Video Multimethod Assessment Fusion (VMAF) on 360VR contents

VQEG Mountain View 2018

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Presentation scheme

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- Introduction
- Review of quality metrics on 360VR contents
- Work approach
- Test material
- VMAF computation
- Subjective assessment
- Results
- Conclusions

Introduction

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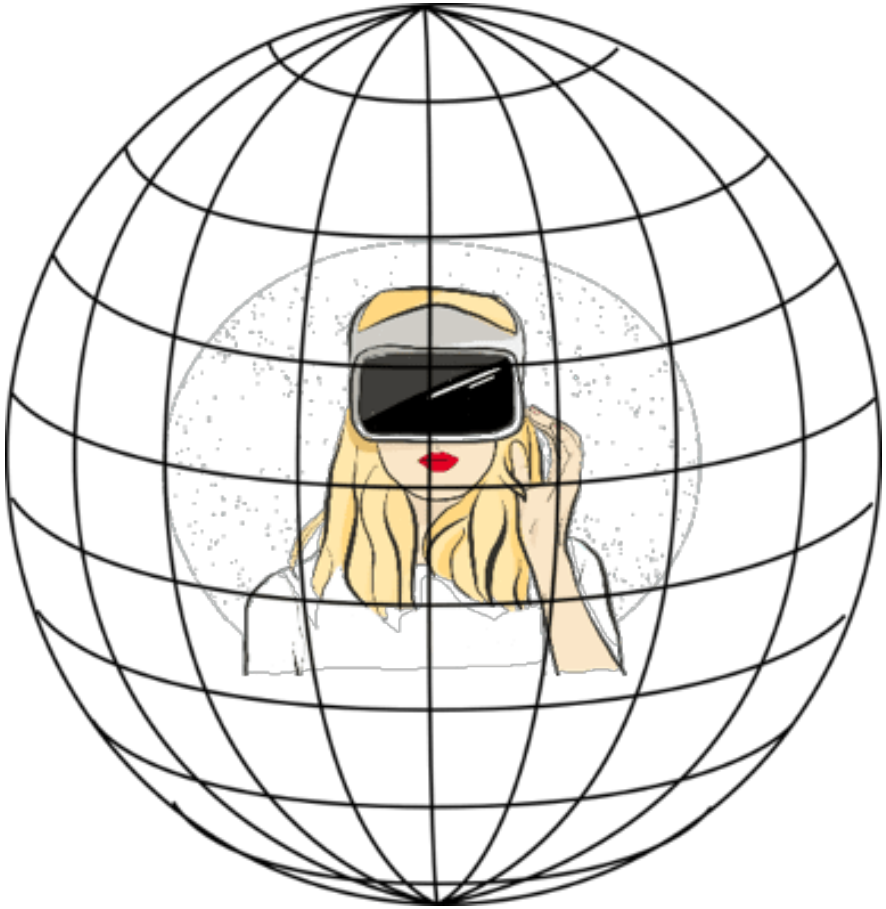
- Main challenge:
  - to provide omnidirectional content guaranteeing an immersive experience and saving bit rate

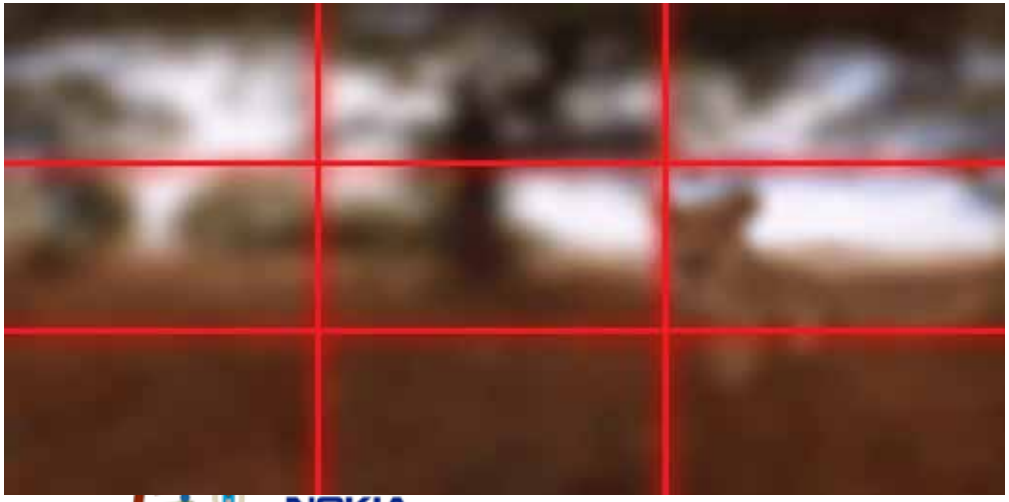
- Main solutions:
  - Definition of different perceptible levels of quality
  - Efficient delivery schemes
  - Users' behavior → Attention maps
  - Exploitation of peculiarities of the type of projection

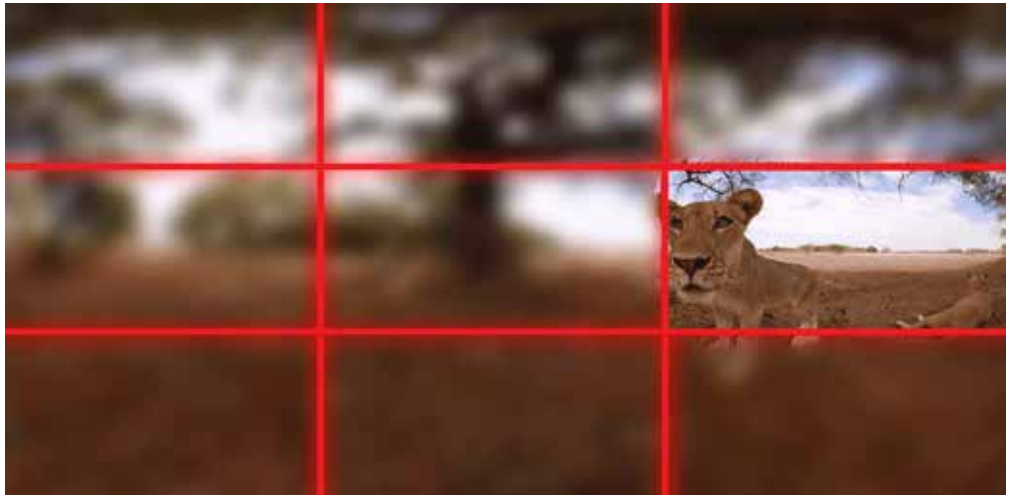
- → All these solutions require **a quality metric**

Introduction – 360VR (omnidirectional) video



Introduction – Video tiling





Review of quality metrics on 360VR contents

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- Spherical - PSNR (S-PSNR)
- Weighted to Spherically - PSNR (WS-PSNR)
- Craster Parabolic Projection - PSNR (CPP-PSNR)
- Uniformly Sampled Spherical (USS-PSNR)
- Multi-Scale SSIM (MS-SSIM)
- **VMAF**
- SpatioTemporal - VMAF (ST-VMAF)

Work approach

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- VMAF has provided significantly good results on different types of non-immersive contents and viewing conditions

- Research question: can VMAF be applied to omnidirectional content without making any specific adjustments?

- Underlying hypothesis:
  There is a monotonic relationship between 2D-VMAF and 360VR-VMAF (non-existing)

- If it is true, we can avoid:
  - generating a large and rich specific 360VR video dataset
  - carrying out numerous subjective quality assessments
  - performing the corresponding training and testing stage

Work approach

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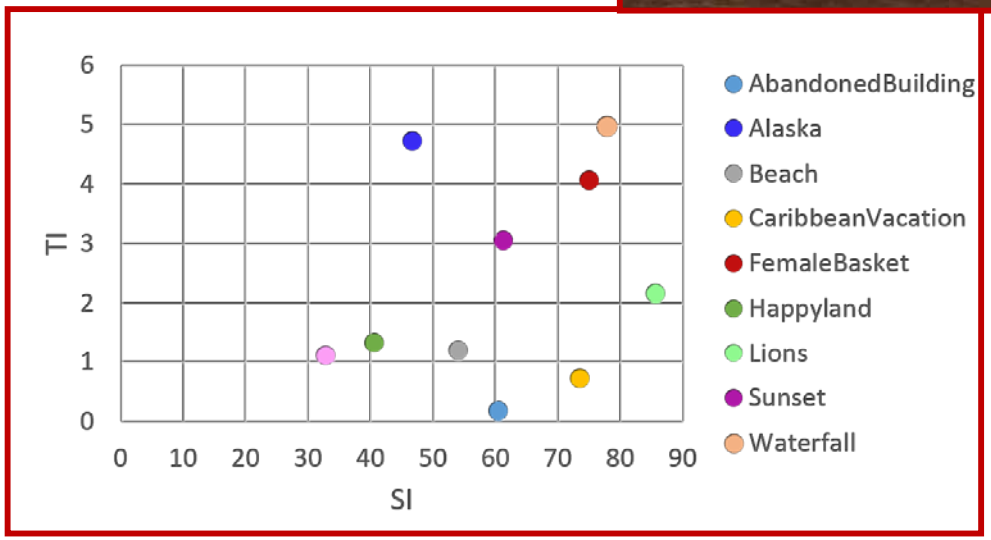
- The validation of VMAF on 360VR contents is carried out in two steps:
  - VMAF application to omnidirectional sequences encoded with constant QP in the whole range of possible values to obtain the variation of the score with the encoding parameter
  - VMAF scores validation through a subjective assessment
    VMAF-vs-QP curve is monotonically decreasing by the nature of the encoding
    → adjustment with a finite number of key operating points

Test material

- A wide range of contents selected with different features in terms of color, texture, camera motion, composition, and content in the scenes



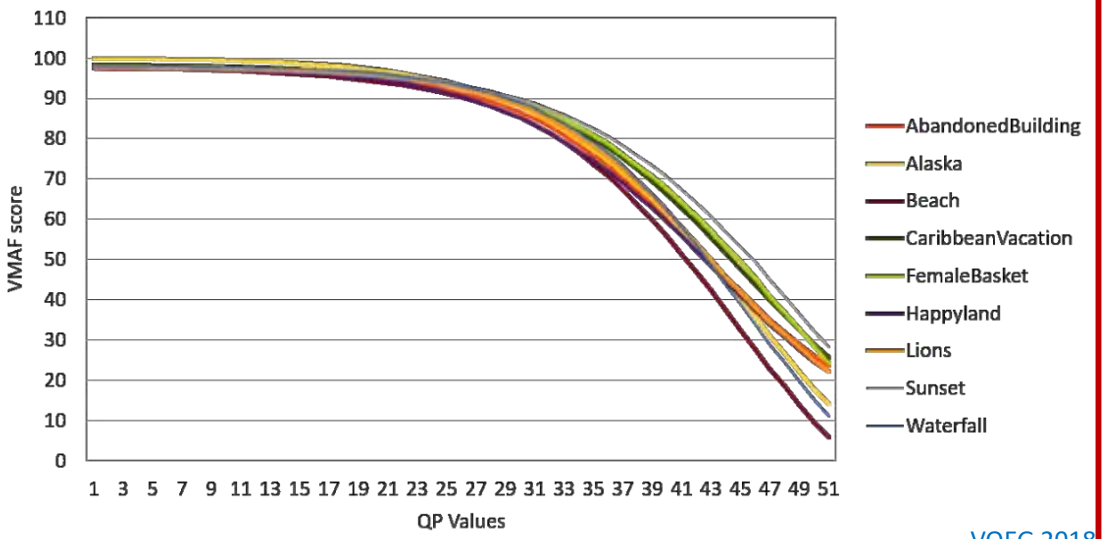
Spatial (SI) and Temporal (TI) information

VMAF computation

Number of reference videos	9
Duration	10 seconds
Encoding	H.265/HEVC
Resolution	4K (3840x1920)
Hypothetical Reference Circuits (HRCs)	QP range (1-51)
Framerate	25 fps
Total number of videos: 459	

No temporal pooling challenge

4K throughout the process



Quality degradation vs QP

QP = 29

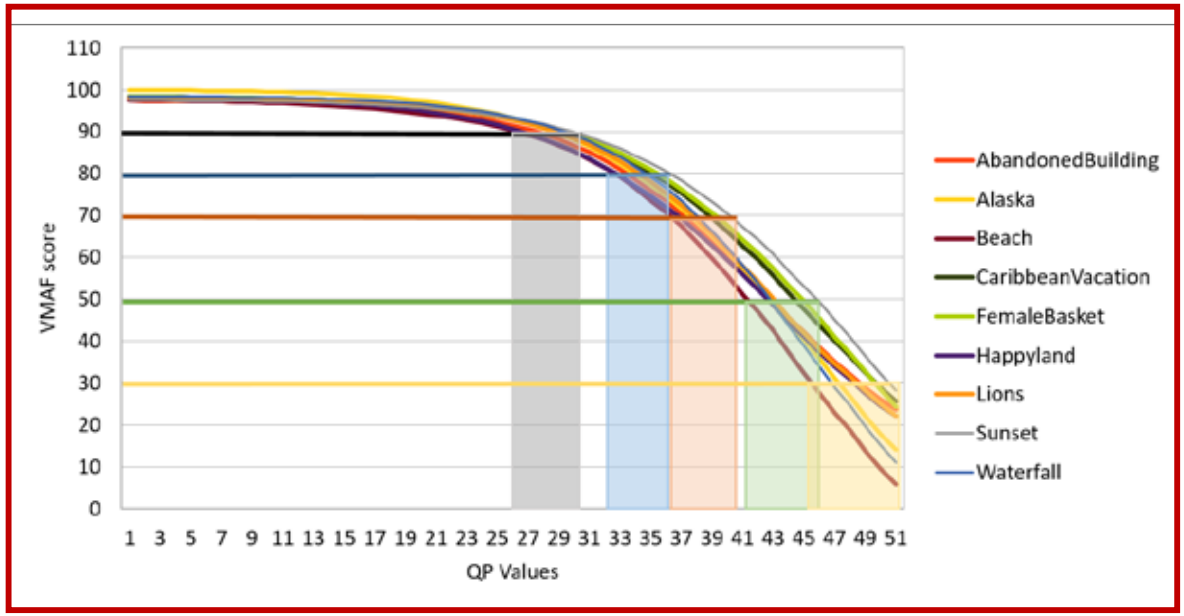
QP = 36

QP = 40

QP = 46

QP = 50

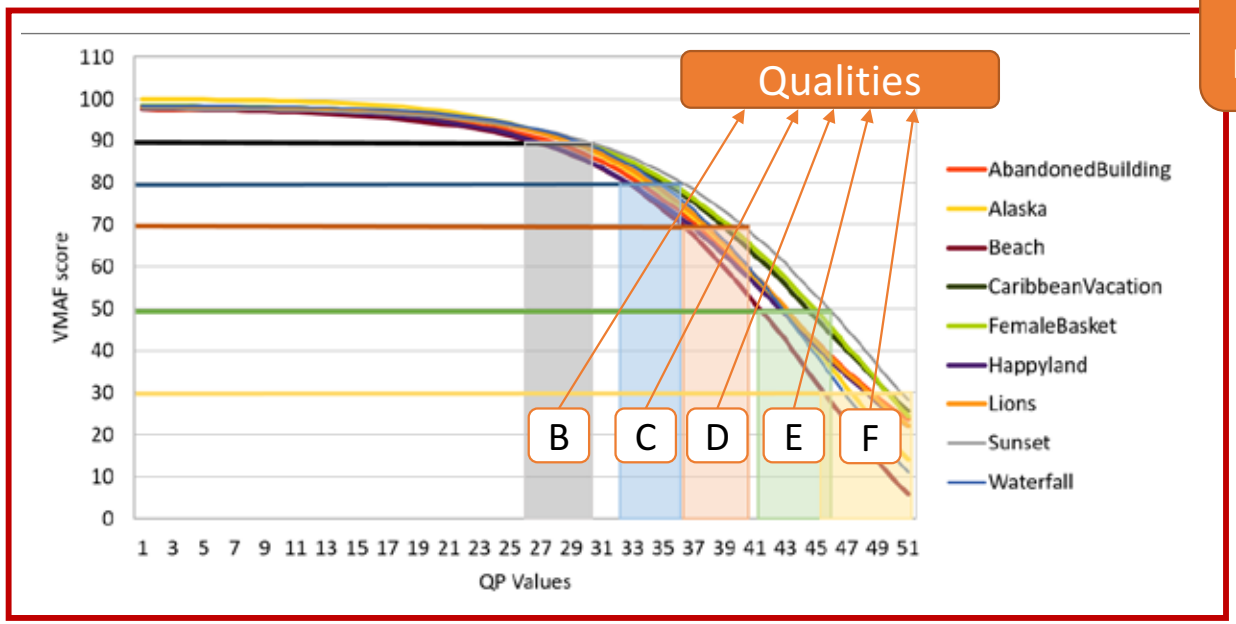
Subjective assessment – Test material



DATASET CHARACTERISTICS	
Number of source videos	9
Duration	10 seconds
Encoding	H.265/HEVC
Resolution	4K (3840x1920)
Number of QP values	6
Total of videos: 54	

Subjective assessment – Test material

- VMAF-vs-QP curve is monotonically decreasing by the nature of the encoding
  → VMAF can be adjusted with a finite number of QPs, which correspond to anchor VMAF scores in the curve for all the used contents



Quality A = Hidden Reference

QP (A) chosen to obtain a bitrate similar to that of the original video available in database

Check: QP (A) < QP (B)

Subjective assessment – Test session

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Methodology

ACR-HR

Five Grade Scale - Quality	
5	Excellent
4	Good
3	Fair
2	Poor
1	Bad

x3

START	VIDEO 1	VOTE 1	...	VIDEO 18	VOTE 18	THE END

- **No training session** (no reference given about max/min quality)
- All videos viewed and scored by each subject
- Duration around **15 minutes** (assuming 5 seconds for evaluation)
- **24 observers** (age between 21 and 36, average age of 26)
- All observers with normal or corrected vision
- No subject removal because of being considered an outlier

Equipment & Environment

Different randomization for each session

Experimental results - MOS

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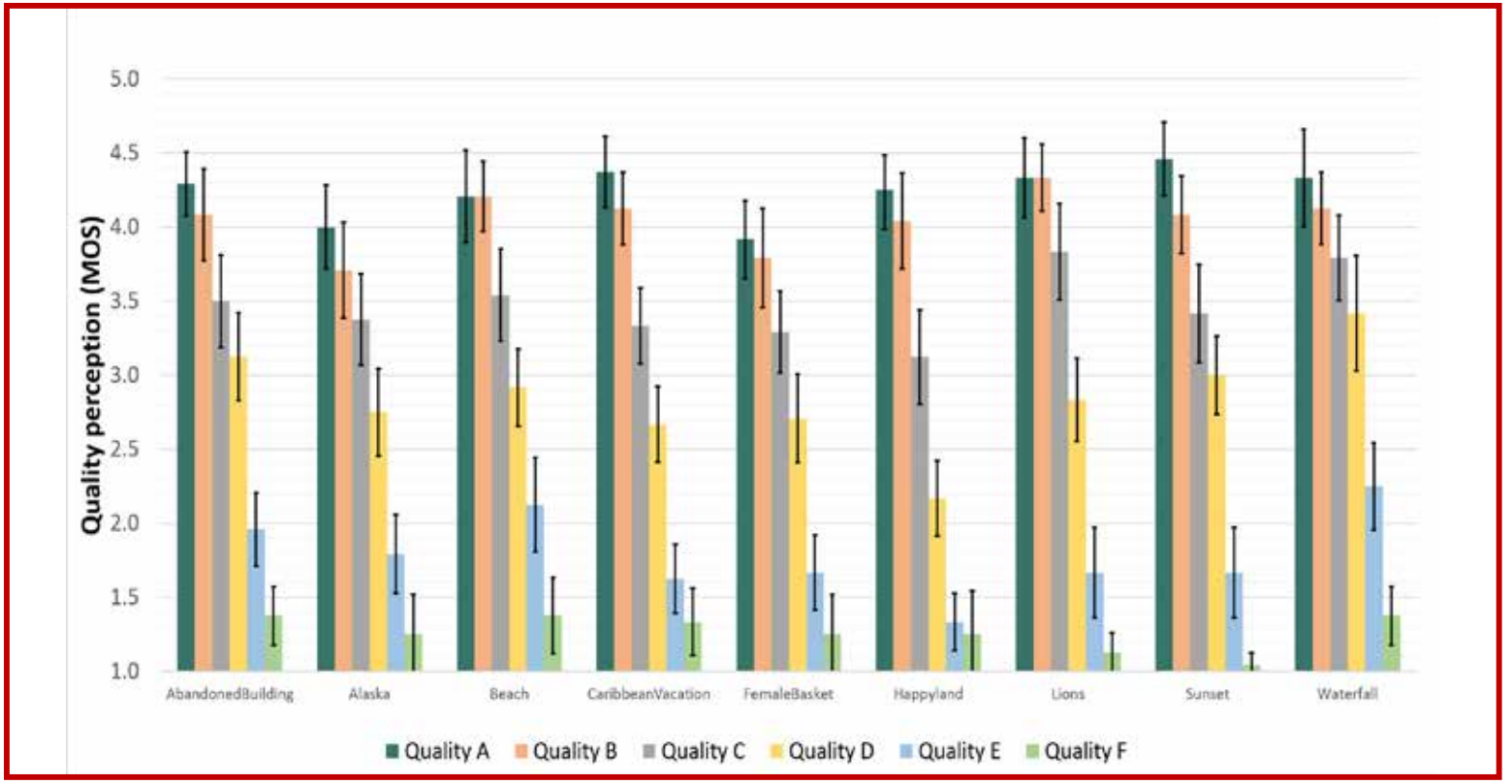
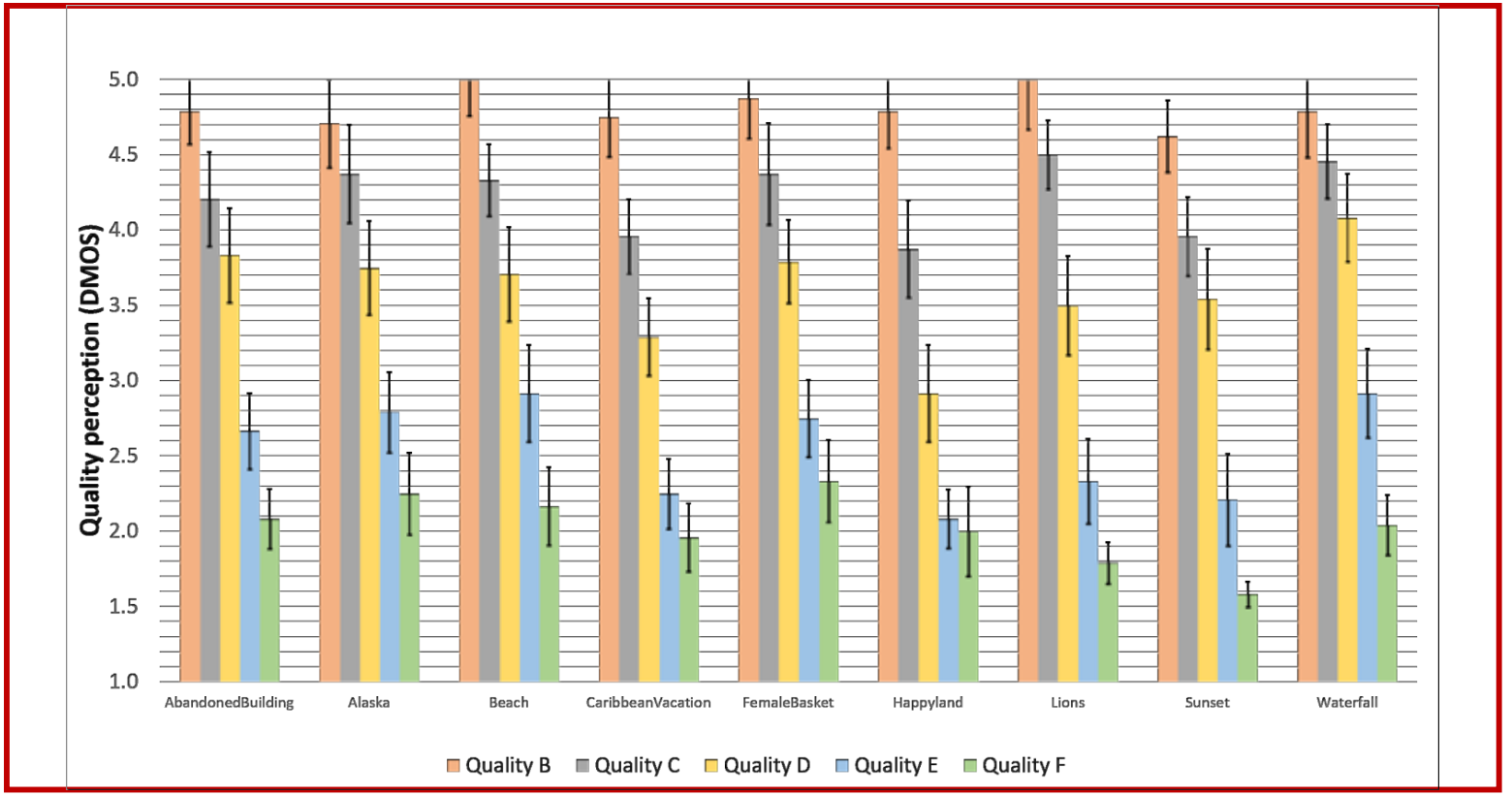
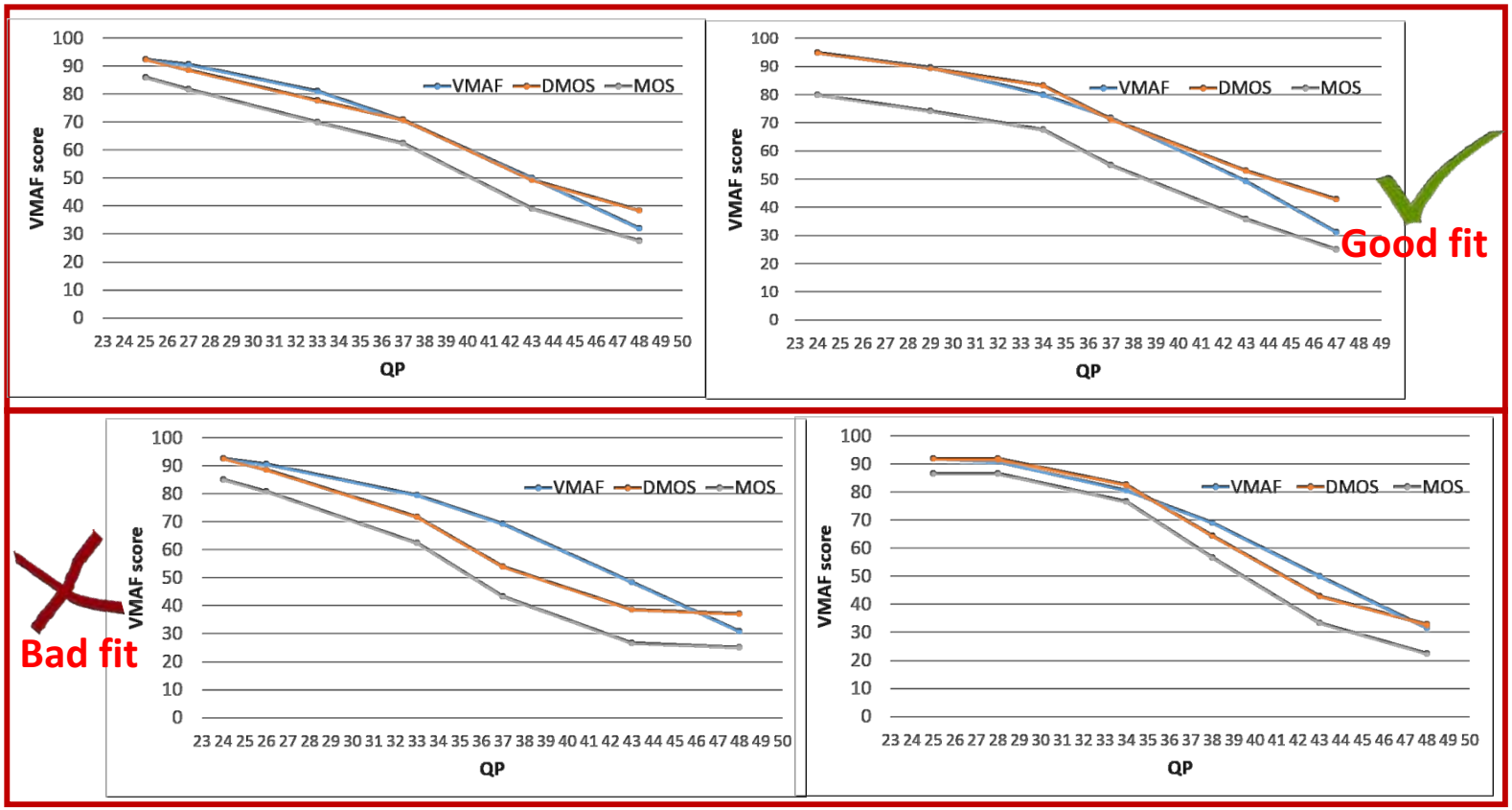


Experimental results - DMOS



VMAF adjustment for 360VR contents



PLCC and RMSE between VMAF and DMOS

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CONTENT	PEARSON (QB, QC, QD, QE, QF)	PEARSON (QB, QC, QD, QE)	RMSE (QB, QC, QD, QE, QF)	RMSE (QB, QC, QD, QE)
AbandonedBuilding	0.995	0.997	3.433	1.983
Alaska	0.992	0.994	5.661	2.488
Beach	0.992	0.991	4.213	2.470
CaribbeanVacation	0.961	0.997	6.982	6.787
FemaleBasket	0.984	1.000	7.097	1.764
Happyland	0.940	0.979	9.338	9.991
Lions	0.987	0.997	4.029	4.446
Sunset	0.996	0.998	5.016	5.490
Waterfall	0.996	0.990	5.511	4.295
AVERAGE	**0.983**	**0.994**	**5.698**	**4.413**

Conclusions

- Exhaustive study on the feasibility of VMAF on 360VR contents
- VMAF works sufficiently correctly with omnidirectional contents, without performing any particular adjustments
- The creation of a 360VR dataset can be avoided, thus saving computing and time resources

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Questions – Discussion – Debate - …

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