Analyze And Predict the Perceptibility of UHD Video Contents.

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based on HVEI/EI 2019 paper: `https://bit.ly/2EE4xmi`

March 4, 2019

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Motivation – UHD vs. HD

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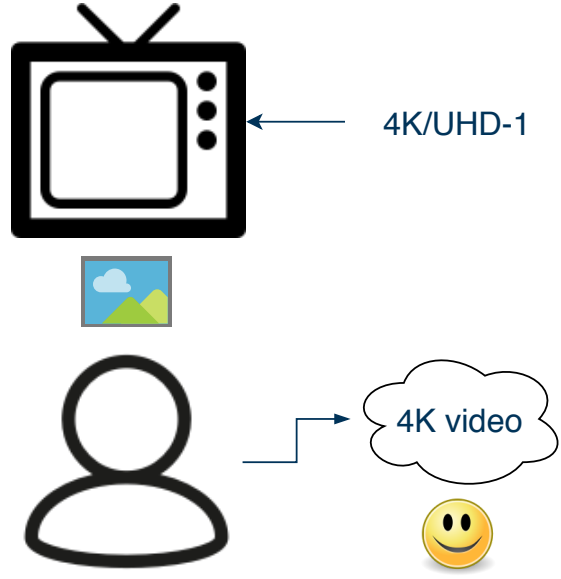
- increasing display density and resolutions, e.g. 4K, 8K [18]
- video streaming with higher resolutions, e.g. Netflix [16]
- is there a –perceptual– real benefit of UHD over HD?



→ short recap of state of the art

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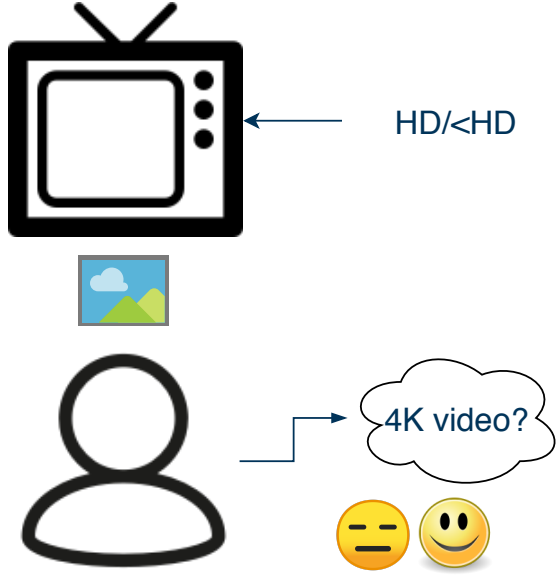

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UHD/4K overview

- recommendation: 1.5 or 1.6 $\times$display height: user-screen [19, 9, 6, 7]
- real world: $>=$ 5.5 display height, Noland and Truong [17]
- UHD vs HD: Berger et al. [2]
  - 1 subjective test: ACR approach, encoded videos
  - border of visual perception reached: hard do see a difference
- $\rightarrow$ **two research questions**:
  - what is a suitable test method for UHD and HD comparison of uncompressed video material?
  - can videos be classified according to their UHD perceptibility?

  $\rightarrow$ test methods and setup

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- classical ACR: Berger et al. [2]
- video stripes (half low resolution, other half higher resolution): Li et al. [13], Van Wallendael et al. [20]
- quality slider
- side-by-side test
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- temporal change of two resolutions
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Stripe Method – *STRIPES*

- extension of one stripe method; total $n = 12$ stripes
- question: has A or B higher quality?

Example Video

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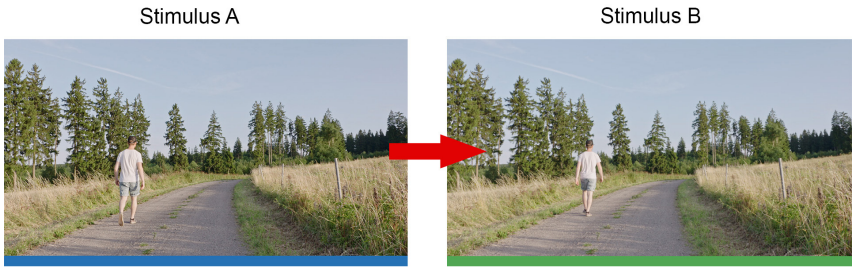
Temporal switching Method – *TEMP*



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- no manual change, comparable with *STRIPES*

Example Video

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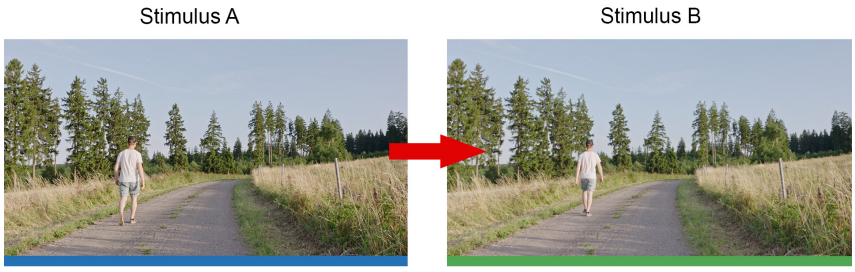

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Videos and Technical Setup

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- 20 videos: uncompressed footage; 10 s 4:2:2, 3840x2160, 60 fps
- selection based on SI-TI diversity (small, mid, high)
- up- and down-scaling: Lanczos-3-algorithm; good quality: Li et al. [13]
- considered resolution pairs: UHD-1 vs HD; UHD vs. 900p, UHD vs. 720p
- Panasonic VIERA TX-65CXW804 65 " screen; ITU-R BT.500-13 [8]
- viewing distance 1.5 · screen height.
- used tool: AVRateNG [12][1] → **later more**

[1] see https://bit.ly/2QlCGft

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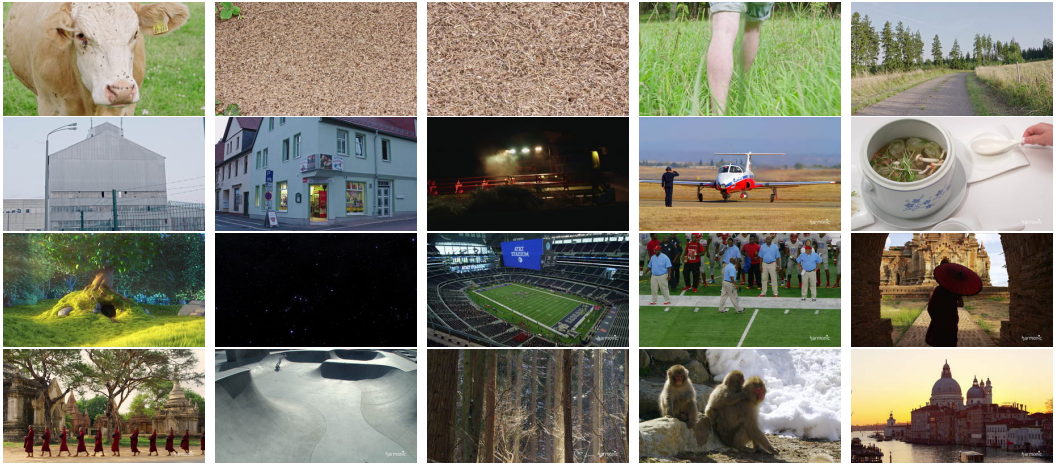
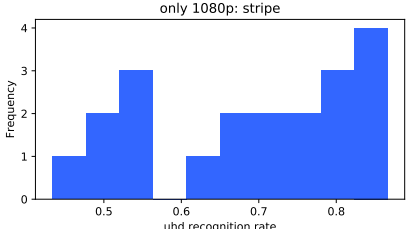
Used Videos in the Test



- 10 videos from harmonic.com [4], big buck bunny [3], BennuProRes [15]
- 8 self recorded sequences

Test Results

- 60 participants for both tests
- UHD-recognition rate: # of cases where UHD correctly identified
- **focus on UHD vs. HD**, good results for UHD vs. 900p/720p



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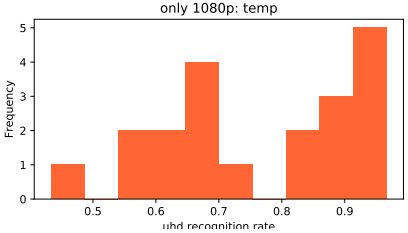
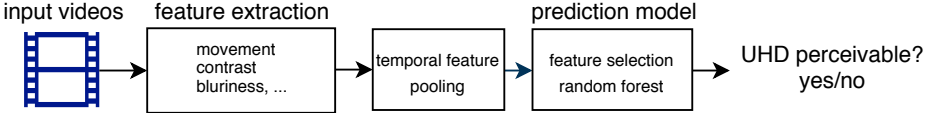


TEMP (better)

→ content is UHD recognizable, if UHD-recognition rate >=80%; 10 videos

Prediction of UHD perceptibility



- classification problem; working with various ml-algorithms
- temporal feature pooling: mean, std, ... groups ($n = 5$, mean, std),
- features: I=image, M=motion based
  - contrast^I, blur^I, uhdhdsim^I, temporal^M, blockmotion^M, movement^M, staticness^M
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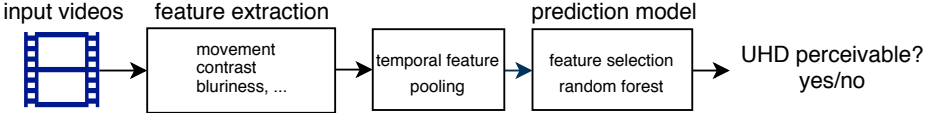

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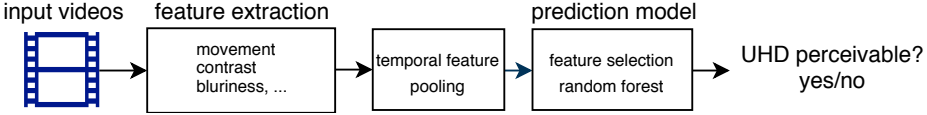

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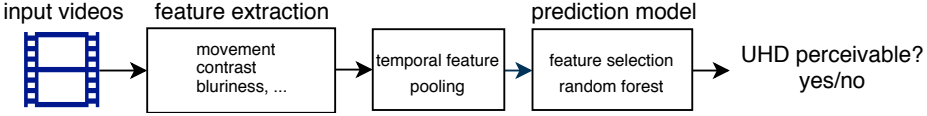

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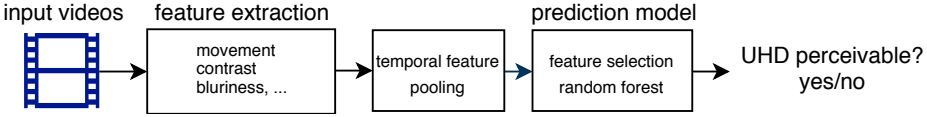

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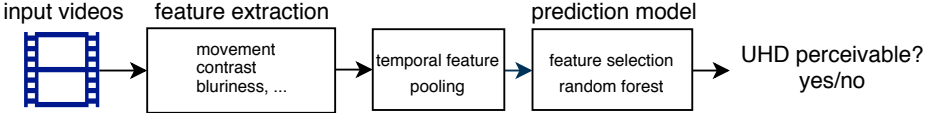

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Evaluation– Synthetic Dataset

- 36 video segments
- down scaled to HD, upscaled again
- is this detectable?, check for our features

class	precision	recall	f1-score	support
0	0.77	0.92	0.84	36
1	0.90	0.72	0.80	36
avg / total	0.83	0.82	0.82	72

Evaluation– subjective dataset

- using UHD-recognition rate from *TEMP* method,
- *STRIPES* similar results
- if UHD-recognition rate $>=80\% \rightarrow$ class=1

class	precision	recall	f1-score	support
0	1.00	0.30	0.46	10
1	0.59	1.00	0.74	10
avg / total	0.79	0.65	0.60	20

Conclusion, Summary and Future Work

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- conducted 2 tests for comparison of UHD and HD
  - **temporal switching** method better results than stripes
  - **50% of our videos**: UHD hard to distinguish with HD
- automated video classification: UHD vs. HD
  - **different+new features introduced** + machine learning pipeline
  - synthetic dataset: good, subjective dataset: good
  - usage: automated video source classification, streaming optimization
- open and next steps:
  - more subjective test data, extension of features
  - still a hard task

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  - still a hard task

Conclusion, Summary and Future Work

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- conducted 2 tests for comparison of UHD and HD
  - **temporal switching** method better results than stripes
  - **50% of our videos**: UHD hard to distinguish with HD
- automated video classification: UHD vs. HD
  - **different+new features introduced** + machine learning pipeline
  - synthetic dataset: good, subjective dataset: good
  - usage: automated video source classification, streaming optimization
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Thank you for your attention

. . . . . are there any questions?

Acknowledgments:
This research work was partially funded by Deutsche Telekom AG, Germany.

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Testroom

Videos