Camera identification on YouTube

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Introduction
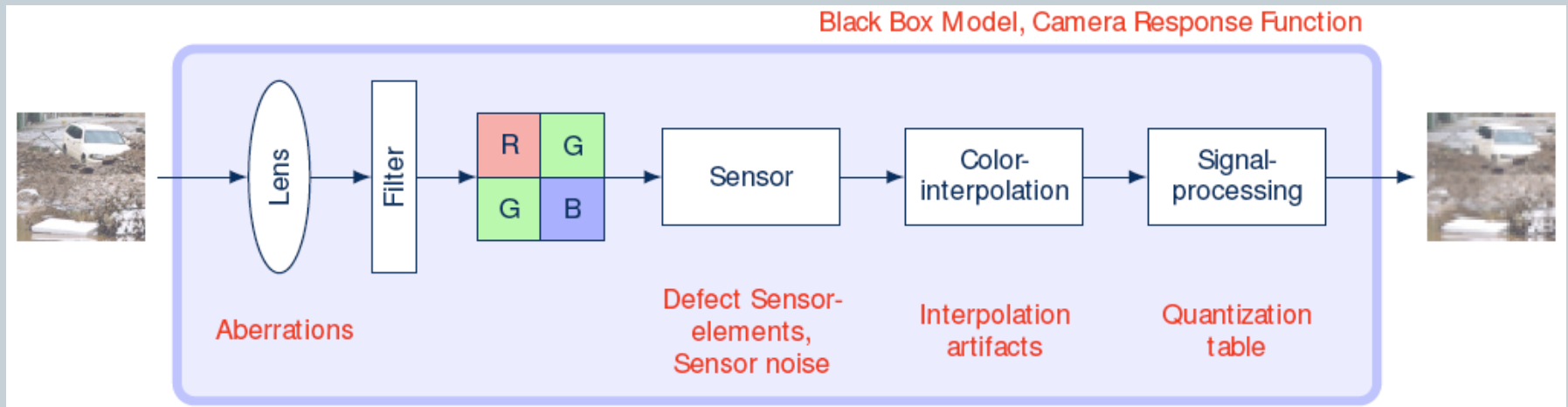
- Why camera identification?

Agenda

* Pattern noise
* Video encoding
* Experiment
* Results
* Analysis
* Conclusion

Noise sources

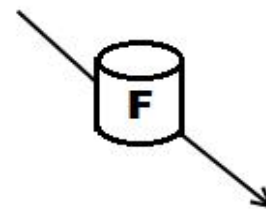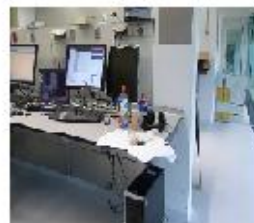Signal processing of a simplified digital camera

Pattern noise

- Present on all frames
- Fixed pattern noise (FPN)
  - Defective pixels
- Photo Response Non-Uniformity (PRNU)

Algorithm

Algorithm

- Correlation between the reference pattern and the video pattern

- Correlation on each color channel (RGB)
  - Sum of correlation on each color channel

- Correlation value between -3 and 3

PRNUCompare

- Algorithm implemented in PRNUCompare
  - Developed by NFI (Netherlands Forensics Institute)
- http://prnucompare.sourceforge.net/

PRNUCompare
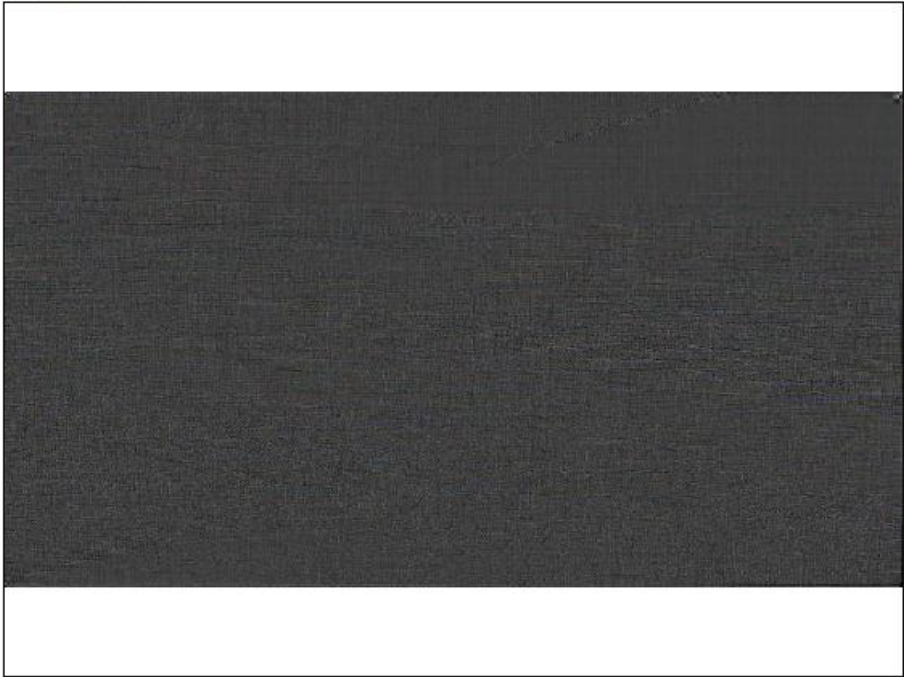
Video encoding

- Advanced Video Codec (AVC)
- Compresses the video stream
- Modifies the pattern noise
- Applies to YouTube

Research question

How does re-encoding the video with the Advanced Video Codec influence the pattern noise?

Experiment

- 5 different camera models
  - Canon Ixus/SX210
  - Panasonic FP7/FZ45
  - Apple iPhone 4
- 5 different cameras per model
- Multiple resolutions
  - 640x480
  - 1280x720

Experiment

- 1 reference video per camera per resolution
- 1 natural video per camera per resolution
- re-encode each natural video
  - AVC encoding setting: CRF 18,21,…,39
- Upload/download videos to/from YouTube

Encoding quality 18

Encoding quality 21

Encoding quality 24

Encoding quality 27

Encoding quality 30

Encoding quality 33

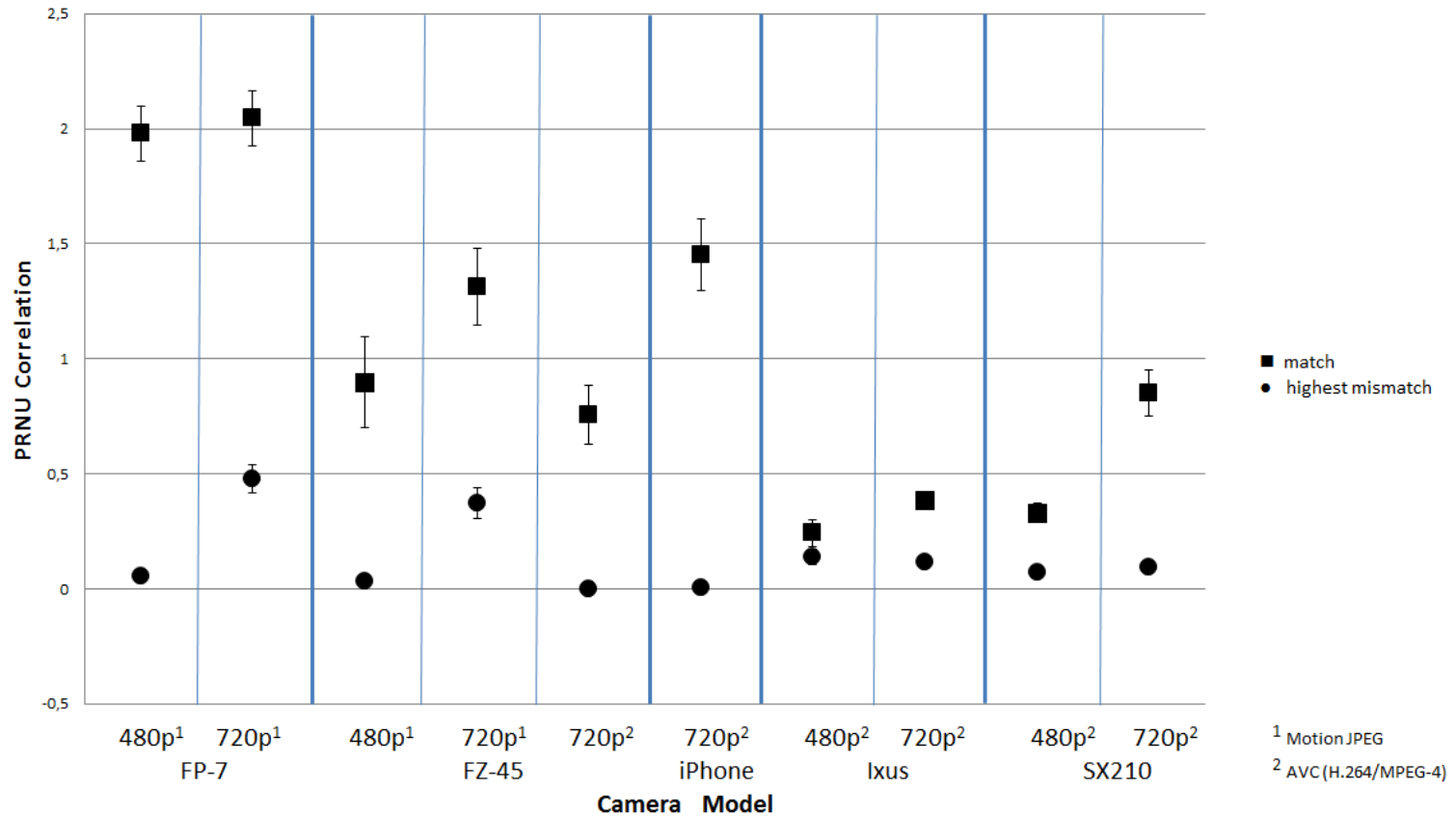# Encoding quality 36

Encoding quality 39

Results

- Extracting the pattern noise for each video
- Correlate each video to the reference patterns
- Total number of videos processed: **835**

Analysis

- Verify that pattern noise can be used for source identification before re-encoding
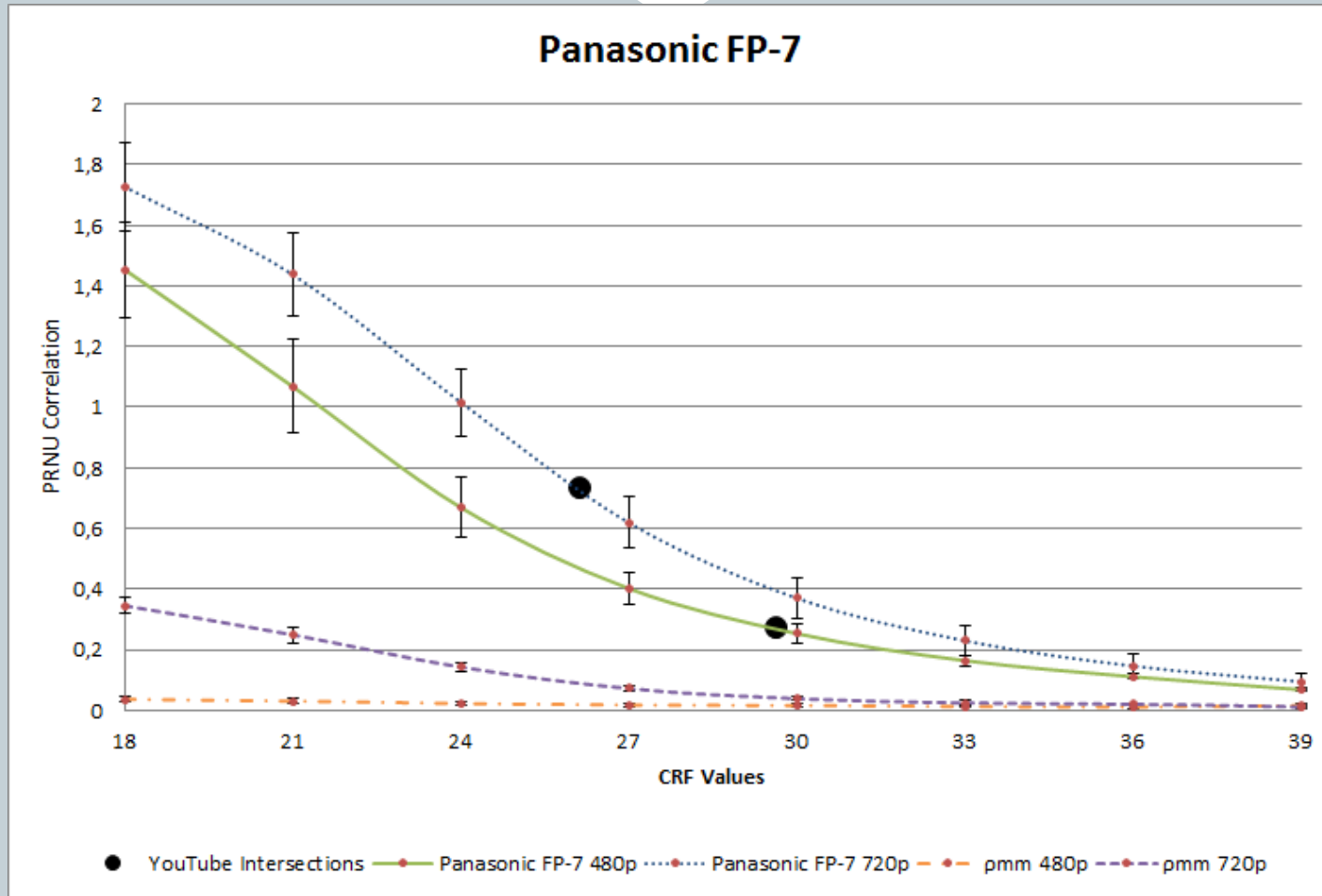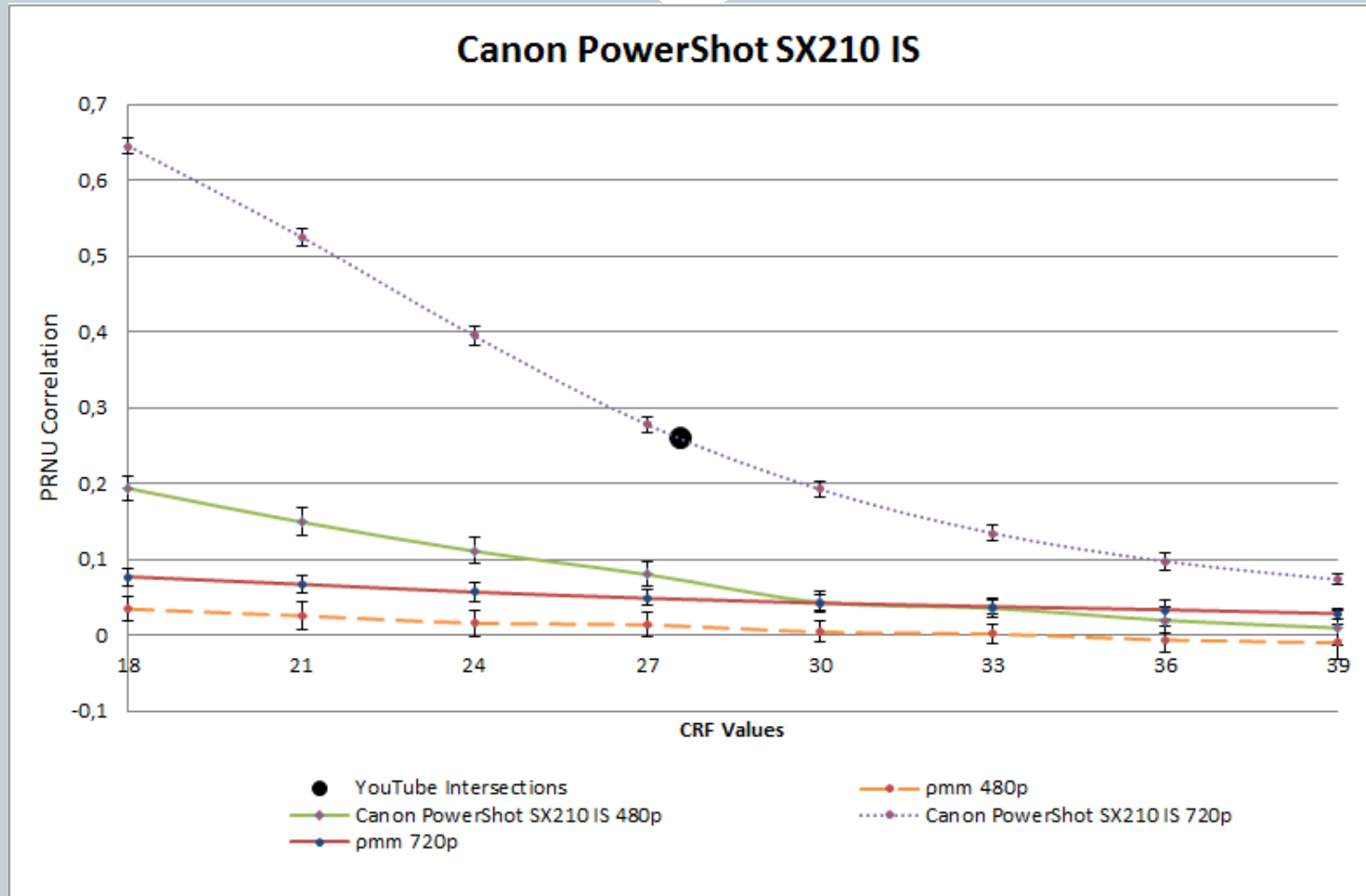
Analysis

Analysis

- Correlation between re-encoded videos and reference patterns

Analysis

Analysis

Canon PowerShot SX210 IS

Conclusion

- Depends on the level of compression
- Presence of pattern noise differs per model
- Higher resolutions videos perform better
  - More pixels == more noise

Conclusion

Even after a re-encode on the video with a compression similar to YouTube, it is still possible to identify the source camera for most cameras.

Questions?

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