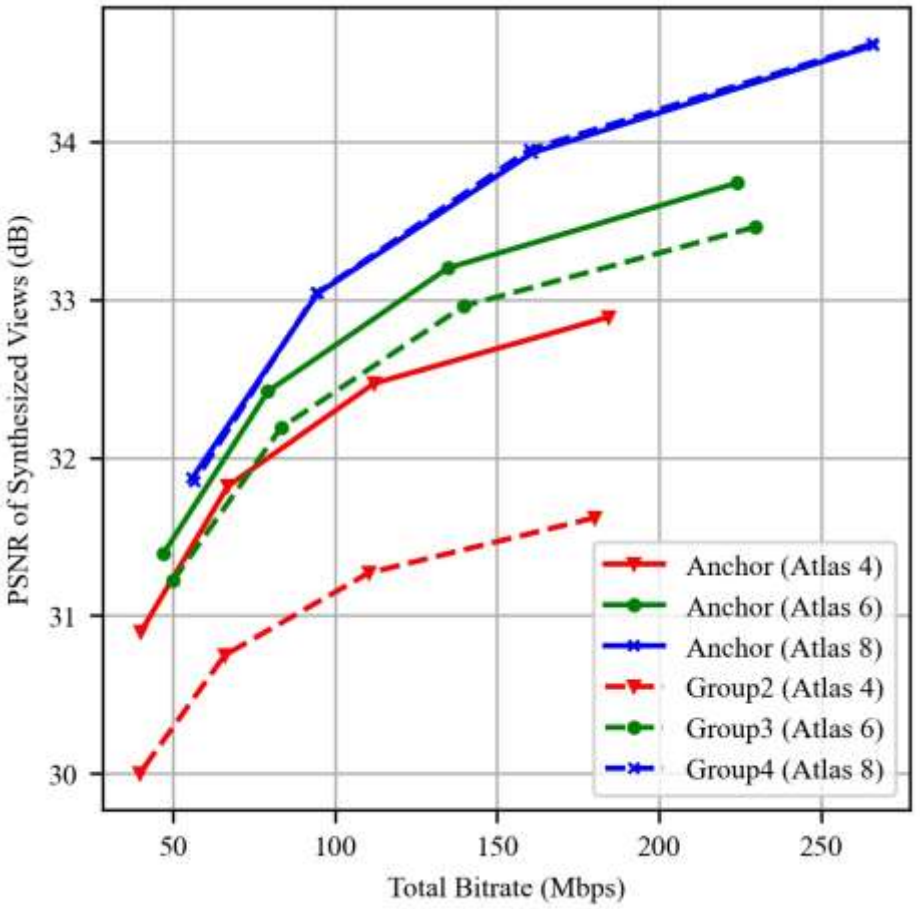
Conclusion

- Motivation
  - Group-based MIV can be used for partial access (e.g., Viewport-dependent streaming)
  - There is no clear solution for viewport-adaptive MIV streaming
- Proposed Methods and Insights
  - As the number of groups increases, it is observed that the improvement in restoration quality exceeds overhead
  - Overall pixel rate increased by up to about 45% with the number of groups, but considering viewport-adaptive streaming scenarios, it is not considered as a big issue
- Future Work
  - Experiments on viewport-adaptive MIV streaming will be conducted

Appendix

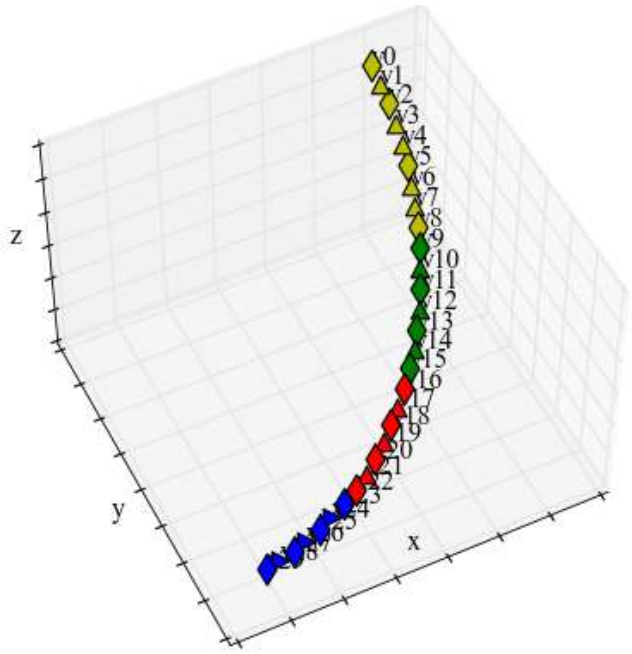


RD-curves of Basketball

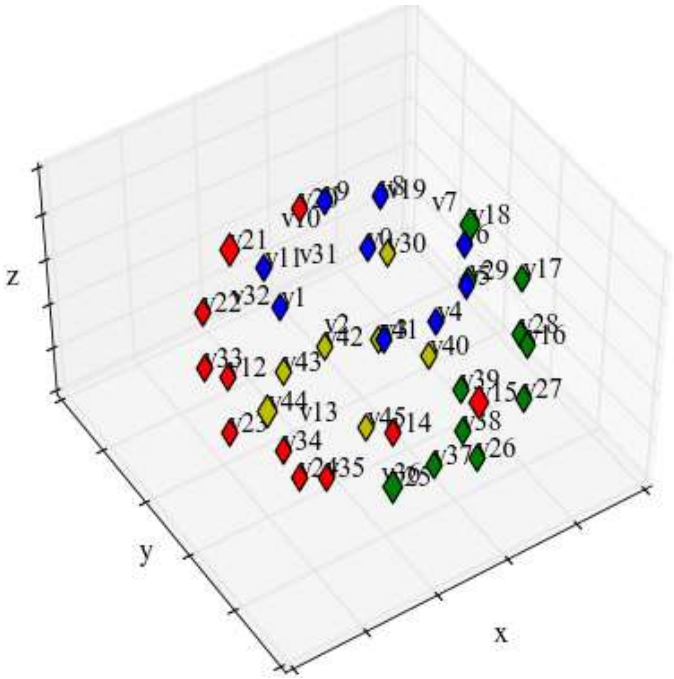


RD-curves of Guitarist

Appendix



Group4 Camera
Visualization (Basketball)



Group4 Camera
Visualization (Guitarist)