Cristal Laboratory, National School of Computer Sciences (ENSI), Manouba, Tunisia

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DEPTH MAPS FAST SCALABLE COMPRESSION BASED ON CODING UNIT DEPTH

Sonia Mosbah, Dorsaf Sebai and Faouzi Ghorbel

PLAN

- Introduction
- Proposed coding unit partitioning method
- Experiments and results
- Conclusion and perspectives

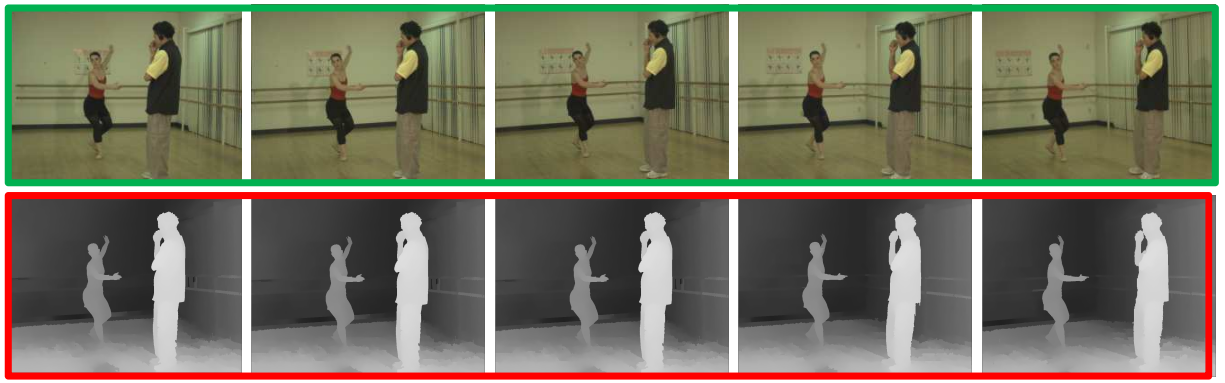
3D videos

3D Television
3DTV

Free viewpoint Television
FTV

Multiview Video plus Depth (MVD)

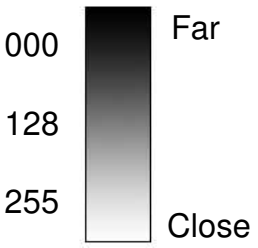
- **N**-texture/**N**-depth



- Depth maps :
  - 2D grayscale images of the same size as the texture images.
  - The gray level of each pixel = distance to the camera of its texture pixel.

Texture image

Depth map

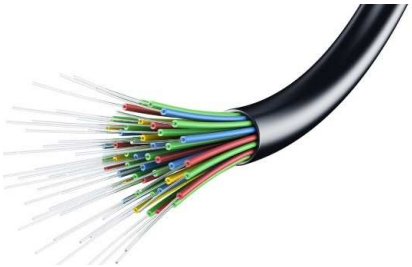


Features of depth maps

- Piecewise planar definition :
  - Each *plan* : object of the scene.
  - Each *contour* : sharp discontinuity.
- Impact of depth discontinuities on the quality of the synthesized views :
  - Compression errors of *smooth regions* : Less noticeable or even limited effect.
  - Compression errors of *contour pixels* : Highly visible degradation.
  - **Preservation of depth discontinuities.**

Scalability (1)

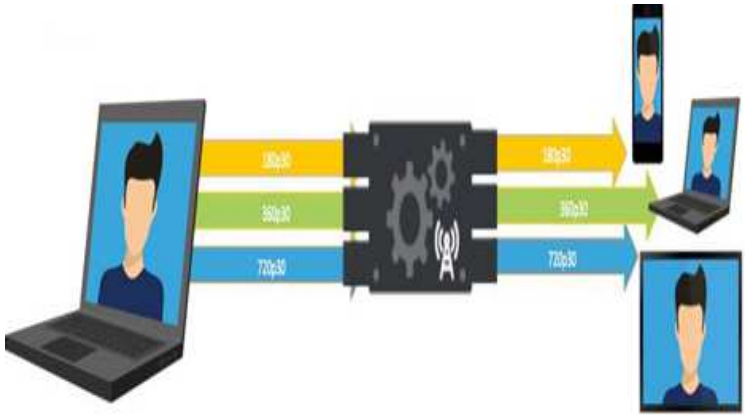


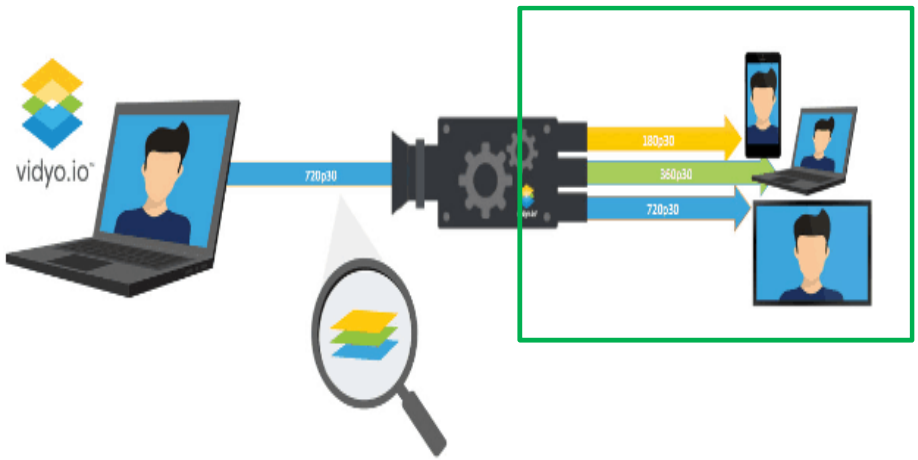
Scalable compression

Scalability (2)

Multicast



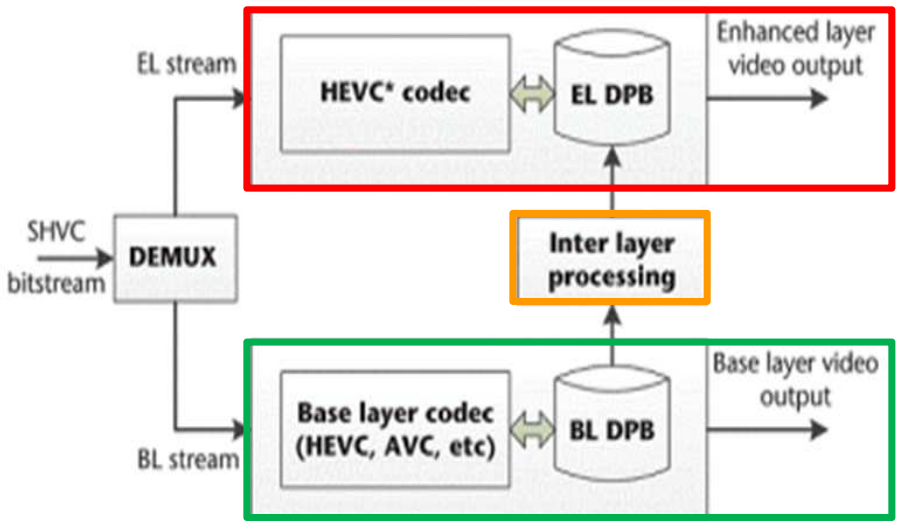
Scalable



SHVC : Scalable extension of HEVC

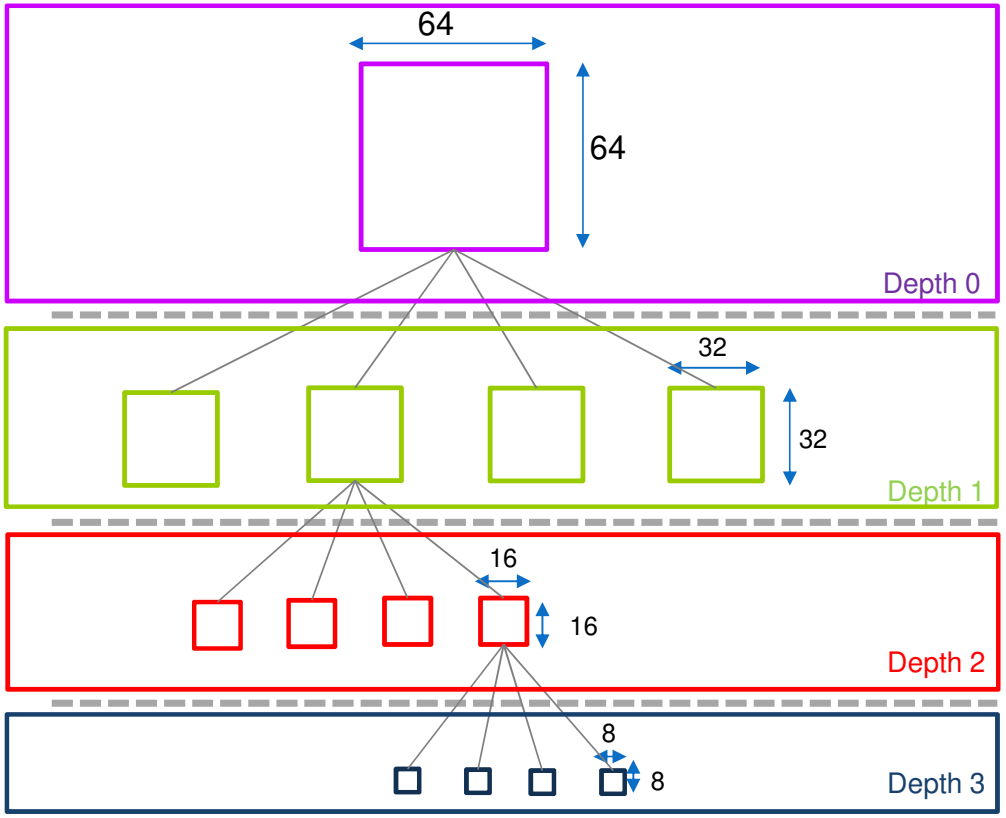
- SHVC architecture :
  - Base Layer (BL).
  - Enhancement Layers (ELs).
  - InterLayer Prediction (ILP).

- **Quality/SNR scalability** :
  - Layers of the same spatial resolutions.
  - Different values of the QP parameter :
    - QP(BL): the higher value.
    - QP(ELs): decreasing QP values.
    - $\Delta QP = | QP(BL) - QP(EL) |$



Hierarchical coding unit structure in SHVC

- The image is first partitioned into CTUs.
- Each CT : recursively partitioned into 4 equal sub CUs : a maximum depth of 4 levels.
- For each depth : the current CU is partitioned into 4 sub CUs using a Rate-Distortion Optimization (RDO) decision function.



Problem statement

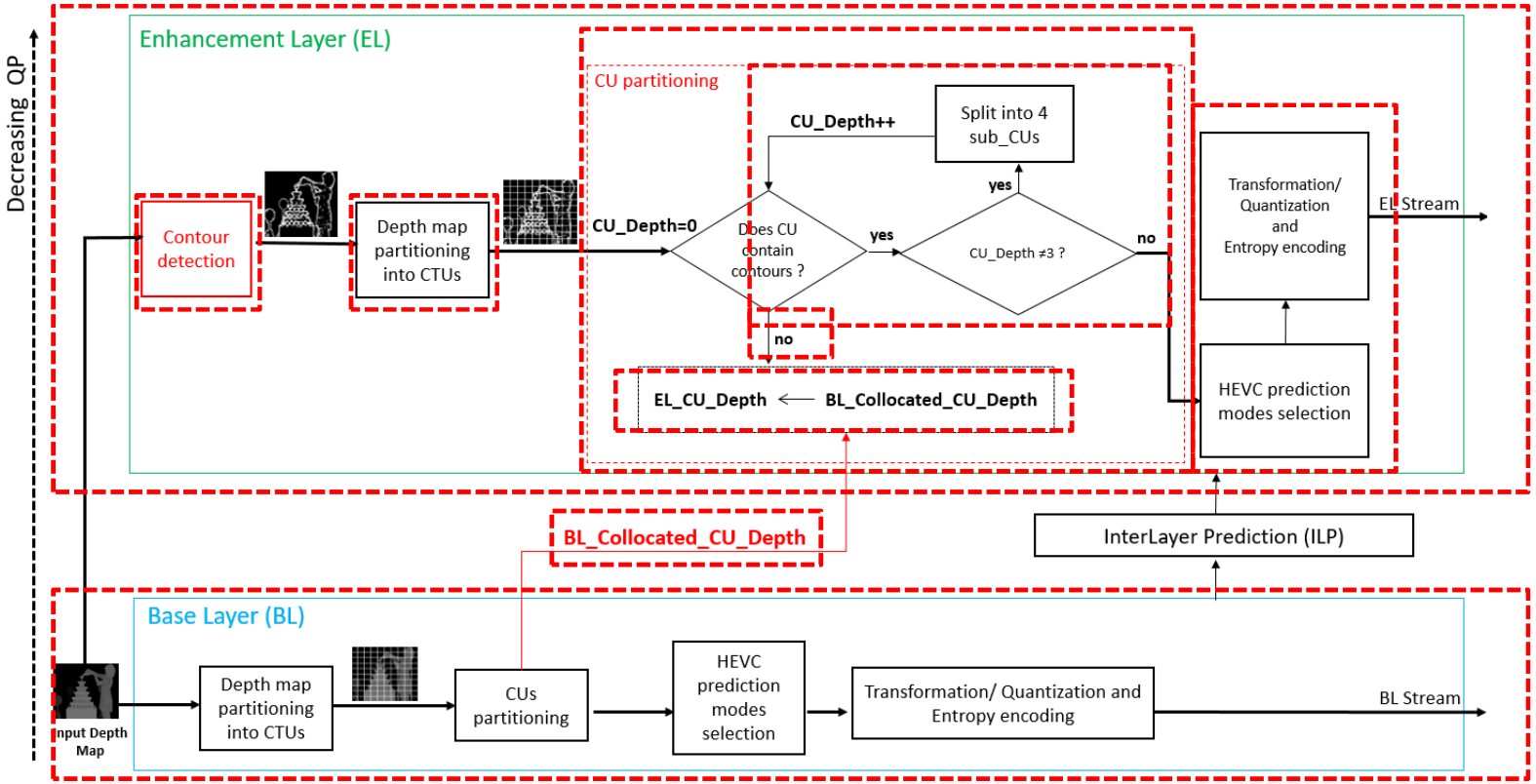
✓ Good performance of SHVC : bandwidth decrease by up to 46.41% compared to SVC.

✗ SHVC is highly computational :

- Image partitioning to coding units + RDO function.
- ILP.

? Improvements to ensure the SHVC practical usability.

Steps of the proposed method



Experimental setup

- SHVC Test Model SHM-12.0.
- 9 test video sequences : 100 frames.

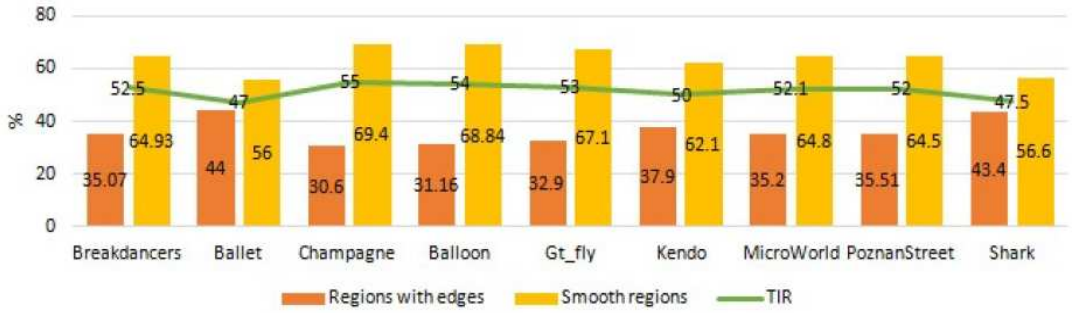
- QP values :
  - BL : 26, 30, 34, 38.
  - EL : 22, 26, 30, 34.
- Thresholds of the contour dectection : 1 and 4.

Time Improving Ratio (TIR)

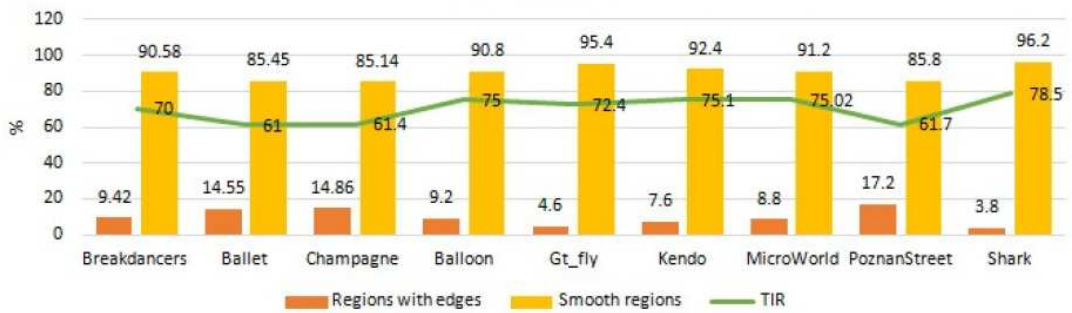
- Evaluation of the Time Improving Ratio (TIR) measurement for the different test sequences using the 2 edge detection thresholds.

- Percentage of smooth and contour regions for each test sequence.

Threshold = 1



Threshold = 4

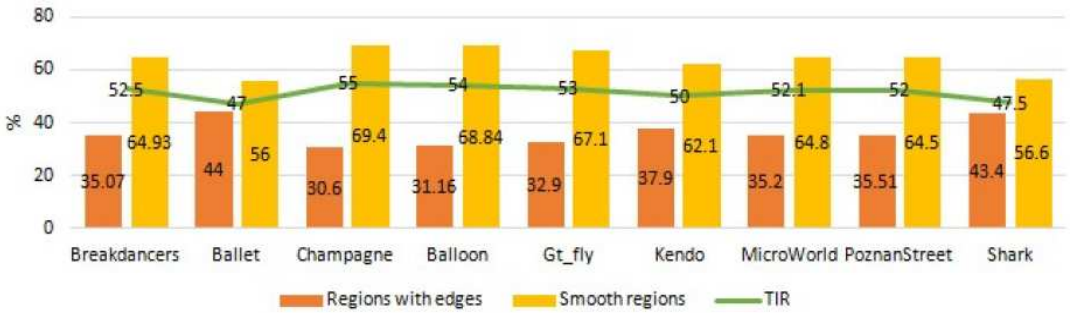


Time Improving Ratio (TIR)

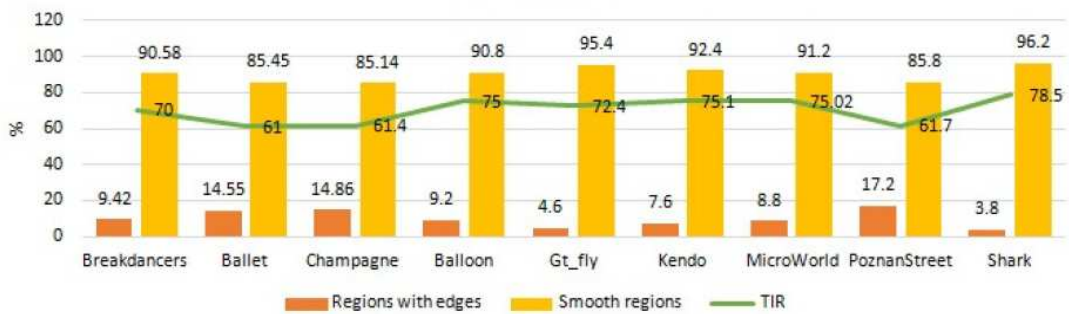
- The proposed method is faster than the unmodified SHVC :
  - Threshold 1 : 51.45%.
  - Threshold 4 : 70.01.

- *TIR is smaller than TIR reached for depth maps of more smooth regions than contour ones.*

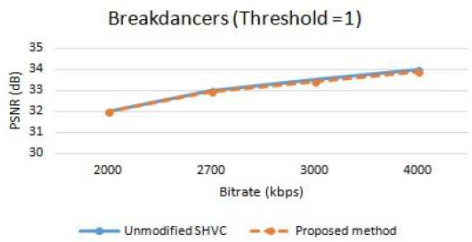
Threshold = 1

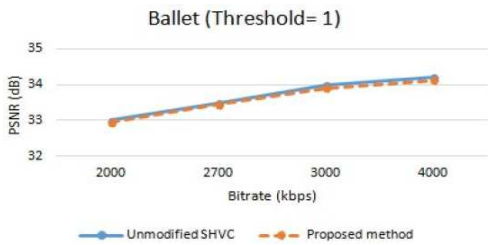


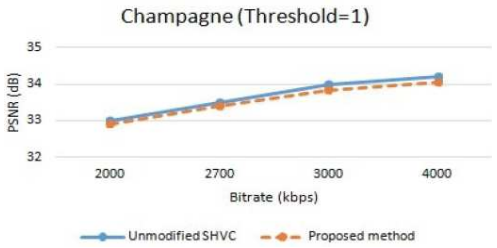
Threshold = 4

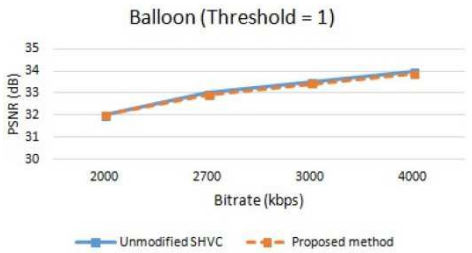


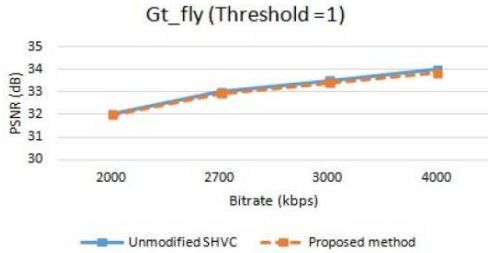
Synthesized views quality (1)

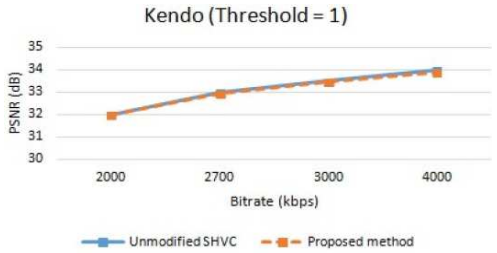


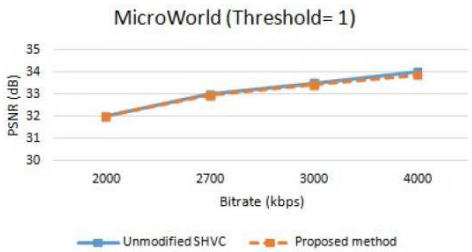


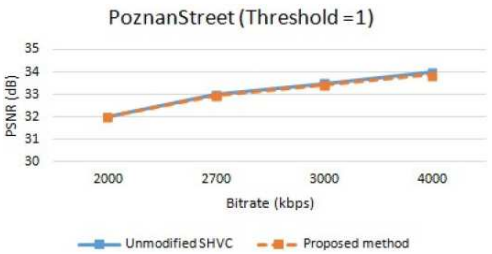


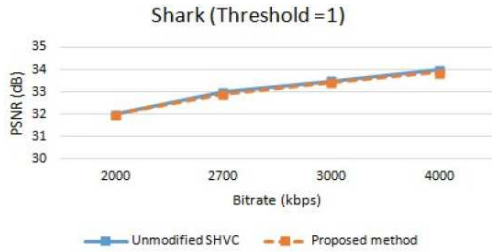






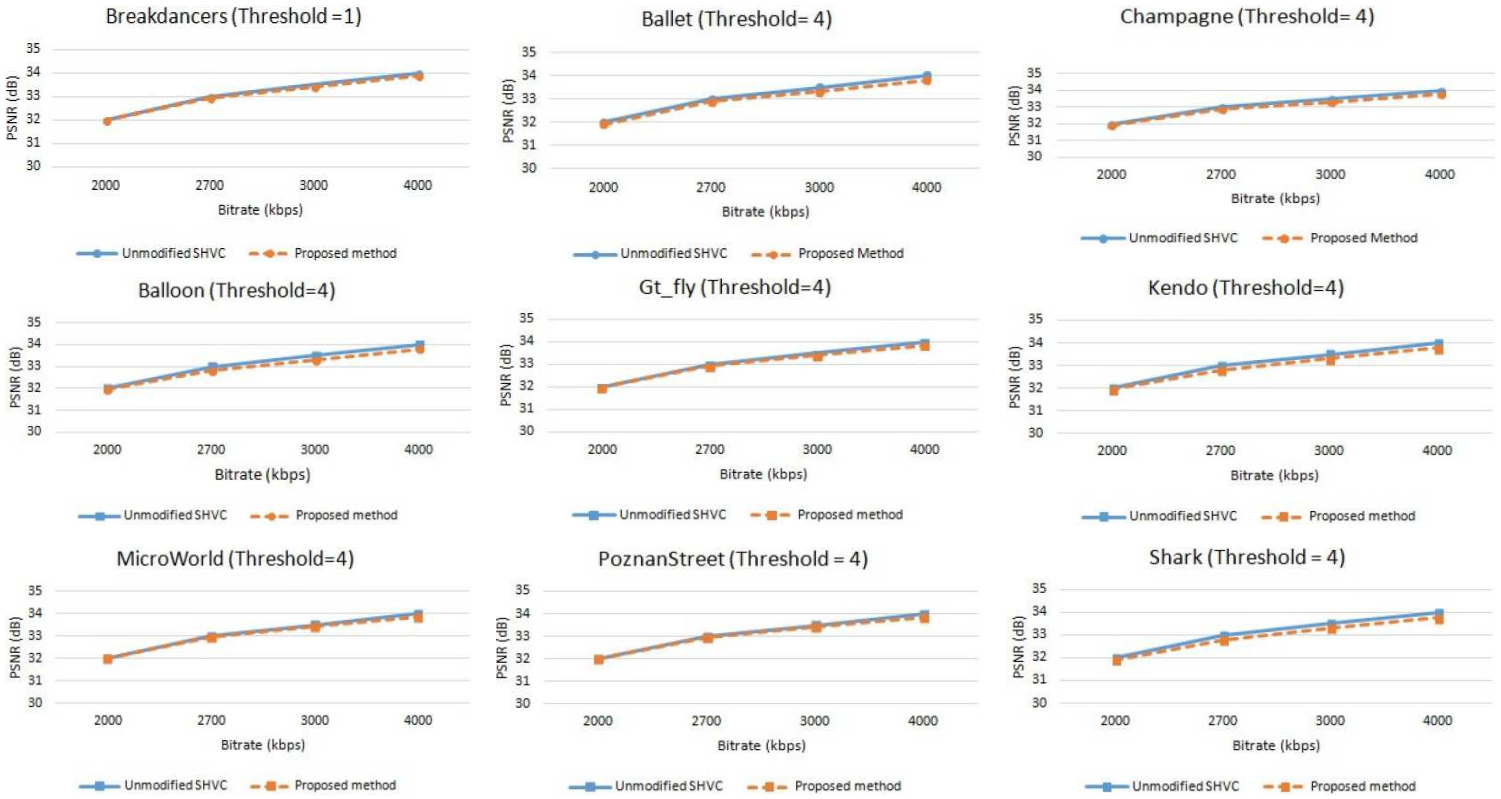






	Threshold = 1	
Sequence	**BD-PSNR**	**BD-Rate**
Breakdancers	-0.020	1.430
Ballet	-0.019	0.970
Champagne	-0.030	1.470
Balloon	-0.023	1.200
Gt_Fly	-0.024	1.011
Kendo	-0.018	0.870
Microworld	-0.019	1.260
Poznan Street	-0.025	1.490
Shark	-0.015	0.770
Average	**-0.021**	**1.163**

Synthesized views quality (2)



	Threshold = 4	
Sequence	**BD-PSNR**	**BD-Rate**
Breakdancers	-0.022	1.030
Ballet	-0.011	0.611
Champagne	-0.014	0.760
Balloon	-0.039	0.390
Gt_Fly	-0.030	0.520
Kendo	-0.031	0.490
Microworld	-0.041	0.500
Poznan Street	-0.016	1.360
Shark	-0.041	0.859
Average	**-0.027**	**0.724**

Fast SNR scalable compression for depth maps.

- Optimization of the CUs partitioning in EL according to their content :
  - *Smooth regions* : maintaining of the same collocated CU structure in BL.
  - *Contour regions* : repeating of the CU partitioning process is in EL.

Preservation of the sharp depth discontinuities for synthesized intermediate views of good quality.

Speed up of the SHVC encoding time by more than half at the cost of a minimal PSNR loss.

Improvement of the synthesized views quality : SHVC is not originally dedicated to depth maps encoding.


Thank You
For Your Atten
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