INVESTIGATION OF PERCEPTUAL VIDEO QUALITY DIMENSIONS

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AGENDA

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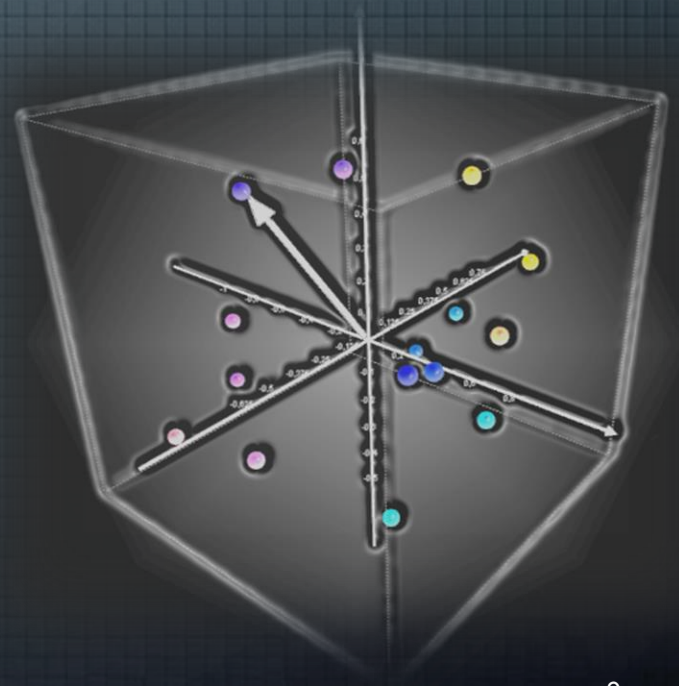
  - ⇒ Quality Rating
  - ⇒ Perceptual Video Quality Dimensions
- ⇒ Experiments – Direct Scaling
  - ⇒ Test method and procedure
  - ⇒ Video degradations
- ⇒ Experiments – Some Results
- ⇒ Quality Prediction
- ⇒ Conclusion and Future Work



INTRODUCTION - QUALITY

⇒ **Quality is a result of an internal comparison between the desired features and the perceived features**

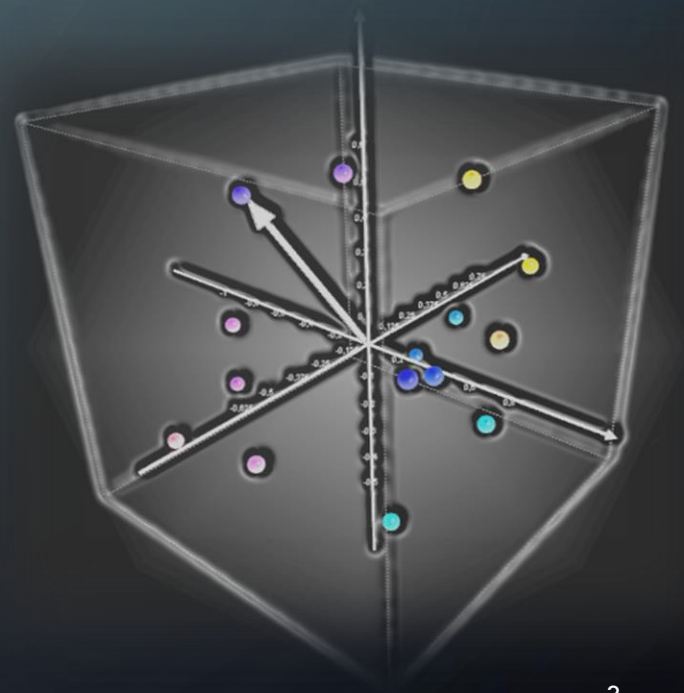
⇒ To uncover the nature of the perceptual event

⇒ Description in a multidimensional feature space.

⇒ Coordinates represents the quantity of the feature values

⇒ If the axes are orthogonal, the features can be regarded as perceptual dimensions

⇒ This approach can help to diagnose the source of suboptimal QoE



INTRODUCTION - PERCEPTUAL VIDEO QUALITY DIMENSIONS

⇒ Perceptual Video Quality dimensions obtained through subjective tests

⇒ PC experiment with a MDS + SD experiment with a PCA

⇒ Resulting in a five dimensional quality space:

Name	Description	Example Impairment
Fragmentation (FRA)	*Fallen apart, torn and disjointed*	*Packet Loss*
Unclearness (UCL)	*Unclear and smeared image*	*Low Coding Bitrate*
Discontinuity (DIC)	*Interruptions in the flow of the Video*	*Buffer Dealy and Limitations*
Noisiness (NOI)	*Random change in brightness and color*	*Quantization, Circuit Noise*
Suboptimal Luminosity (LUM)	*Too high or low brightness*	*Under- & Overexposure*

EXPERIMENT - TEST METHOD *DIRECT SCALING*

⇒ Directly scaling the perceptual dimensions through the participant

⇒ Verification in three different experiments

- ⇒ Two experiments with head+shoulder video material (I + II)
- ⇒ One experiment diverse video content (III)

⇒ Impairments introduced in the video via matlab, ffmpeg, netem and TC

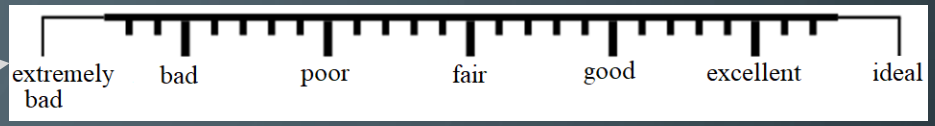
⇒ video degradations potentially appearing in video transmission

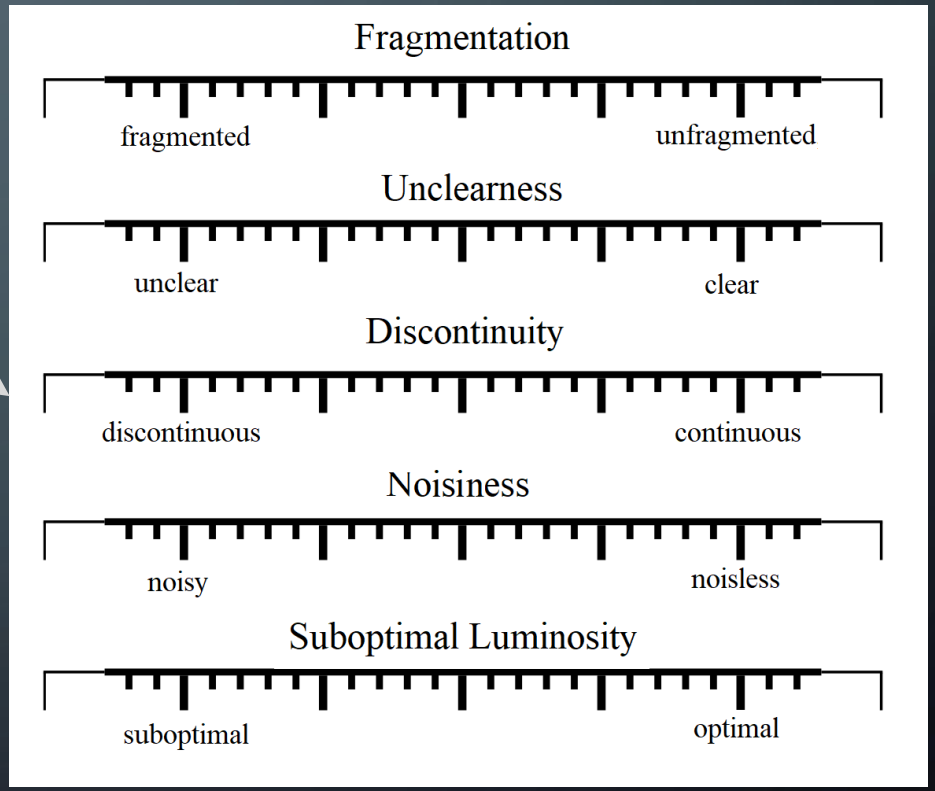
EXPERIMENT - TEST PROCEDURE

⇒ Quality rating scale

⇒ Dimension rating scales

- ⇒ Based on Likert-scale
- ⇒ Dimension name as label
- ⇒ Antonym pairs describes scale range
- ⇒ Range 10 – 70 (70 = optimum)
- ⇒ Optimum on the right side (unipolar)





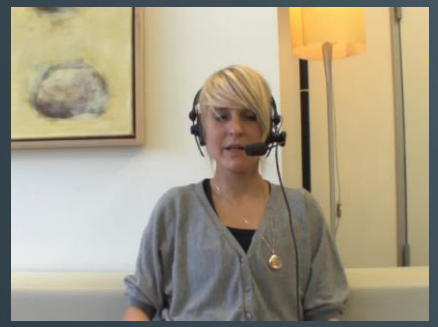
EXPERIMENT - OVERVIEW DEGRADATIONS

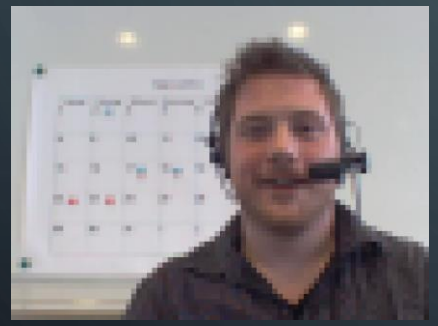
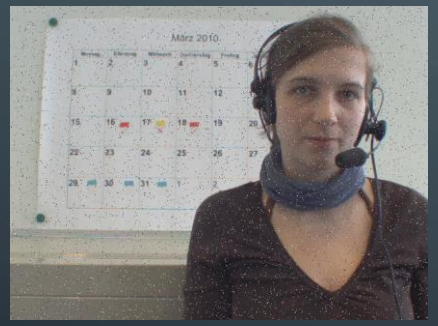
⇒

Name	Description	Experiment
Reference	Unimpaired Material	*I + II + III*
RISV Artificial Blockiness	All Frames (2x2 - 11x11 - Block Size Setting)	*I + II*
RISV Artificial Blurring	All Frames (7 Filter Settings)	*I + II + III*
RISV Artificial Jerkiness	Jerkiness (3 - 18 Frames freeze)	*I + II + III*
RISV Artificial NoiseQ	Salt & Pepper Noise (1-15% Pixel/Frame)	*I + II + III*
Bitrate XX kbps	H.264-Codec BR (28-256kbps -> 2-pass Coding)	*I + II*
Packet Loss (Random)	H.264-Codec, TC, NetEm, PLR (0.25-1.8%)	*I + II + III*
Luminance Impairment I (darker)	Luminance Value reduced	*I + II + III*
Luminance Impairment II (lighter)	Luminance Value raised	*I + II + III*
Additional Combinations for all Types of Degradations		*II*

EXPERIMENT - TEST MATERIAL EXAMPLES

H+S Video Material



Other Material





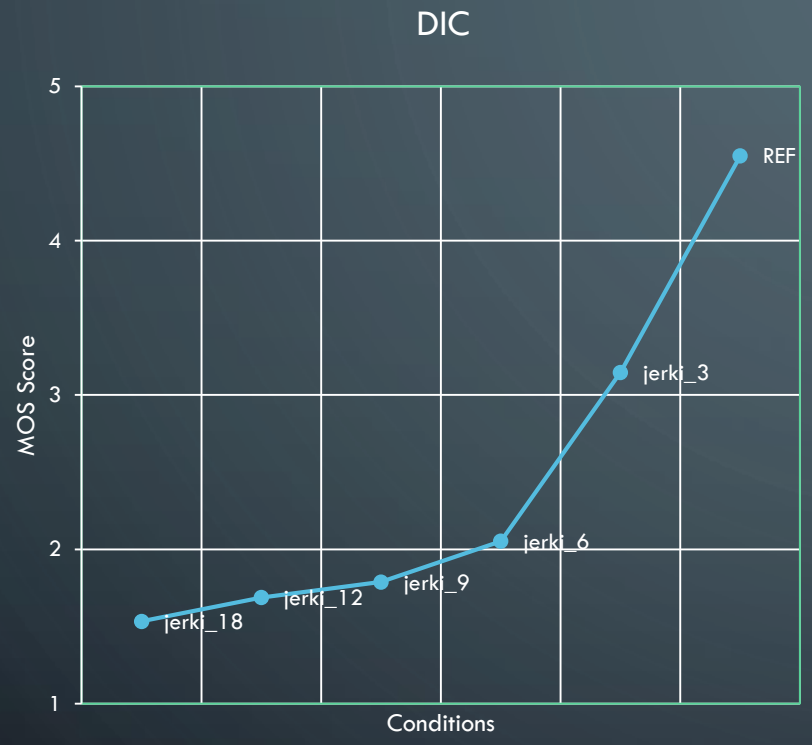

EXPERIMENT - SOME RESULTS: TEST I H+S

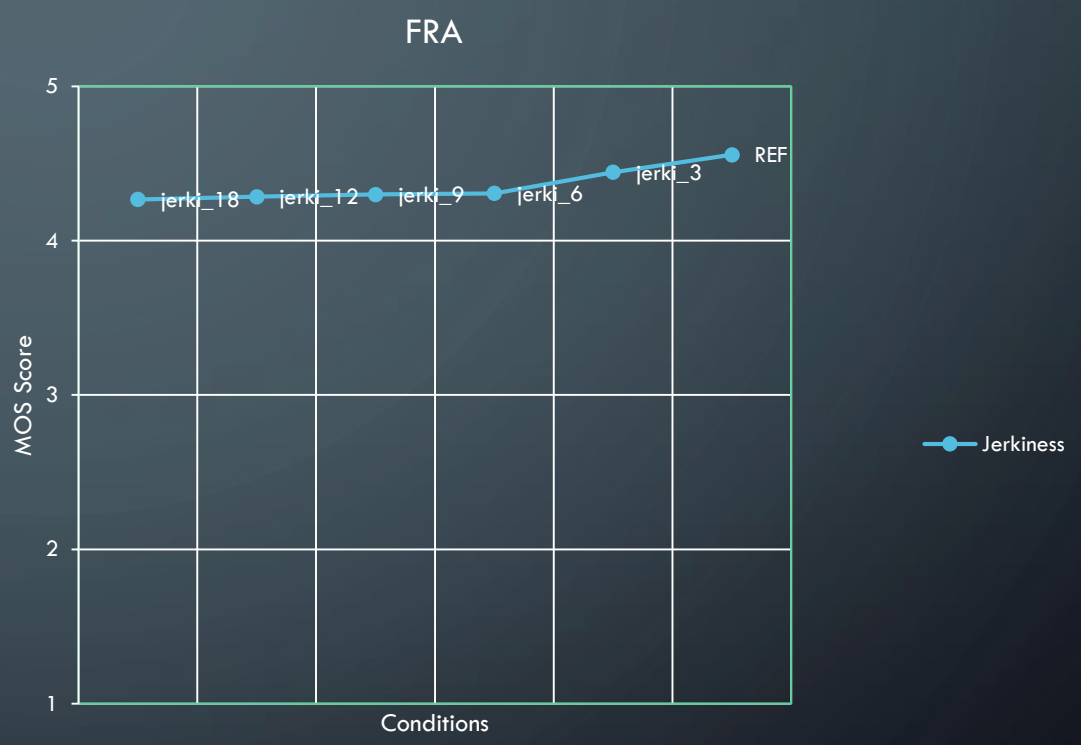
CONDITION	FRA	UCL	DIC	NOI	LUM
Reference	59.45	57.38	58.95	59.07	58.38
H264 Bitrate 28kbps	30.28	28.14	49.68	51.23	50.96
H264 Bitrate 56kbps	39.80	33.84	52.35	53.60	52.96
RISV Artificial Blockiness 5x5	38.25	33.41	54.96	53.80	54.09
RISV Artificial Blockiness 8x8	34.13	29.95	53.72	51.98	52.36
RISV Artificial Blurring ITU(F1)	57.15	35.61	55.86	56.59	55.19
RISV Artificial Blurring Filter7	55.91	26.84	55.57	53.97	52.80
Luminance Impairment I (darker)	57.35	47.73	55.69	57.31	24.69
Luminance Impairment II (lighter)	58.36	51.47	57.29	57.71	30.29
RISV Artificial Jerkiness 11 Frames	55.15	50.05	26.47	56.88	54.97
RISV Artificial Jerkiness 6 Frames	55.30	50.72	31.82	56.43	54.97
RISV Artificial NoiseQ 15%	54.41	44.65	55.03	22.64	53.26
RISV Artificial NoiseQ 3%	55.13	50.34	56.36	30.08	54.42
Packet Loss 0.5%	40.03	47.96	52.67	55.96	55.13
Packet Loss 1.5%	26.13	43.59	50.01	54.73	54.17

EXPERIMENT - SOME RESULTS: TEST III OTHER CONTENT

CONDITION	UCL	LUM	FRA	DIC	NOI
Reference	58.60	57.89	59.75	58.24	60.14
RISV Artificial Blurring ITU (F1)	35.13	49.05	54.99	53.86	54.31
RISV Artificial Blurring Filter7	26.90	46.74	54.05	51.38	49.99
RISV Artificial Jerkiness 3 Frames	52.93	53.77	55.74	39.30	57.08
RISV Artificial Jerkiness 6 Frames	51.41	53.42	53.70	29.32	56.09
RISV Artificial NoiseQ 3%	45.37	48.59	54.79	54.05	27.89
RISV Artificial NoiseQ 15%	40.95	46.39	51.58	53.73	23.26
Luminance Impairment (darker)	56.28	41.95	59.11	57.70	58.81
Luminance Impairment (lighter)	49.86	28.42	57.57	56.57	56.46
Packet Loss 0.25%	43.22	50.97	24.13	33.91	52.07
Packet Loss 0.5%	41.84	50.96	23.37	34.32	50.42

EXPERIMENT - SOME RESULTS: TEST II H+S





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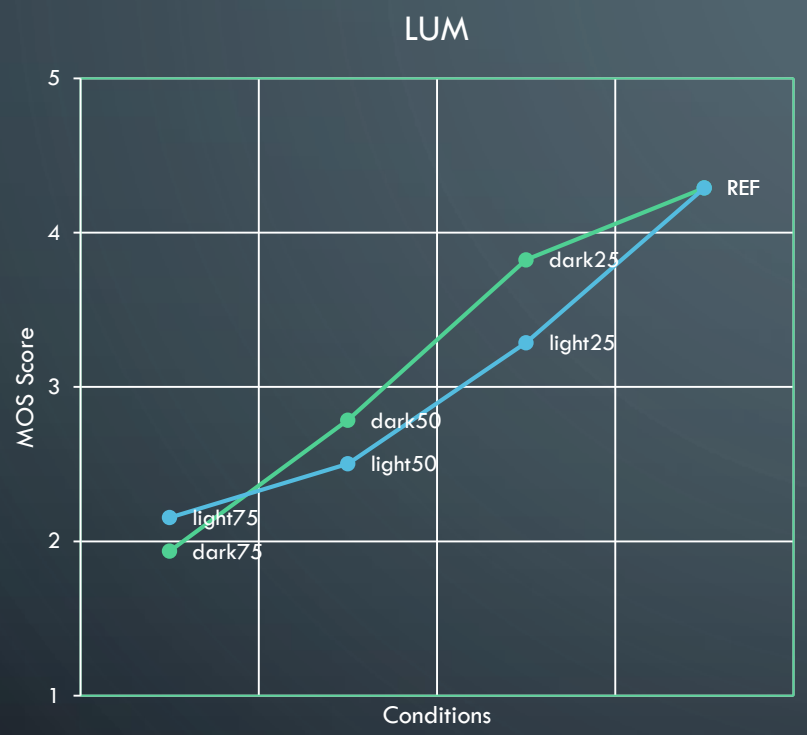
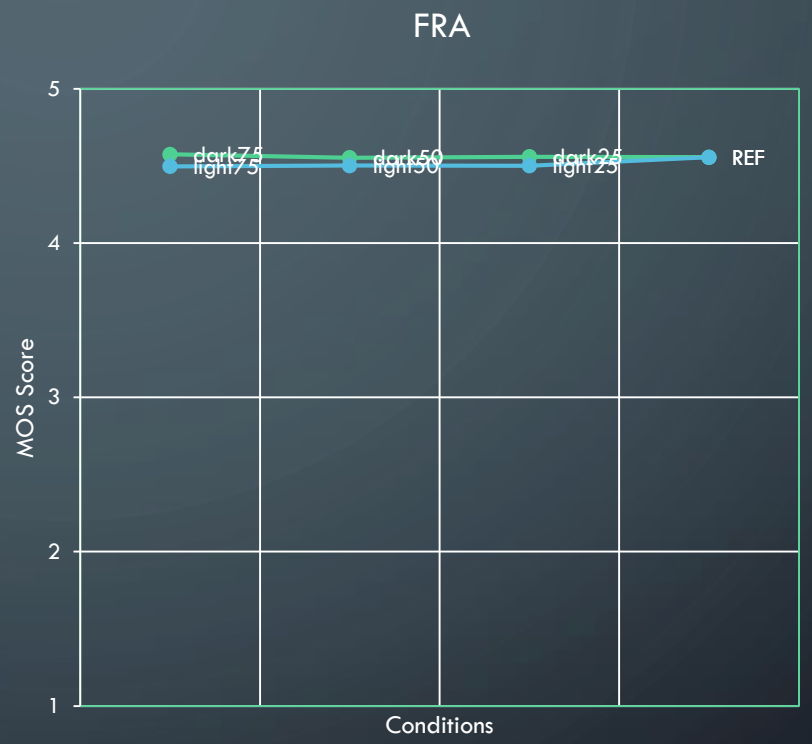
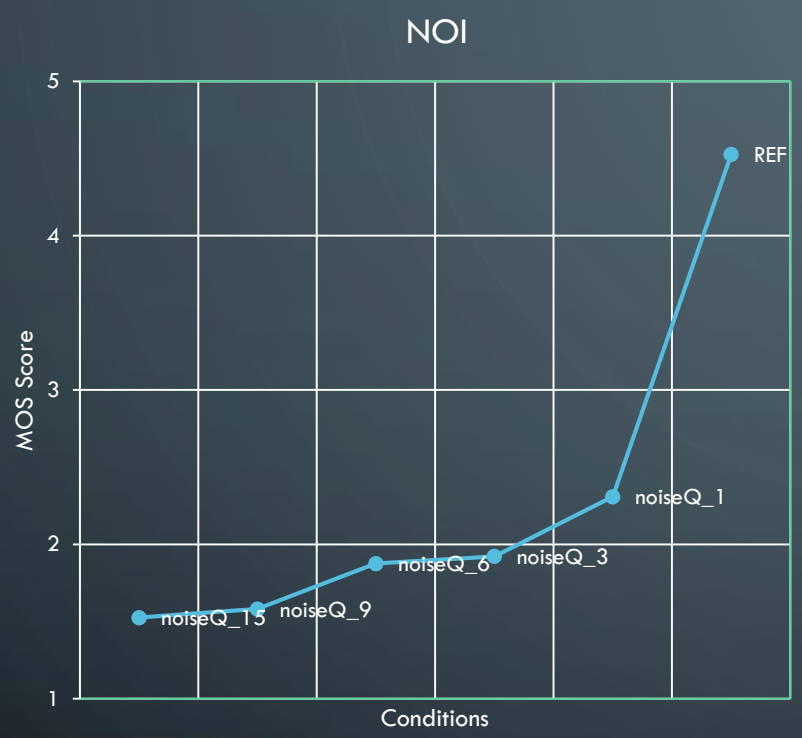
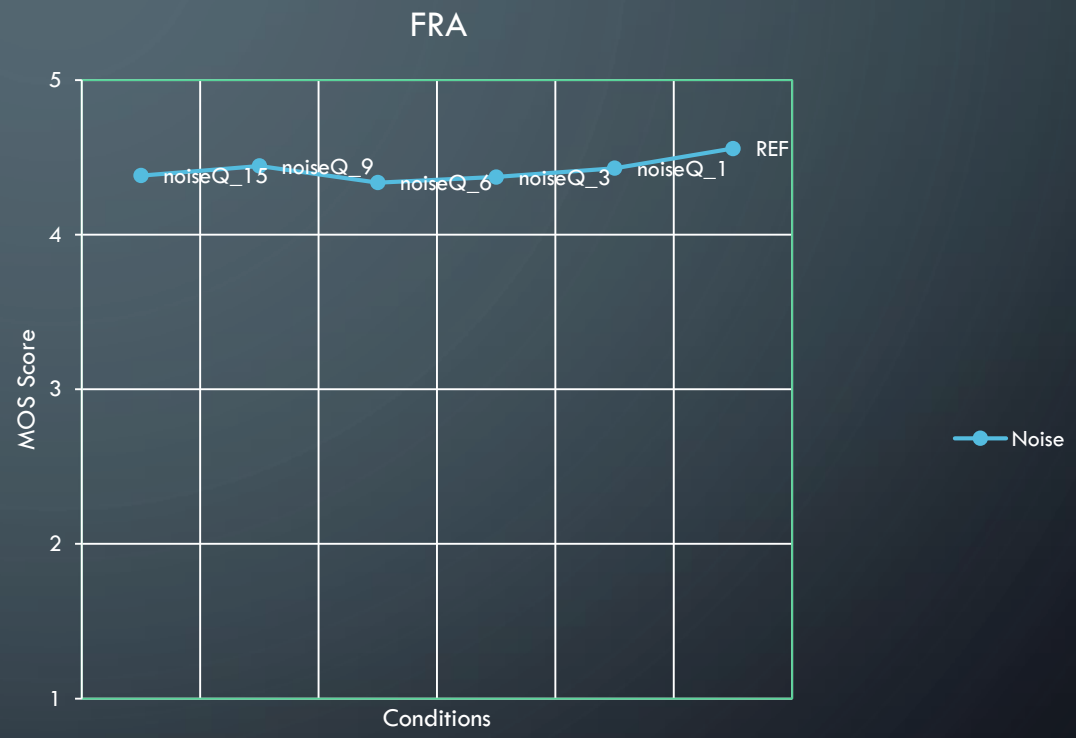




Darker
Lighter

EXPERIMENT - SOME RESULTS: TEST II H+S





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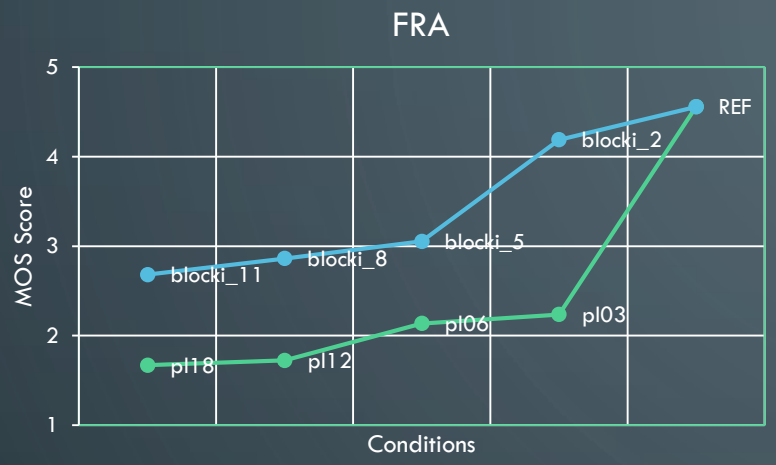

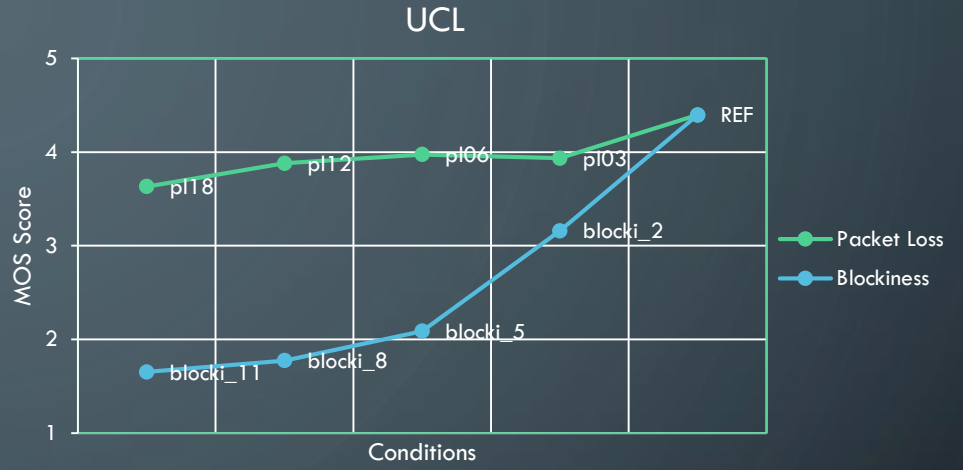

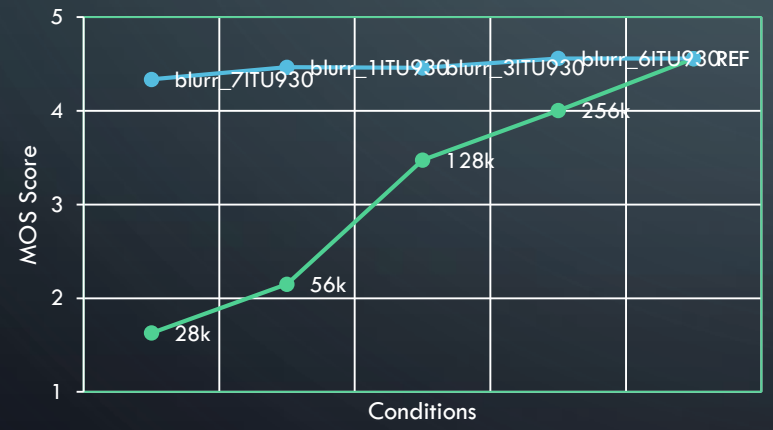

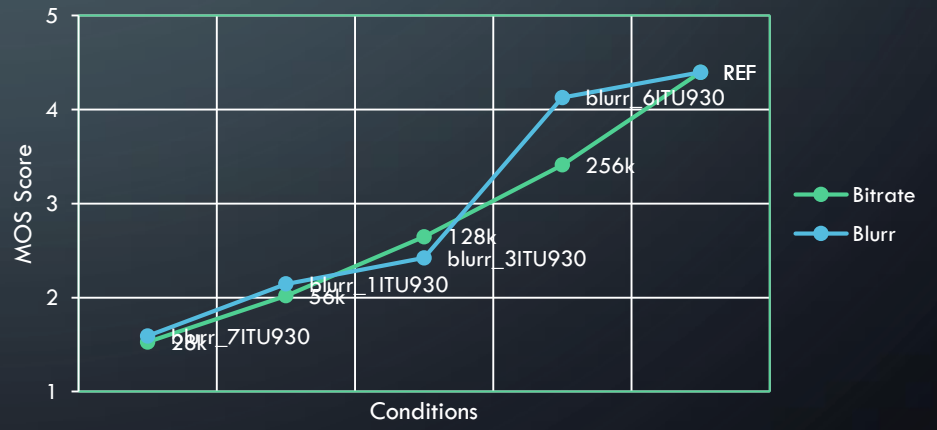

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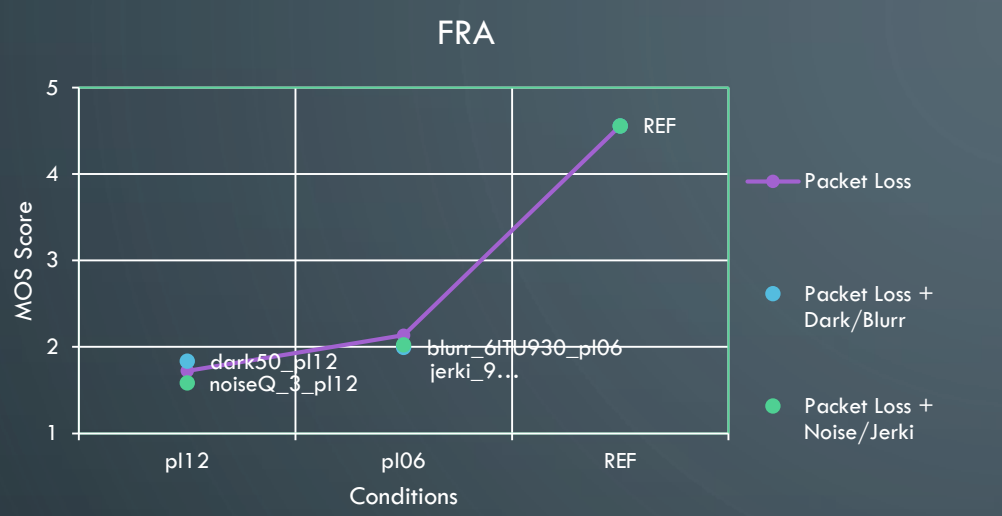

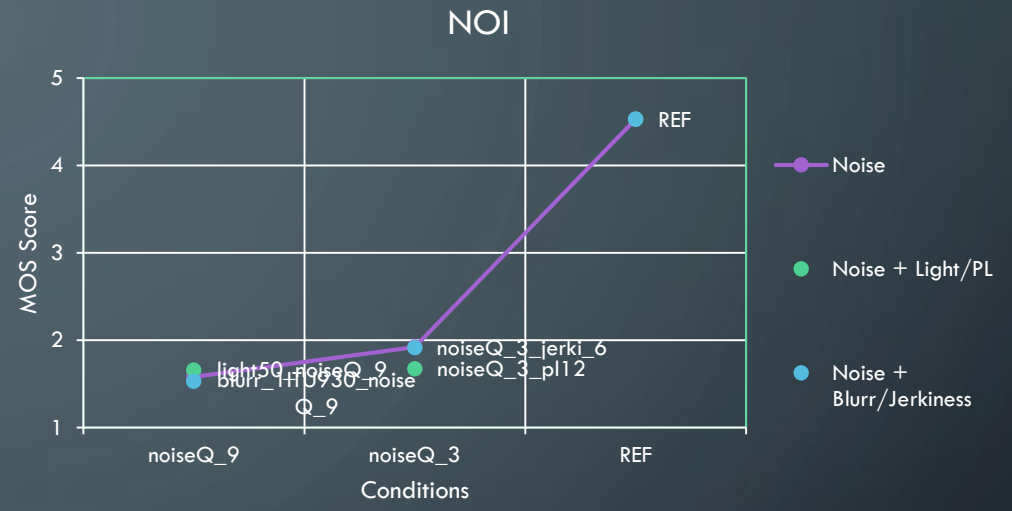

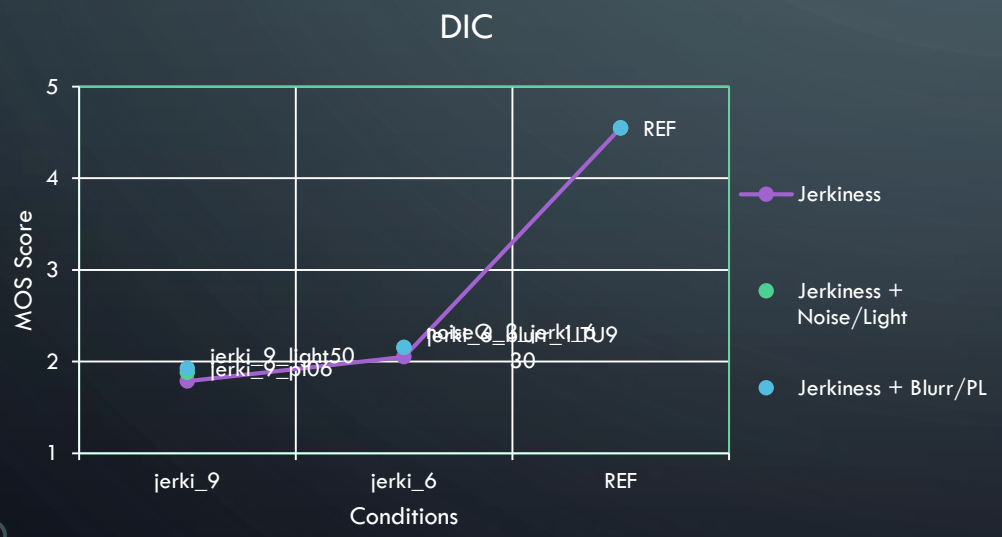

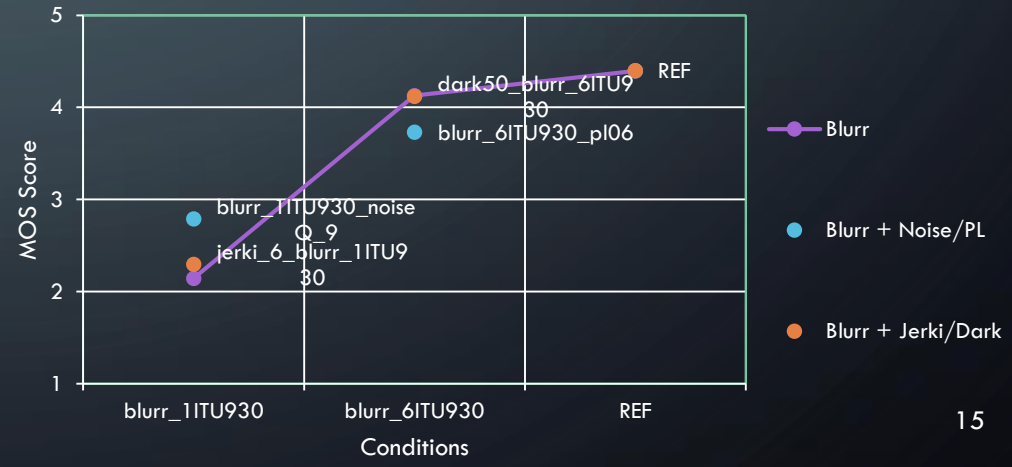

QUALITY PREDICTION - MOS_VQ VS. MOS_VQDIM (HSII)

$\Rightarrow$ MOS_VQDIM = -5.94 + (0.21 · FRA) + (0.73 · UCL) + (0.53 · DIC) + (0.47 · NOI) + (0.31 · LUM)

PEARSON = .90

RMSE = .45

CONCLUSION & FUTURE WORK

⇒ The perceptual video quality space consists of five dimensions.

⇒ It can be assessed directly via the corresponding quality dimensions.

⇒ It is independent from the video content.

⇒ Possible to model overall video quality model from the dimension scores.

⇒ Prediction of the five dimensions using exsiting metrics.

⇒ Additional studies are ongoing to confirm the findings.
(Results will be presented next at ITU-T May ’19)

THANK YOU FOR YOUR ATTENTION

⇒ ANY QUESTIONS