

# **VIEWPORT-ADAPTIVE ENCODING AND STREAMING OF 360-DEGREE VIDEO FOR VIRTUAL REALITY APPLICATIONS**

Kammachi-Sreedhar et al.  
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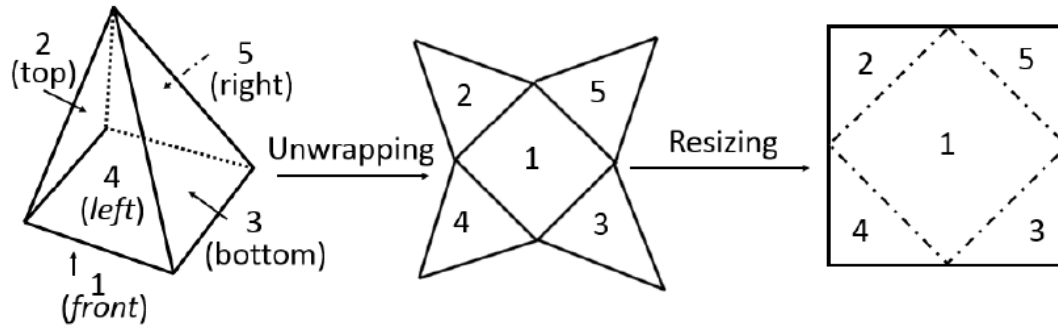
# INTRODUCTION

It's sub-optimal to send the whole 360-degree video content in full resolution over a streaming

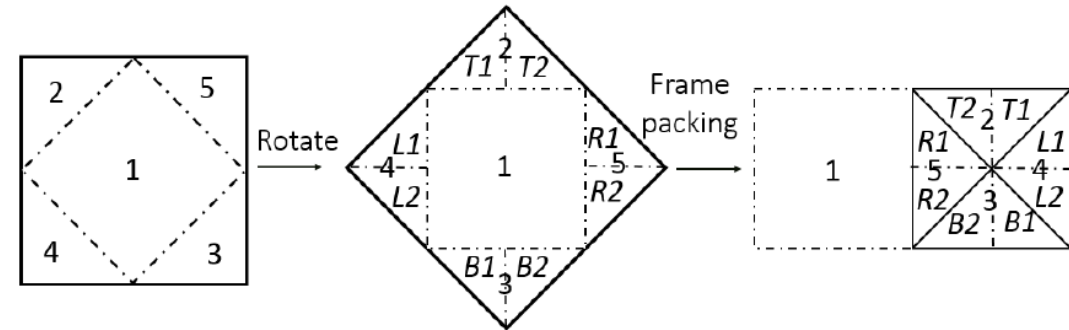
The paper proposed the **multi-resolution** versions of the ERP and CMP schemes

It also developed methodology for comparing the **rate-distortion (RD)** performance of the schemes

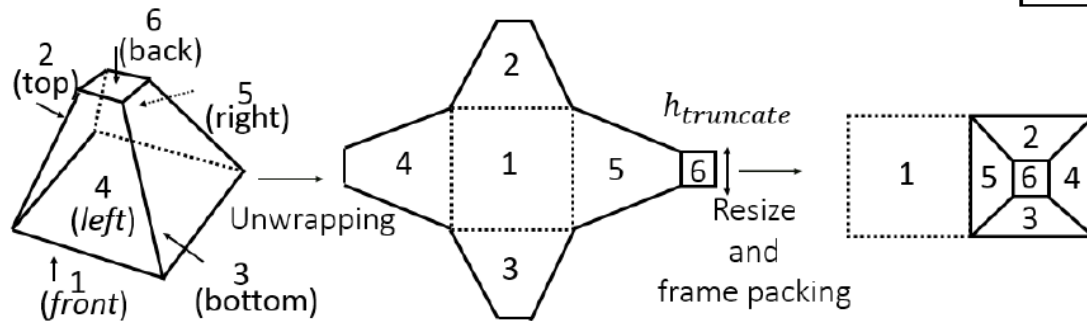
# VIEWPORT DEPENDENT MAPPING



**Rhombic Pyramidal Mapping**



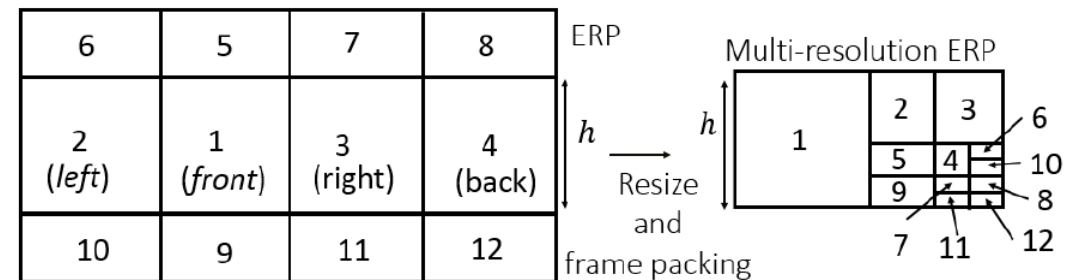
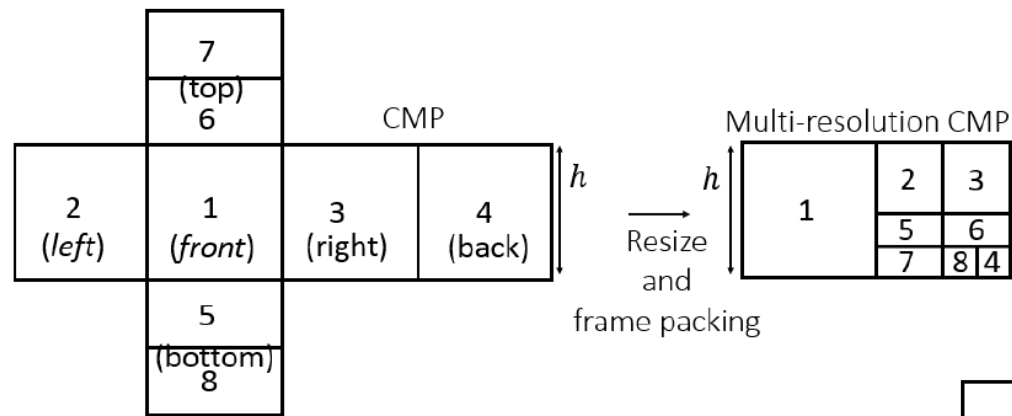
**Square Pyramid Mapping**



**Truncated Pyramid Mapping**

# VIEWPORT DEPENDENT MAPPING CONT.

## Multi-resolution *Equirectangle* and *Cubemap* Projections

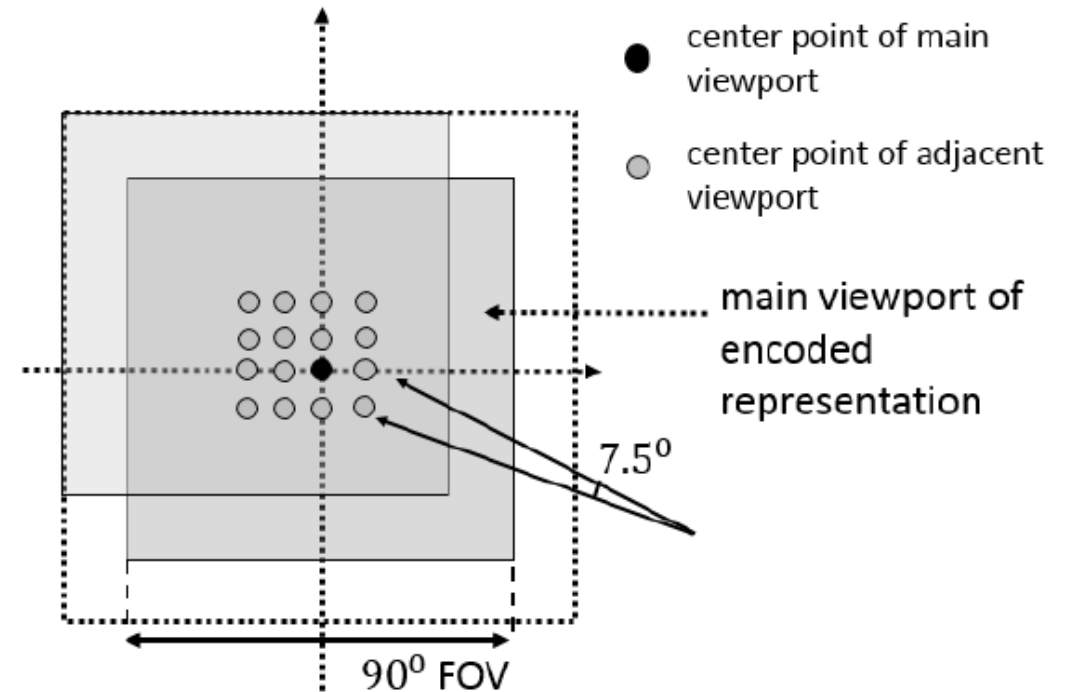


# OBJECTIVE METRICS - MAIN VIEWPORT

The orientation of the client might not match the ideal orientation (main viewport) assumed in the encoding

Calculate the PSNR over the range of viewing orientations around the center of the main viewport

16 uniformly distributed orientations



# OBJECTIVE METRICS - BACKGROUND

Instead of subjective testing, they measure the PSNR of the other faces in the spherical domain

When the approaches have similar RD performance for the main face and the secondary faces, it can be assumed that they have similar subjective quality in response to head turning

# EXPERIMENTS

Full resolution ERP is used as an anchor method for evaluating the performance of other projection types

RD performance is calculated by averaging the bitrate over **12 viewports**

PSNR is averaged over **16 center points** for a given viewport

Eight test sequences of 49 frames with the frame rate of 25 fps

# RESULTS

TABLE I. COMPRESSION PERFORMANCE OF DIFFERENT MAPPINGS IN THE FRONT VIEWPORT BD-RATE(%).

Sequences	Resolutions ( W x H )	Rhombic Pyramid	Square Pyramid	Truncated Pyramid	Multi-resolution Equirectangle	Multi-resolution Cubemap
MyShelter-sta	2048x1024	8.34%	-10.34%	-10.76%	-14.64%	-14.21%
MyShelter-mov	2048x1024	38.52%	-15.87%	-18.27%	-20.97%	-23.16%
Kremlin	4096x2048	-8.47%	-30.1%	-30.39%	-37.49%	-40.89%
Lisboa	4096x2048	8.51%	-18.91%	-19.57%	-34.8%	-23.62%
Moscow	4096x2048	9.64%	-14.44%	-14.84%	-14.59%	-16.84%
Daisy	3072x1536	13.04%	-19.04%	-19.42%	-27.93%	-29.46%
Sheriff	4096x2048	3.32%	-23.02%	-22.97%	-26.54%	-31.46%
VRC-concert	3072x1536	19.83%	-31.29%	-32.06%	-39.71%	-34.02%
Average		11.59%	-20.38%	-21.04%	-27.08%	-26.71%

TABLE II. COMPRESSION PERFORMANCE OF DIFFERENT MAPPINGS IN THE BACKGROUND BD-RATE(%).

Sequences	Rhombic Pyramid	Square Pyramid	Truncated Pyramid	Multi-resolution Equirectangle	Multi-resolution Cubemap
Average	24.3%	-19.7%	-30.92%	-30.6%	-31.2%



# RESULTS CONT.

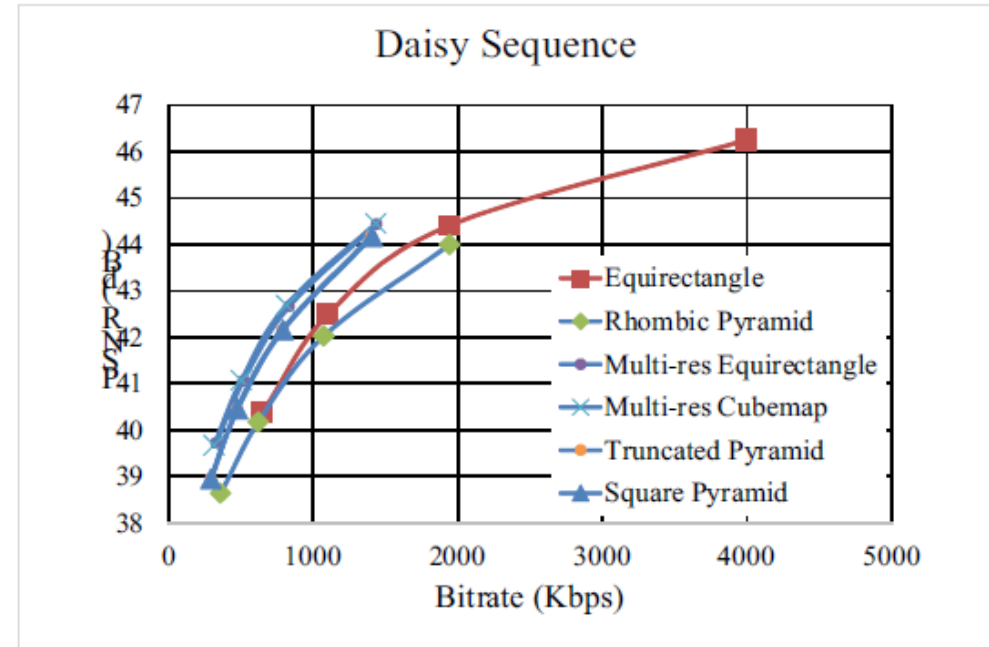
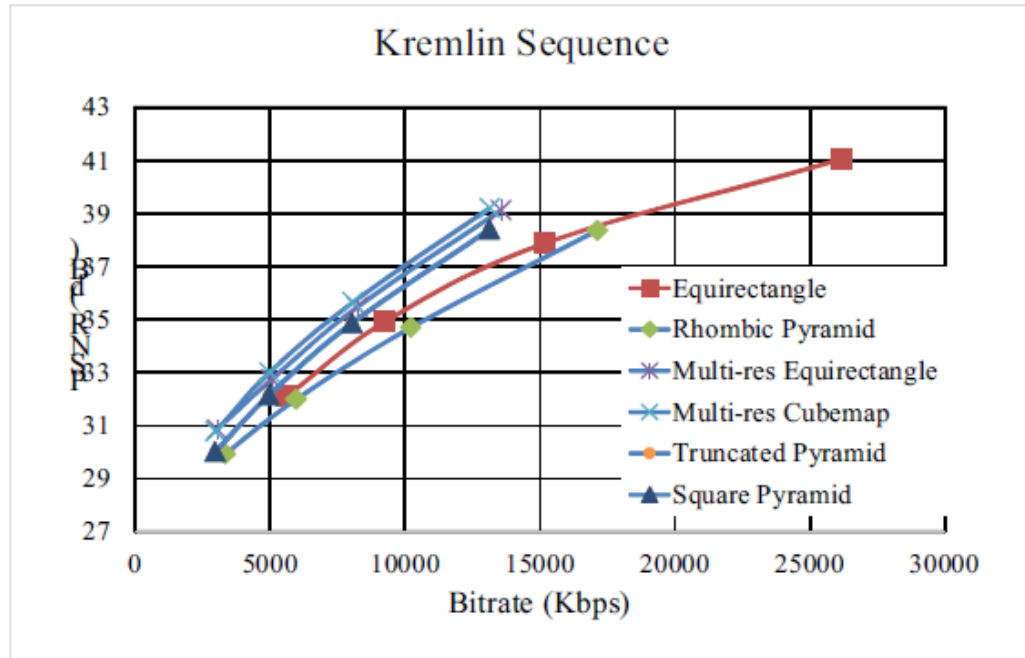
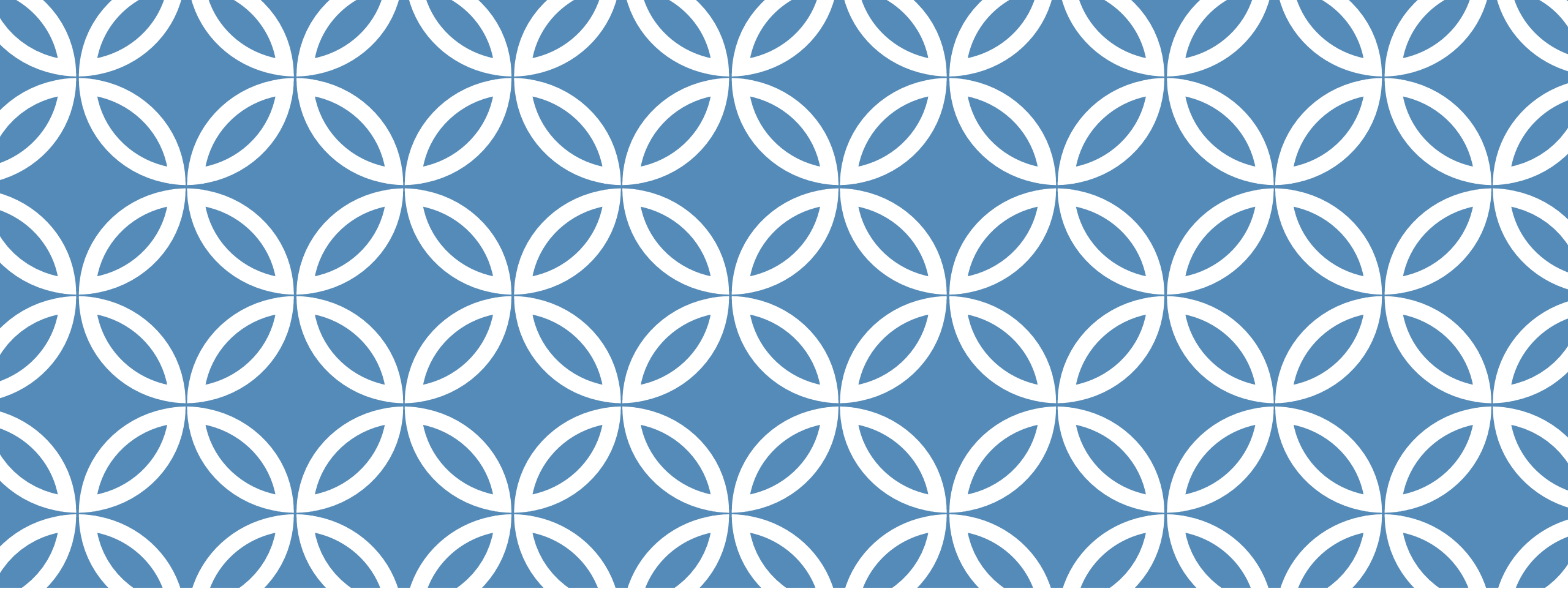


Figure 7. RD Curve, viewport dependent vs full resolution ERP streaming for Kremlin and Daisy sequences.

# CONCLUSION

The objective metric measures the distortion over a range of viewing orientations from the given main viewport center

The multiresolution versions of Equirectangle and Cubemap projection schemes achieved significant compression gains against other viewport-adaptive schemes



**THX FOR LISTENING!**

Questions?