

3 DATASETS FOR QUALITY ASSESSMENT IN THE CONTEXT OF FREE VIEW POINT VIDEO

SUIYI LING, PATRICK LE CALLET



Outline

- Introduction
- Problem Statement
- FTV related Database

Examples of specific artifacts

Existing metrics tested on the corresponding dataset

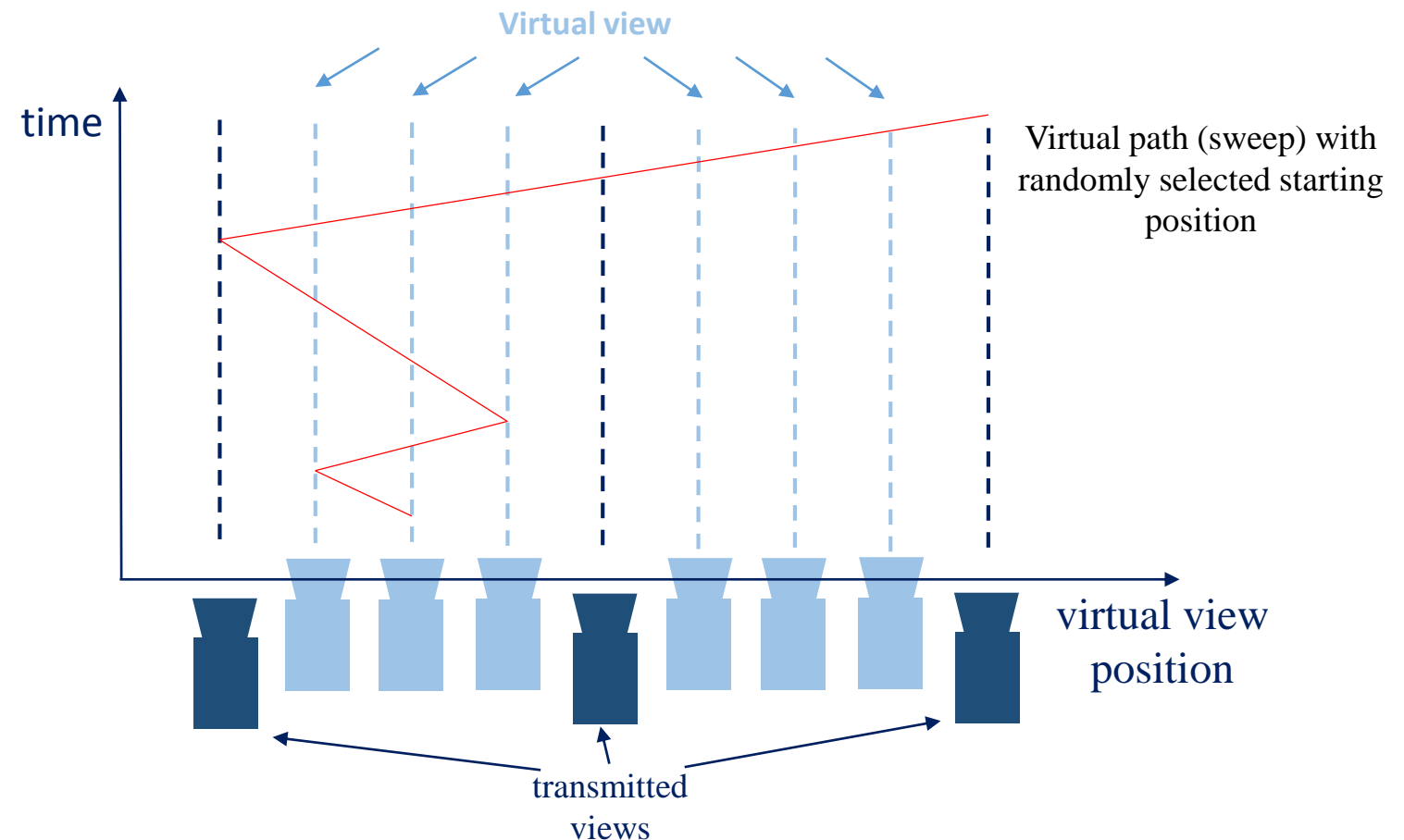
Conclusion

Free viewpoint television is a framework that allows viewing of a 3D world by freely changing the viewpoint.

Free viewpoint video can be understood as the functionality to freely navigate within real world visual scenes, as it is known for instance from virtual worlds in computer graphics.

Depth-Image-Based Rendering is the process of synthesizing virtual views of the scene from captured color images or videos with associated depth information.

- **Free Navigation**



FTV related Database

DIBR Images database

DIBR Videos database

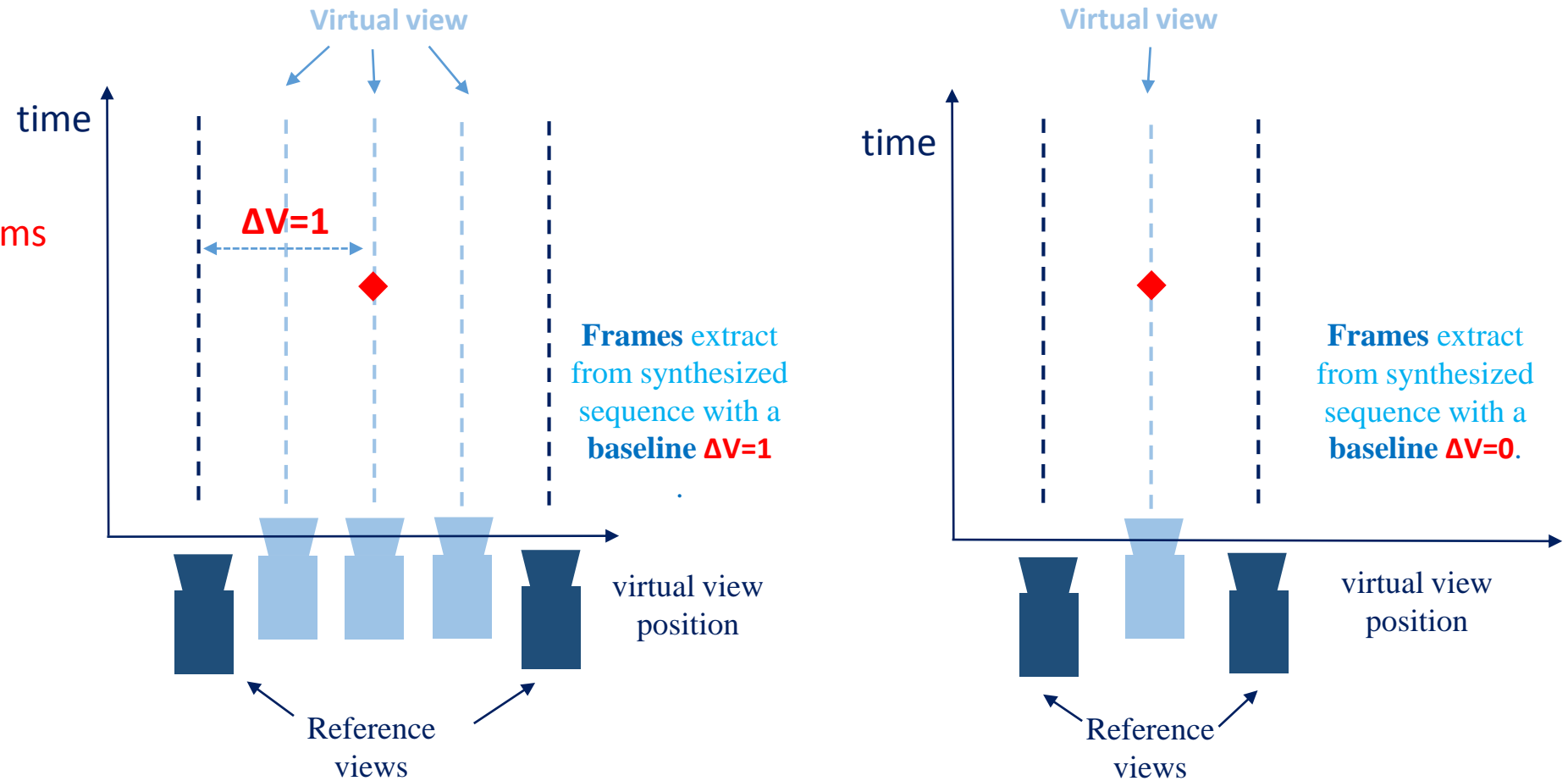
Free-Viewpoint Synthesized Videos database

1st step : DIBR Images database^[1] synthesis

3 MPD videos (1024x768) x 7 DIBR algorithms x 4 new viewpoints -> 96 videos -> 96 images

Spatial artifacts

- Different DIBR algorithms
- Different baseline



[1] Bosc, Emilie, Romuald Pepion, Patrick Le Callet, Martin Koppel, Patrick Ndjiki-Nya, Muriel Pressigout, and Luce Morin. "Towards a new quality metric for 3-D synthesized view assessment." *IEEE Journal of Selected Topics in Signal Processing* 5, no. 7 (2011): 1332-1343.

DIBR Images database



Reference



A1



A2



A3



A4



A5



A6



A7

Existing metrics

Metric	Name
VSQA [1]	Objective view synthesis quality assessment
3DswIM[2]	Objective image quality assessment of 3d synthesized views
MW-PSNR[3]	Morphological Wavelet Peak Signalto-Noise Ratio metric
MP-PSNR[4]	Morphological Pyramids decomposition Peak Signalto-Noise Ratio metric
ST-SIQA[5]	Sketch-Token based synthesized image quality assessment

Problem: Mainly in base of values differences or signal characteristics. A certain extend of global consistent stretched/bent shapes are acceptable while severely local geometric distortion are not.

Purpose: To quantify the change of contours from a higher semantic level by checking the change of contour class.

[1]Conze, Pierre-Henri, Philippe Robert, and Luce Morin. "Objective view synthesis quality assessment." IS&T/SPIE Electronic Imaging. International Society for Optics and Photonics, 2012.

[2]Battisti, Federica, et al. "Objective image quality assessment of 3D synthesized views." Signal Processing: Image Communication (2015)

[3]Dragana Sandić-Stanković, Dragan Kukolj, and Patrick Le Callet. 2015. DIBR synthesized image quality assessment based on morphological wavelets. 2015 Seventh International Workshop on Quality of Multimedia Experience (QoMEX). IEEE, 1–6

[4]Sandic-Stankovic, Dragana, Dragan Kukolj, and Patrick Le Callet. "DIBR synthesized image quality assessment based on morphological pyramids." 3DTV-Conference: The True Vision-Capture, Transmission and Display of 3D Video (3DTV-CON), 2015. IEEE, 2015.

[5]Suiyi Ling, Patrick le Callet. " Image quality assessment for free viewpoint video based on mid-level contours, IEEE INTERNATIONAL CONFERENCE ON MULTIMEDIA AND EXPO (ICME) 2017

Experimental Result

Metric	PCC	SCC	RMSE
VSQA	53.78	-	0.58
3DswIM	0.7617	-	0.42
MP-PSNR	0.8874	0.8175	0.3165
MW-PSNR	0.8855	0.8298	0.3188
ST-SIAQ	0.8877	0.8525	0.3070

Database : IRCCyN/IVC DIBR image database^[2]

Criteria :

Pearson correlation coefficient (PCC)

Spearman's rank order correlation coefficient(SCC)

Root mean squared error (RMSE)

"Irc cyn ivc dibr database website," ftp://ftp.ivc.polytech.univnantes.fr/IRCCyN_IVC_DIBR_Images.

FTV related Database

DIBR Images database

DIBR Videos database

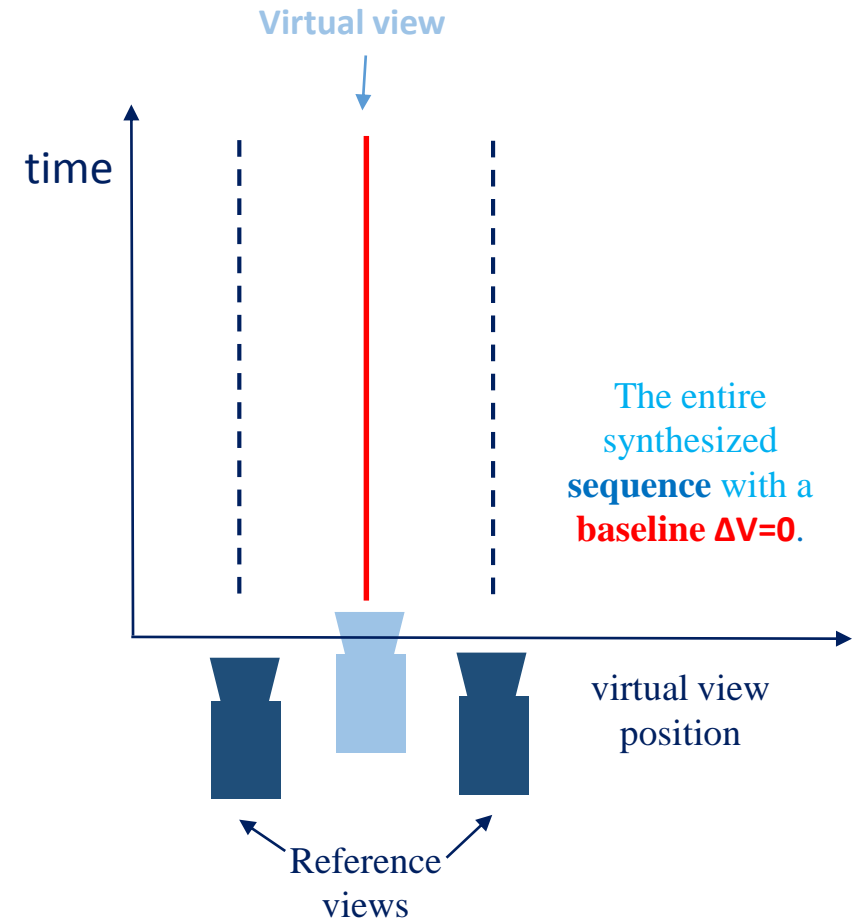
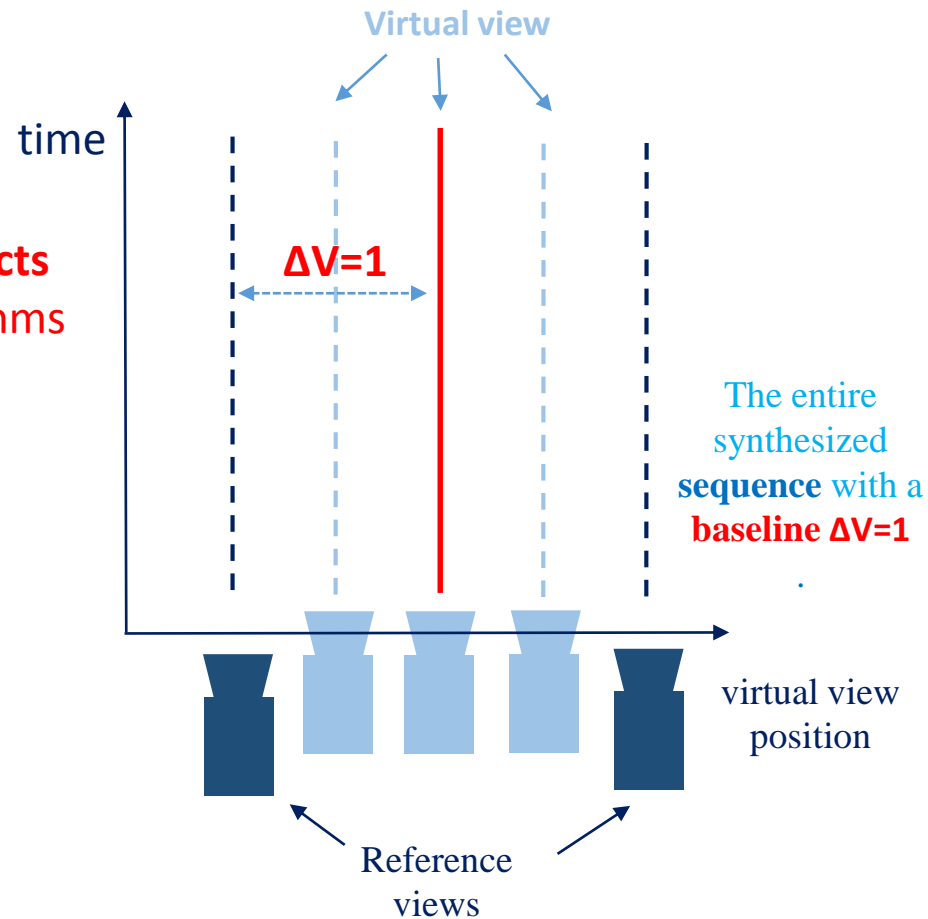
Free-Viewpoint Synthesized Videos database

2nd step DIBR Videos database [6]

synthesis + compression

3 MPD videos (1024x768) x 7 DIBR algorithms x 4 new viewpoints + 3 bitrates -> 102 videos

- Spatial + Temporal artifacts**
- Different DIBR algorithms
 - Different baseline

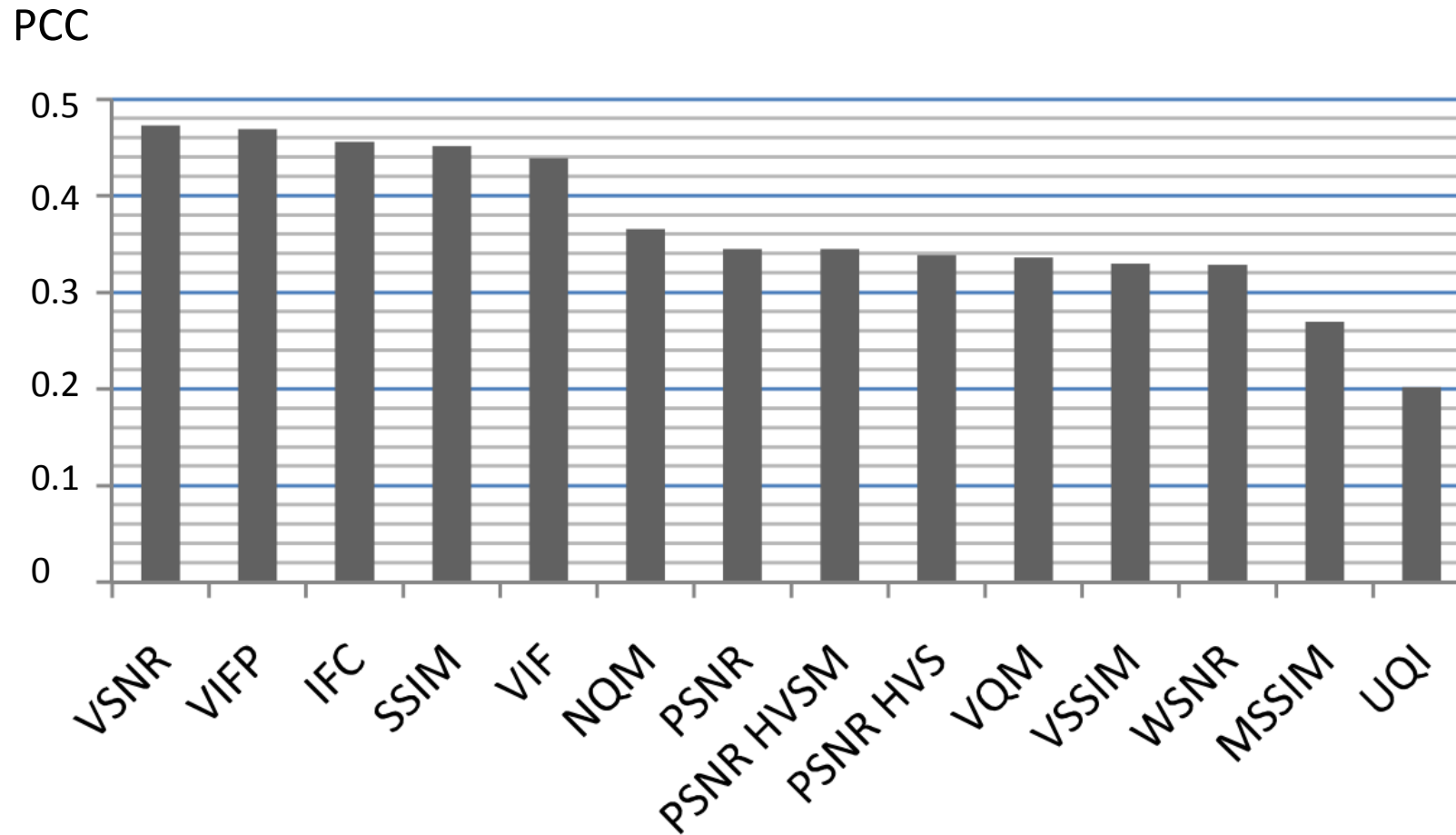


[6] Bosc, Emilie, Patrick Le Callet, Luce Morin, and Muriel Pressigout. "Visual quality assessment of synthesized views in the context of 3D-TV." In *3D-TV system with depth-image-based rendering*, pp. 439-473. Springer New York, 2013.

Algo: A1 Content: 'Newspaper' Sythesized view: view5



Performance of commonly used metrics



FTV related Database

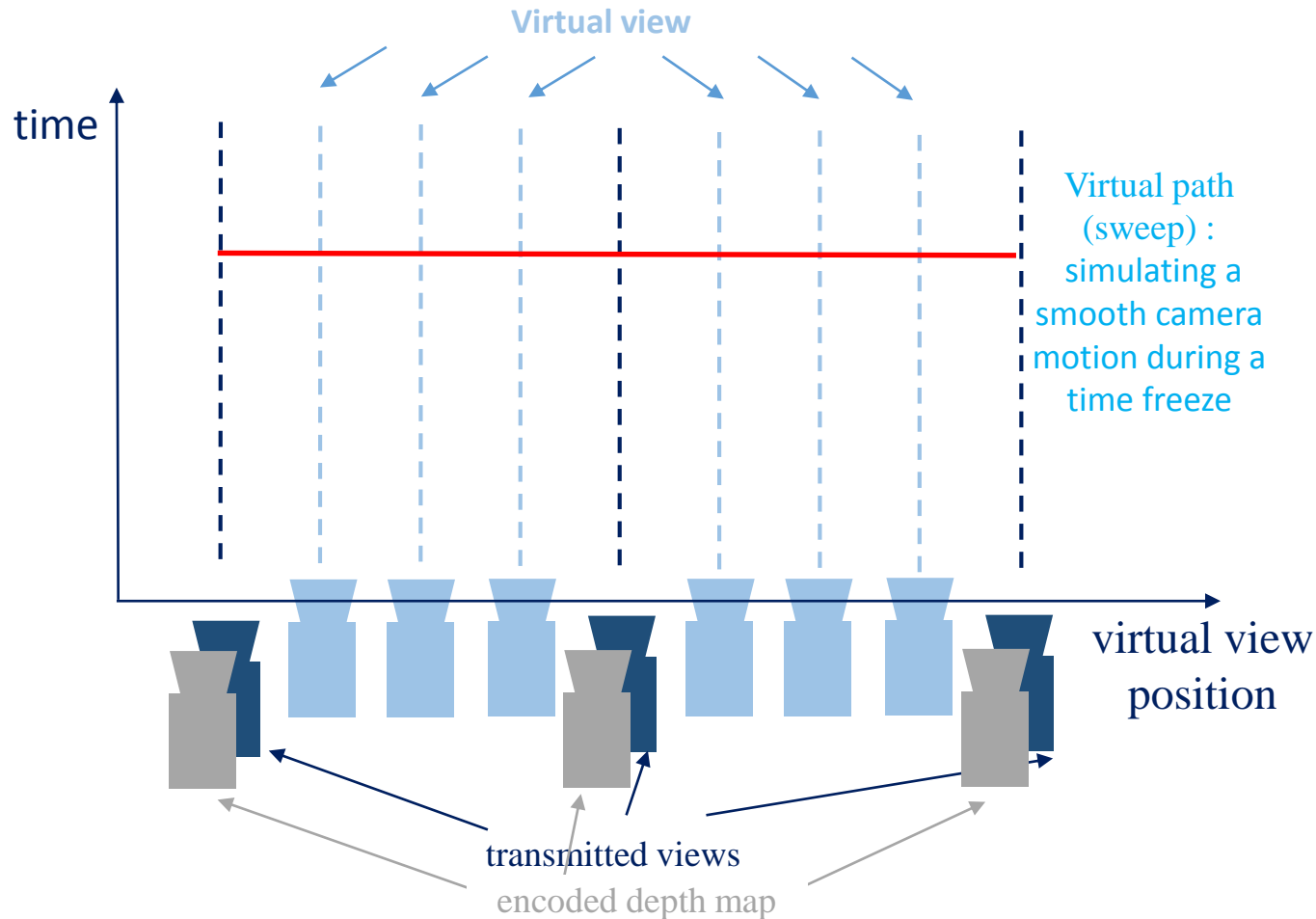
DIBR Images database

DIBR Videos database

Free-Viewpoint Synthesized Videos database

3rd step Free-Viewpoint Synthesized Videos database^[7] synthesis + compression on depth map

6 MPD videos (1024x768 / 1920x1080) x 7 depth coding algorithms x 3 bitrates -> 264 videos



View navigation + Compression on Depth map

- View-sweep effect
- Effect compression on depth map

codecs	HRC descriptions
C1	3D-HEVC Test Model, 3D-HTM 0.4
C2	Multiview Video Coding (MVC), JM 18.4.
C3	HEVC Test Model, HM 6.1.
C4	JPEG2000, Kakadu implementation.
C5	A lossless-edge depth map coding
C6	Correlation is exploited with color frames.
C7	Z-LAR-RP, a region-based algorithm.
Original	Use the real depth maps without any degradation

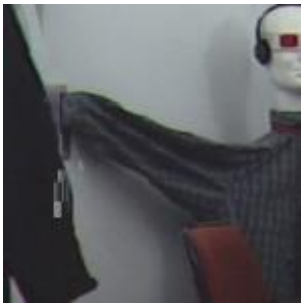
[7] Bosc, Emilie, Philippe Hanhart, Patrick Le Callet, and Touradj Ebrahimi. "A quality assessment protocol for free-viewpoint video sequences synthesized from decompressed depth data." *Fifth International Workshop on Quality of Multimedia Experience (QoMEX)*, 2013.



(1)



(2)



(3)



Effects on depth map:

Scattered blocking effect

Effects on depth map:

Staircase effect on object edges

Codec: C2(MVC) Content: 'bookArrival' Bitrate: R47 Synthesized view: view8



(1)



(2)



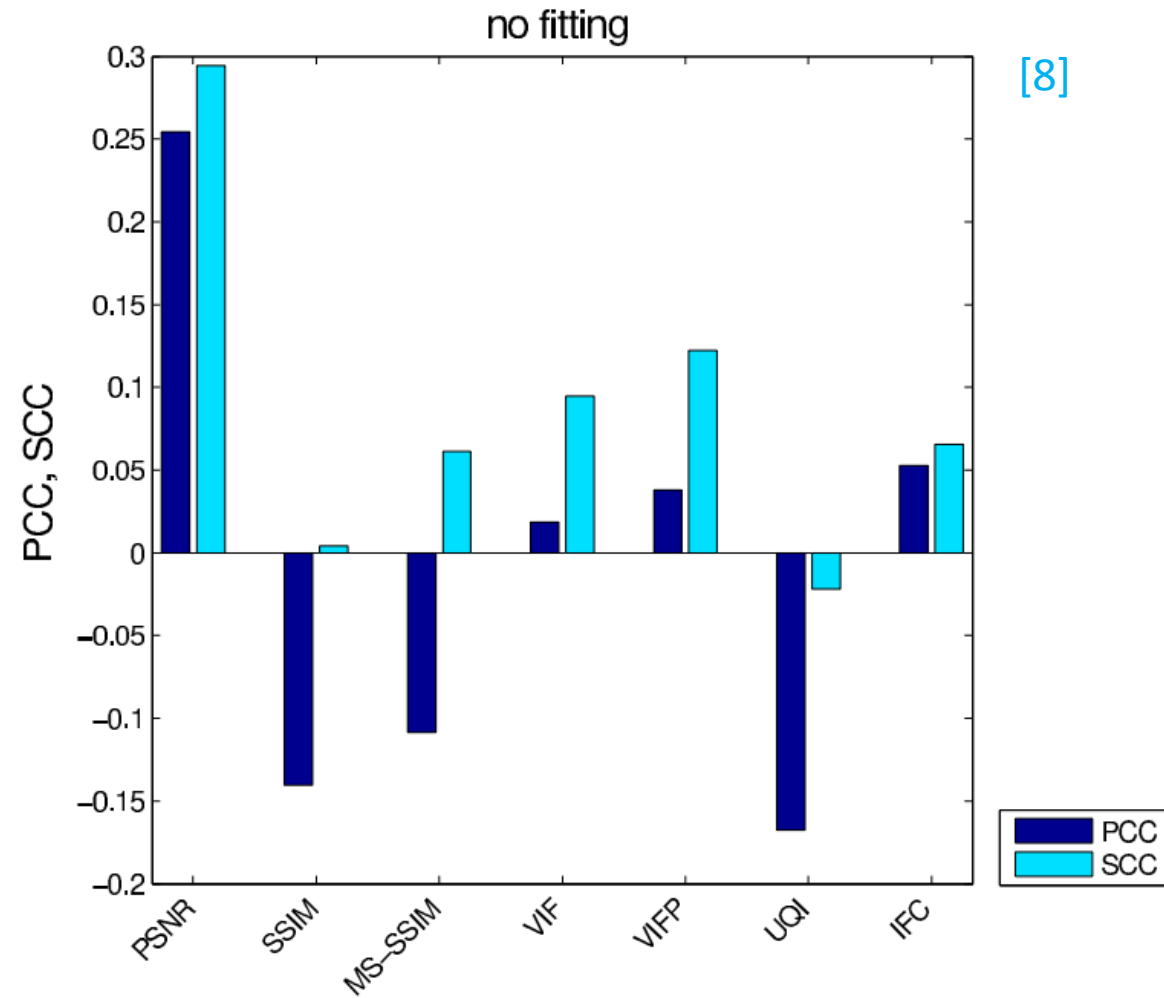
(3)



Effects on depth map:
Blur

Effects on depth map:
Inaccurate edges

Performance of commonly used metrics



[8] Hanhart, Philippe, Emilie Bosc, Patrick Le Callet, and Touradj Ebrahimi. "Free-viewpoint video sequences: A new challenge for objective quality metrics." In *Multimedia Signal Processing (MMSP), 2014 IEEE 16th International Workshop on*, pp. 1-6. IEEE, 2014.

FTV related Database for evaluating the performance of metrics designed for :

1. DIBR Images database

-> Synthesized algorithms (in consider of spatial artifacts)

2. DIBR Videos database

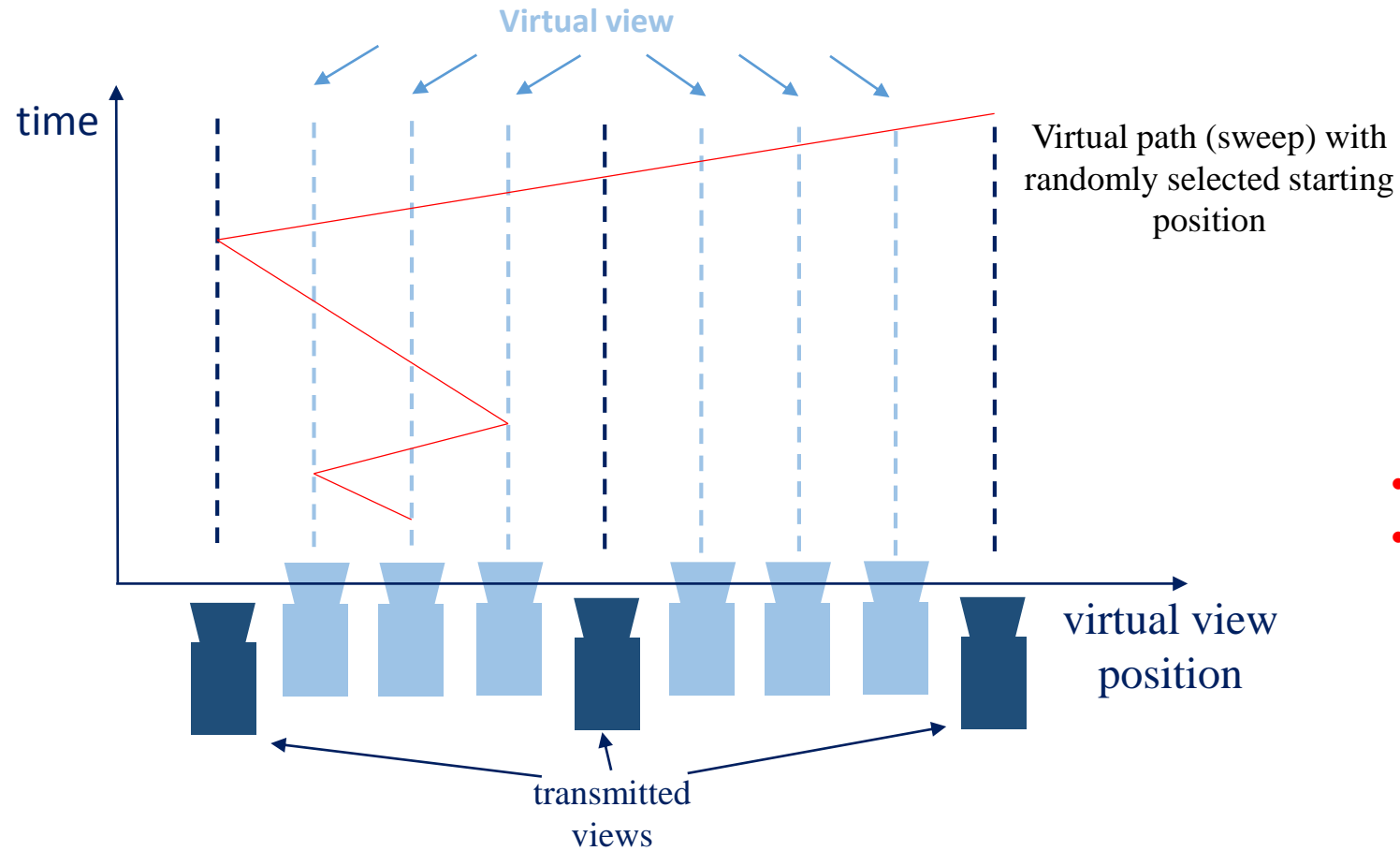
-> Synthesized algorithms (in consider of spatio-temporal artifacts)

3. Free-Viewpoint Synthesized Videos database

-> Condecs

-> View-sweep effect

4th step : Free navigation videos database (on going work)



- Compression (texture + depth map)
- Different camera configuration

Conclusion

Special artifact : Object shifting , Geometric distortion, Blurring due to inpainting , Flickering

Special location : These artifacts mainly locate around disoccluded areas.

The lack of proper metrics for assessing the performances of multi-view videos compression, depth map compression and view synthesis techniques :

Technical decisions for standard (MPEG, JPEG, VQEG) related to Virtual Reality (VR), FTV where view synthesis is under consideration. Decision must be taken to compare various solutions in a use case where the **reference is available**. There is a clear lack of such tool for the evaluating the performance of related techniques so far. The monitoring of possible service, where ad hoc no reference metric would be useful, should come after once decision and technology fixed. The community is not yet there.

Thank you

Question?