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Institute for Information and Communication Technologies

Efficient Video Breakup Detection and Verification

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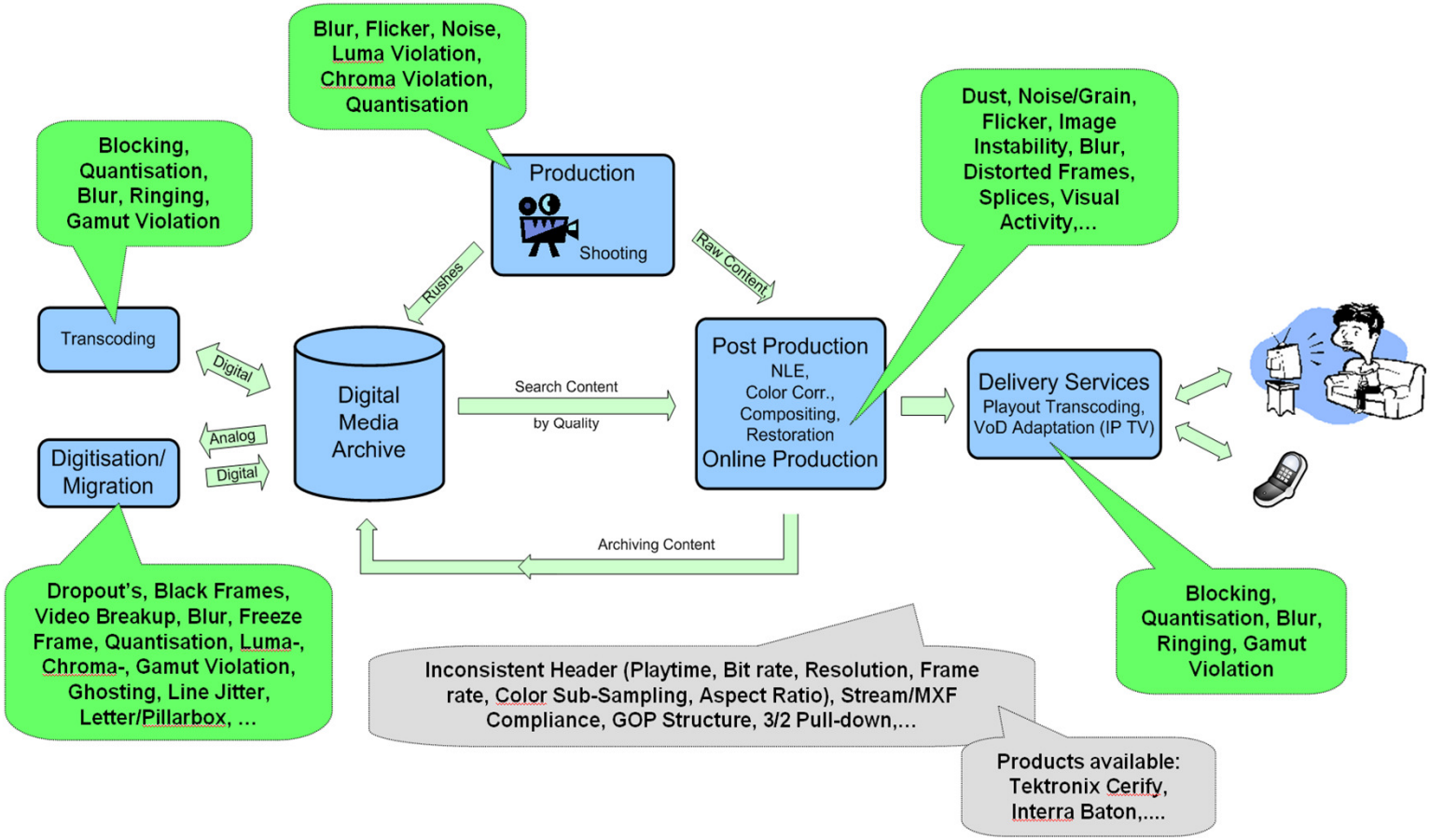
Why „Quality Analysis“?

- Avoid error-prone and cost intensive manual inspection of video material



General Requirements

- At least semi-automatic detection (workflow)
- Runtime efficiency
  - Delivery → on the fly
  - Archives → amount of data
  - Simple approach required
- High quality of detection (performance)
  - Recall as high as possible
  - FPS per minute as practical measure
- Easy, intuitive assessment of „overall quality“
  - Abstract, compact information
- Focus today on **”Video Breakup”** detection

What is Video Breakup?

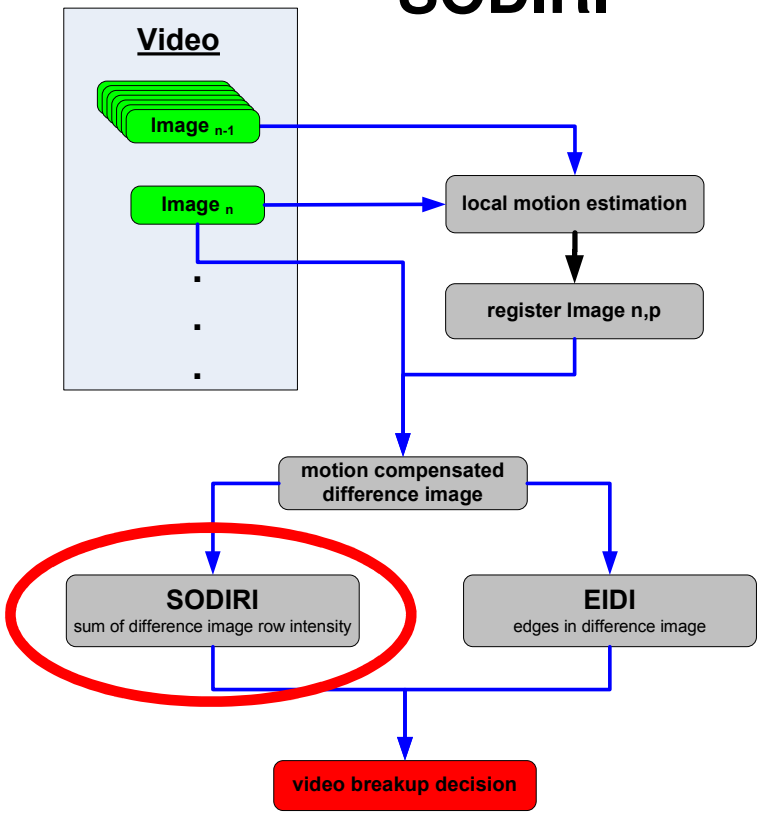
<u>Video Breakup</u>: “umbrella term for various strong visual distortions”

- Typically caused by tape transportation problems (analogue)
- Partially broken (blocking/black) video streams (digital)

- Has diverging properties in space, time, colour, luminance ⇒ several forms of appearances
- No common property useful for single detector!

Algorithm (1a)

"SODIRI"

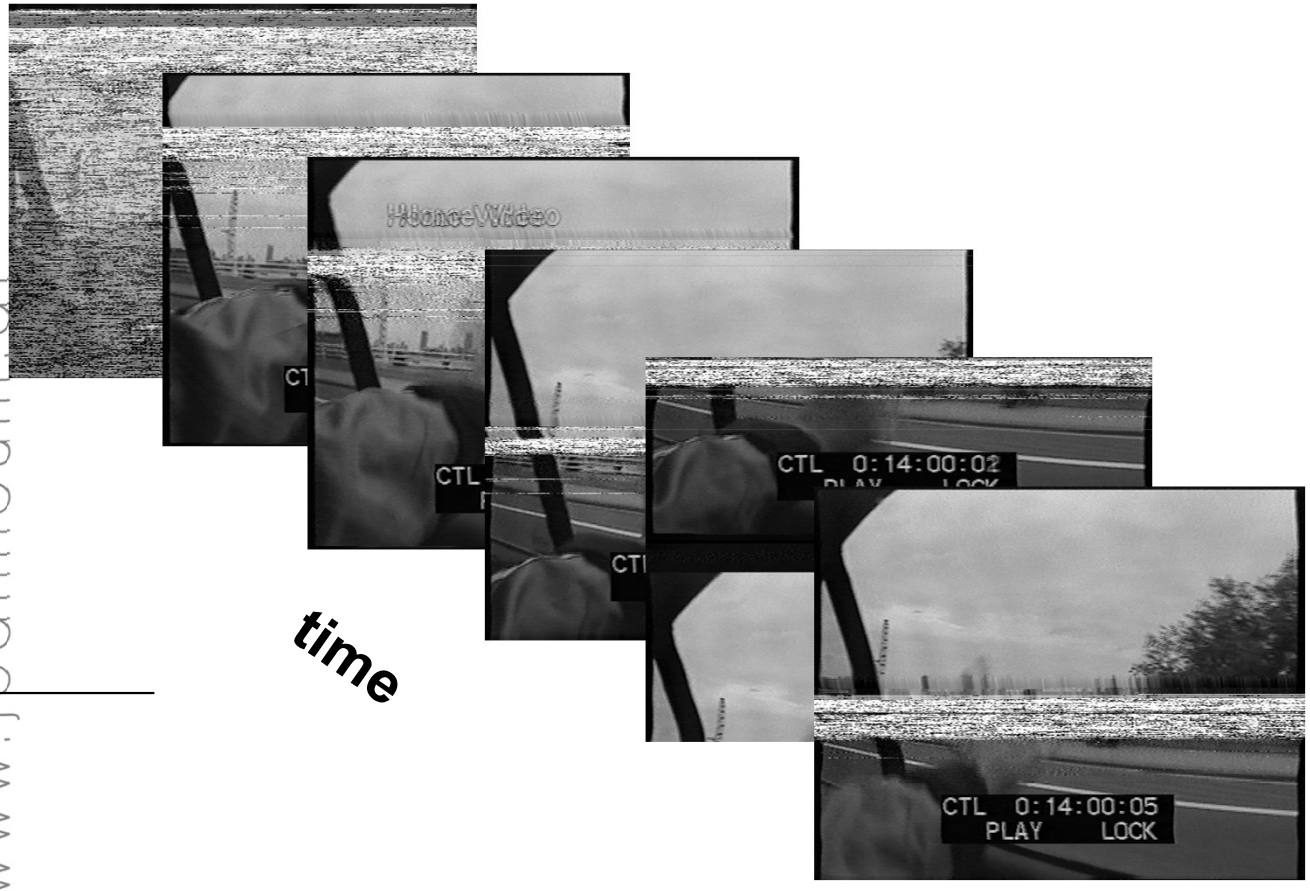


- **Principle**
  - Implicit modelling of „normal" video behaviour
  - Detection via violation of motion constraints
  - Based on pixel differences of consecutive frames
  - Basic and „motion compensated" (GPU) version

- "**S**um **o**f **d**ifference **i**mage **r**ow **i**ntensity"
  - Mean, row-wise difference between (motion compensated) preceding and actual field
  - Similar to stripe images, compact representation of not compensable motion

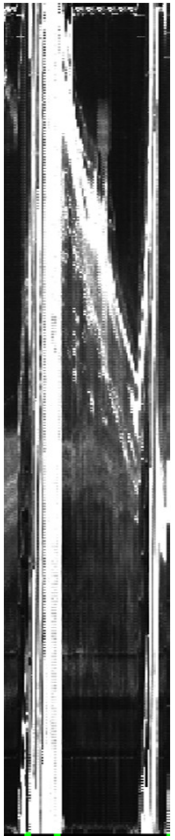
Algorithm (1b)

Images



time

SODIRI



time

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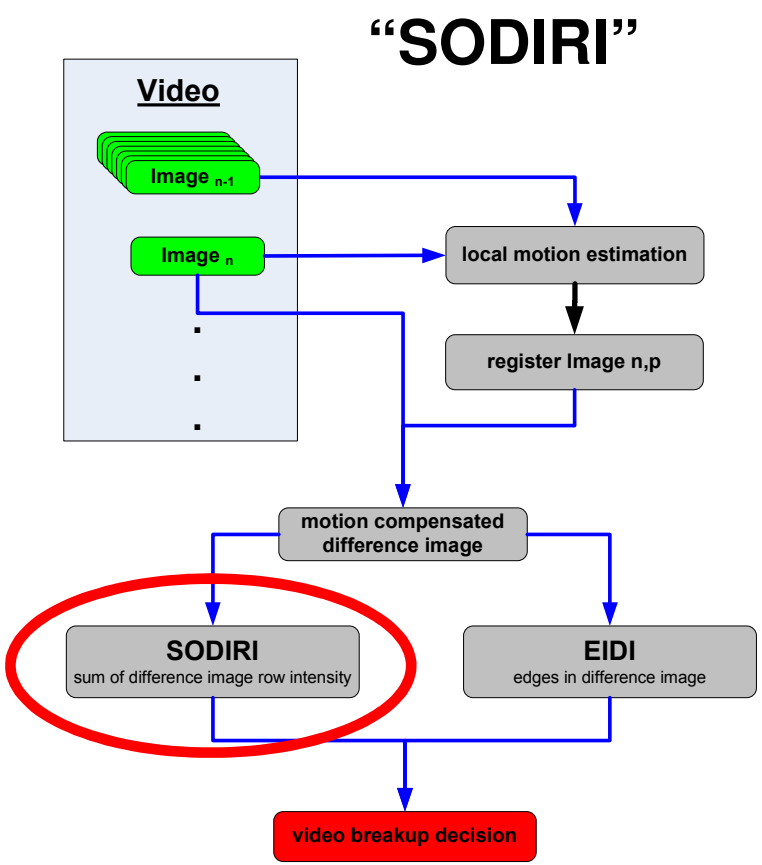
Algorithm (1c)

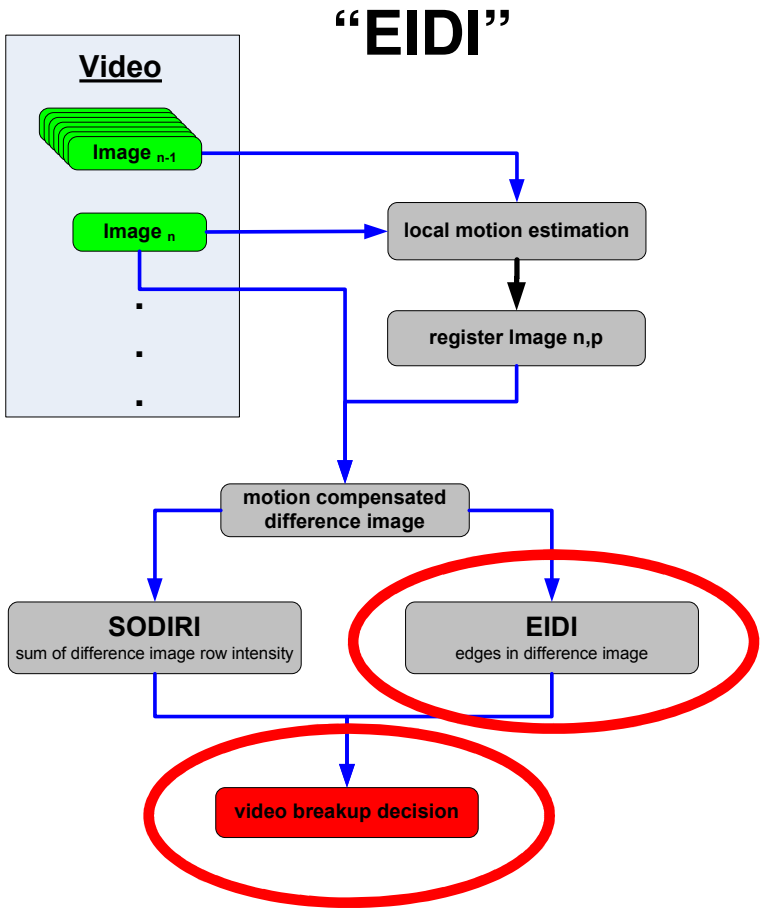


- **Principle**
  - Implicit modelling of „normal" video behaviour
  - Detection via violation of motion constraints
  - Based on pixel differences of consecutive frames
  - Per field processing of video
  - Basic and „motion compensated" (GPU) version

- **"Sum of difference image row intensity"**
  - Mean, row-wise difference between (motion compensated) preceding and actual field
  - Similar to stripe images, compact representation of not compensable motion
  - Comparison of consecutive columns by fuzzy distance measure(*)
  - High recall, but fair precision

(*) Dietrich Van der Weken, Mike Nachtegael, and Etienne Kerre, "Using Similarity Measures for Histogram Comparison," Proc. 10th International Fuzzy Systems Association World Congress, pp.1-9, 2003.

Algorithm (3)



- **E**dges **I**n **D**ifference **I**mages
  - Pixel-wise ratio between(strong) H/V edges
  - Overhang of horizontal edges in image
  - (Original edges compensated if OF used)
  - Increased robustness against illumination changes

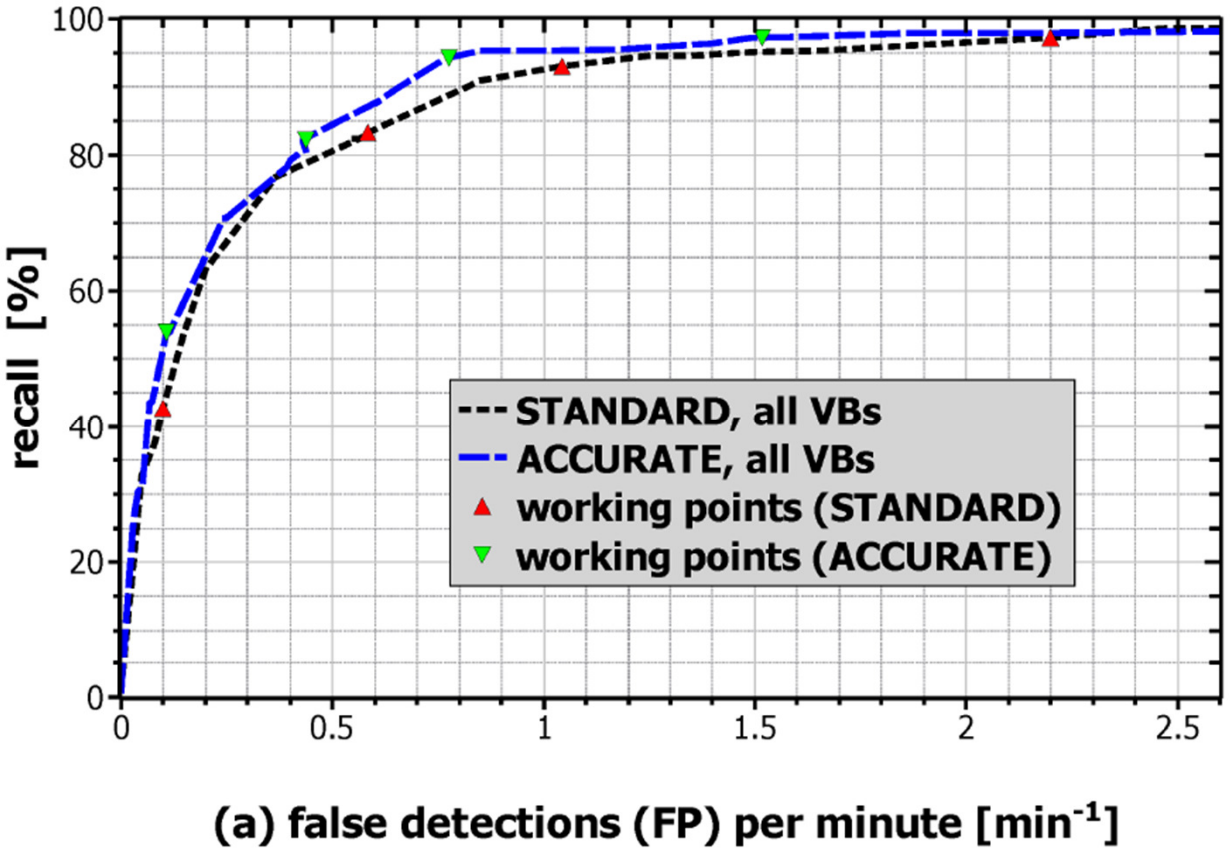
- Simple combination of measures
  - Both measures required
  - Fusion of temporally neighbouring detections
  - Significant reduction of false positives

Evaluation

- MATLAB batch evaluation tool for “regression tests”
- 51 videos in large, difficult evaluation dataset (452 min),
  - Various content types and strong other impairments (noise, flicker, instab.)
- Multi-dimensional optimization of parameters
- Ground Truth
  - Initial ground-truth taken 1:1 from expert annotations!
- Definitions
  - TP: if there is any response(!) within ground truth segment
  - FP: if there is no corresponding ground truth region for each detection
  - FN: ground truth region with no corresponding detection
  - Recall / False Positives per minute as “practical” measures

Performance Evaluation (1)

- Results for 51 videos, 452 min overal



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Performance Evaluation (2)

format/mode	RT	tot.(ms)	VB(ms)
SD, ACC	$0.25 \pm 9\%$	162.1	144.6
SD, STD	$1.47 \pm 1\%$	27.2	9.7
SD	$2.29 \pm 1\%$	17.5	-
HD, ACC	$0.06 \pm 14\%$	657.9	583.3
HD, STD	$0.31 \pm 2\%$	127.4	53.3
HD	$0.54 \pm 1\%$	74.3	-

– Runtime on Intel Core2 Quad CPU (2.4GHz) with 3GB of RAM and a NVIDIA GeForce GTX 285 (240 shaders)

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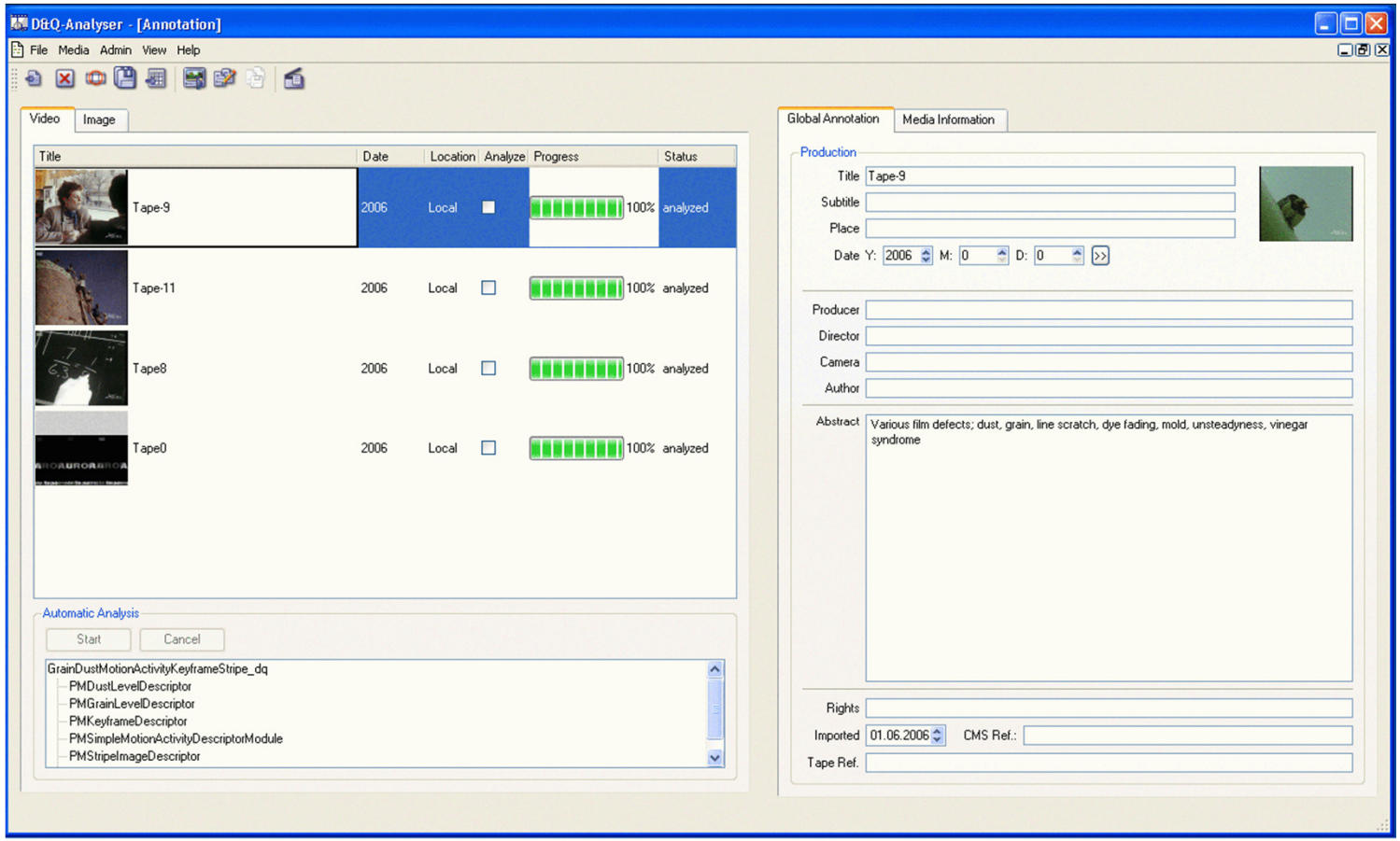
Quality Analyse



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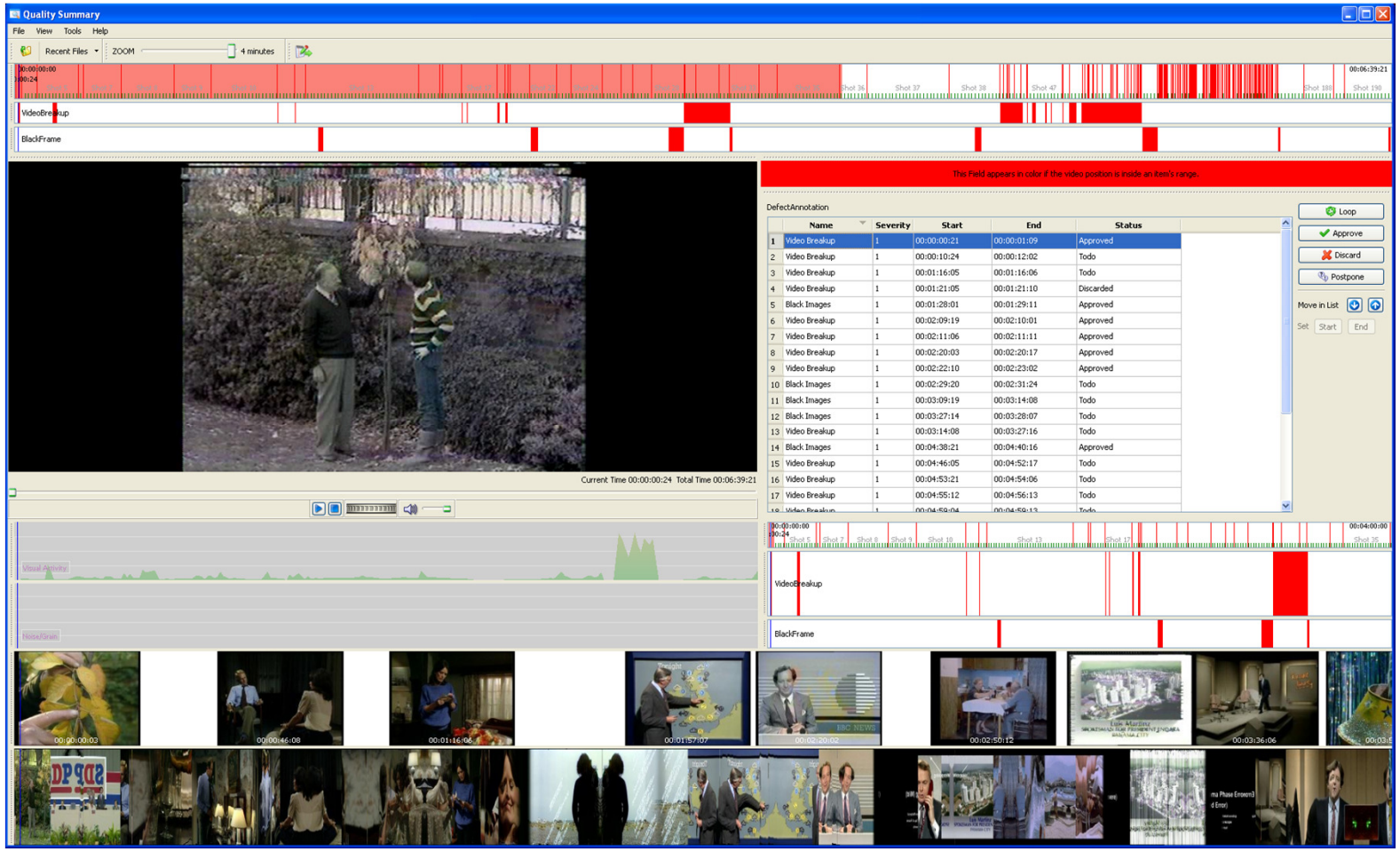
Quality Summary Viewer



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