



VK Multimedia Information Systems

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Dienstags, 16.00 Uhr s.t., E.1.42



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Video Retrieval



<http://www.uni-klu.ac.at>

- Motivation & Problems
- Features & Descriptors
- Some Methods
 - Text Based
 - Shot Detection
- Video Retrieval Evaluation
- Applications
 - Video Summaries



Motivation



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Szenario A: Ad Hoc Search - Pull Information

- Alice has heard about a recent event
 - Examples: Red Bull Air Race, etc.
- She wants to get an overview on
 1. Overview on **context**
 2. Coverage on the **outcomes & highlights**

Szenario A: Google Video



<http://www.uni-klu.ac.at>

The screenshot shows a Mozilla Firefox browser window with the address bar at <http://video.google.com/videosearch>. The search term 'redbull air race' is entered in the search box. The results page shows several video entries:

- Redbull Air Race Monument Valley, Utah**
8 min - 14-May-2007
Red Bull Air Race World Series Monument Valley, Utah 5/12/07
<http://www.youtube.com/watch?v=EGYioj4mG4Y>
Watch video here
- Redbull Air Race Istanbul Final**
10 min - 02-Jun-2007 - ★★★★★ (1 rating)
Red Bull Air Race Klasmanı "Red Bull Air Race World Series" in İstanbul'da ...
<http://www.youtube.com/watch?v=U0LxTXGInNc>
Watch video here
- RedBull Air Race İstanbul (http://cizbiz.tr.cx)**
6 min - 05-May-2007 - ★★★★★ (3 ratings)
... daha fazlasını iste <http://cizbiz.tr.cx> ...
<http://www.youtube.com/watch?v=5GxjERSE6Ck>
Watch video here
- Redbull Air Race 2006 Istanbul**
5 min - 31-Jul-2006 - ★★★★★ (5 ratings)
Redbull Air Race 2006 Istanbul
<http://video.google.com/videoplay?docid=-1303441116156582200>
Watch video here
- RedBull Air Race Qualificação**
3 min - 21-Apr-2007 - ★☆☆☆☆ (1 rating)
... ABRIL DE 2007 NO RIO DE JANEIRO FOI REALIZADA A CLASSIFICAÇÃO DA 2ª ETAPA REDBULL ...
<http://www.youtube.com/watch?v=gRC2C4Ckst8>
Watch video here
- FSX REDBULL AIR Race with TrackIR**
6 min - 20-May-2007
FSX Training RedBull Air Race
<http://www.youtube.com/watch?v=EpcTc3F-4y4>
Watch video here

The browser's taskbar at the bottom shows the system tray with a clock at 0.359s, Tor Disabled, and Adblock.

stems

Szenario A: Web Site



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Szenario A: Analysis



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Google Video	Air Race Web Site
Simple (Term) Search	Navigation (Gallery -> Video)
Short and ambiguous descriptions	Clear and intuitive meta information (thumbnails)
No additional information / interlinking	Further information provided
Fast, clean and efficient interface	Frisky and colorful interface
Legal issues ...	No legal issues

Szenario B:



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Szenario B: Media Observation

- George B. wants to find everything
 - Concerning certain Persons / Communities
 - Capturing the mood of media
- This includes
 - News broadcasts (language independent)
 - YouTube, MyVideo, etc.



Problems



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- Video Retrieval is a very broad field
 - Demands differ from professionals to hobbyists
- Videos are commonly rather 'big'
 - Sighting of raw footage and search results is time consuming
 - Extraction, analysis and indexing of descriptors are challenging
- Indexing is rather complicated
 - Videos are multimodal

Example Problem: Size



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- 15 minute video -> 25 fps, 720x576
 - # frames = $15 * 60 * 25 = 22,500$
 - With 65k colors
 - Raw size = $22,500 * 720 * 576 * 2 \sim 17.4$ GB
 - Indexed by color histogram
 - 256 colors with 256 levels each -> 16 Bit / frame
 - Size = $22.500 * 2 \sim 43.95$ kB
 - In a video database
 - 1,000 videos -> ~ 44 MB descriptor data
 - 1,000,000 videos -> ~ 44 GB descriptor data

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Features and Descriptors



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- Visual Descriptors:
 - Additional dimension: **Time**
 - Related to audio information
 - Movement (change over time)
- Audio Descriptors
 - Related to visual information
- Multiple Streams
 - Different languages, comments
 - Different angles / viewpoints

Video streams



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Video stream \leftrightarrow sequence of still images

- Index single images
 - Using arbitrary features (color, texture, ...)
- Instead of single picture
 - Group of Frames (short: GOF)
 - Group of Pictures (short: GOP)
 - e.g. averaged color of multiple frames

Video Streams



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- Motion based descriptors
 - Find shots with zoom / pan
 - Camera vs. object motion
- Feature extraction
 - Motion estimation (see video coding)
 - Motion histograms
 - Dominant or averaged motion direction

Temporal Segmentation



News Broadcast



Temporal Segmentation



- A single decomposition
 - Three different levels
 - Non-overlapping segments
- Visual and audio descriptors
 - Attached to nodes
 - Describing sequence of frames



Example: MPEG-7



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- Multiple segmentation trees possible
- Different stream combined
- No “general description format”
 - How many segmentations / levels
 - Selection of descriptors at nodes
 - Interconnection of streams

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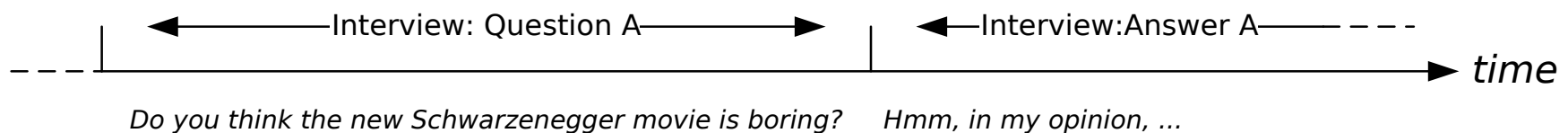


Text Based Retrieval



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- Text annotations assigned to segments
 - Transcriptions, metadata, etc.
- Retrieval is based on text
 - Inverted lists
 - Retrieval of relevant parts/documents



Text Based Retrieval: Applications



<http://www.uni-klu.ac.at>

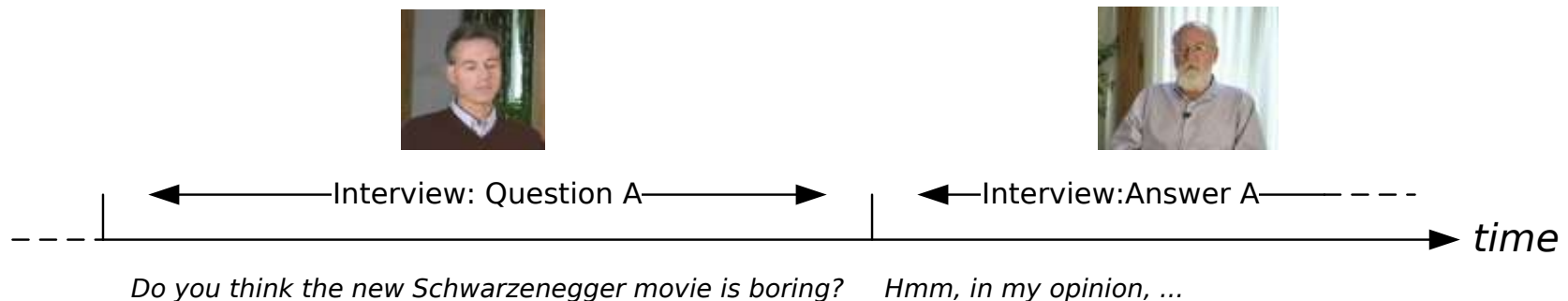
- Speech oriented videos
 - Speech recognition & manually
 - Transcription available for disabled people
 - Examples: News, Cartoons
- Metadata of videos
 - Tagging and descriptions like in YouTube
 - Manual annotations (e.g. sports videos)
 - Spotted keywords

Shot Detection



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- Automatic Segmentation of video stream
 - Find frame where new shot starts
 - Find frame describing the shot best



Different Cuts

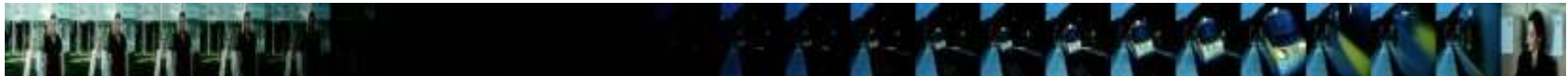


<http://www.uni-klu.ac.at>

- Simple Cuts (elephantsdream)



- Transitions & combinations (casino royale)



Shot Detection: Methods



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- Uncompressed Domain
 - Video is decoded
 - RGB or YUV values are used for computation
- Compressed Domain
 - Characteristics of the codec are exploited

Shot Detection: Uncompressed Domain



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- Rather good methods already available
 - Detection up to 95%
 - Depends on domain
- General approaches
 - Low level features
 - Change over time, tracking rapid changes
 - Grey values / Color Histogram

Shot Detection: Uncompressed Domain



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Common Algorithm

- For each frame n
 - Extract *histogram*(n)
 - Compute distance to *histogram*($n-1$): $d(n-1, n)$
 - If ($d(n-1, n) > threshold$) report shot boundary
- Problems
 - Each frame has to be decompressed
 - Threshold is domain dependent.

Shot Detection: Uncompressed Domain



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- Scene heuristics
 - Studio environments (backgrounds)
 - Sports events
 - News broadcasts
 - Interviews, round tables and discussions
 - “Fade to black” transitions
 - Find black frames as shot boundaries
 - Boundary scenes
 - e.g. “Millionenshow”, ads, ...
 - Common duration, average color

Shot Detection: Compressed Domain



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- Motion Vectors
 - Investigate major direction / amount changes
- Bit Rate
 - VBR: Higher amount -> shot boundary
- Number Macro Blocks / Type
 - More I-Blocks -> shot boundary
- Position of I-Frames
 - Actually a shot detection in encoding

Video Indexing based on Shots



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- Indexing Shots instead of frames
 - Number of shots depends on the domain
 - Considerably smaller than number of frames
- What to index about a shot?
 - Identify one or more “key frames”
 - Index the key frames
- Retrieval based on shots
 - Result is “part of the video”
 - Grouping possible, weighting necessary

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Retrieval Evaluation



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- Similar to IR Evaluation
- Several different tasks
 - Depending on the forum

Retrieval Evaluation Forums



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- TRECVID
 - Indexing and searching in video DBs
- VideoCLEF
 - Video content in multilingual environments
- INEX Multimedia
 - XML (Fragments) based multimedia retrieval

TRECVID 2007



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- Shot boundary Detection
 - Automatic comparison to human annotation reference data.
- High Level Feature Extraction
 - Classification based on 39 concepts
- Search
 - Ranked list based on shots compared to test collection
 - automatic, manually assisted & interactive
- Rushes Summarization
 - Management of raw video material (near duplicate scenes, no audio etc.)
 - Evaluation by a single human judge

VideoCLEF 2008



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- Classification Task: Vid2RSS
 - Dutch television footage
 - Dual language: English & Dutch
 - Both contribute, not translations
 - Transcriptions, keyframes, metadata provided
 - Task: RSS feed for each category
- ImageCLEF
 - Image retrieval tasks



- Retrieving relevant document fragments with multimedia character
- Input (Query):
 - Either Text or Text & Image
- Output (Result):
 - Image or text or both
- Evaluation
 - Human assessment

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Video Summaries






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- Methods for getting the most out of a video in minimum time




Editor's Picks

more »

 <p>Ram Bus by invisibleeng 160 views</p>	 <p>Living the Dream by livingthedream 66 views</p>	 <p>Politics in the Morning by MyNameisBill 258 views</p>
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Recently Added

more »

 <p>The Money by tropfest@yourCut 6 views</p>	 <p>HIP HOP 3 by HMAN 24 views</p>	 <p>PublicDomainTV-Classic Marilyn-Monkey Business by PublicDomainTV 16 views</p>
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Video Summary Example



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IMB II

Die Intelligente Multimediale Bibliothek

[Search](#)
[Interface](#)
[About](#)
[Help](#)

- X

Autor: Neuschmied, Helmut
Genre: Daily news
Duration: 00:05:07 22 frames (25 fps)
Filesize: 53694468 Bytes

Aufzeichnung der ZIB Sport Sendung vom 10.05.2002.

Semantische Objekte:

Keyframes:

Decomposition

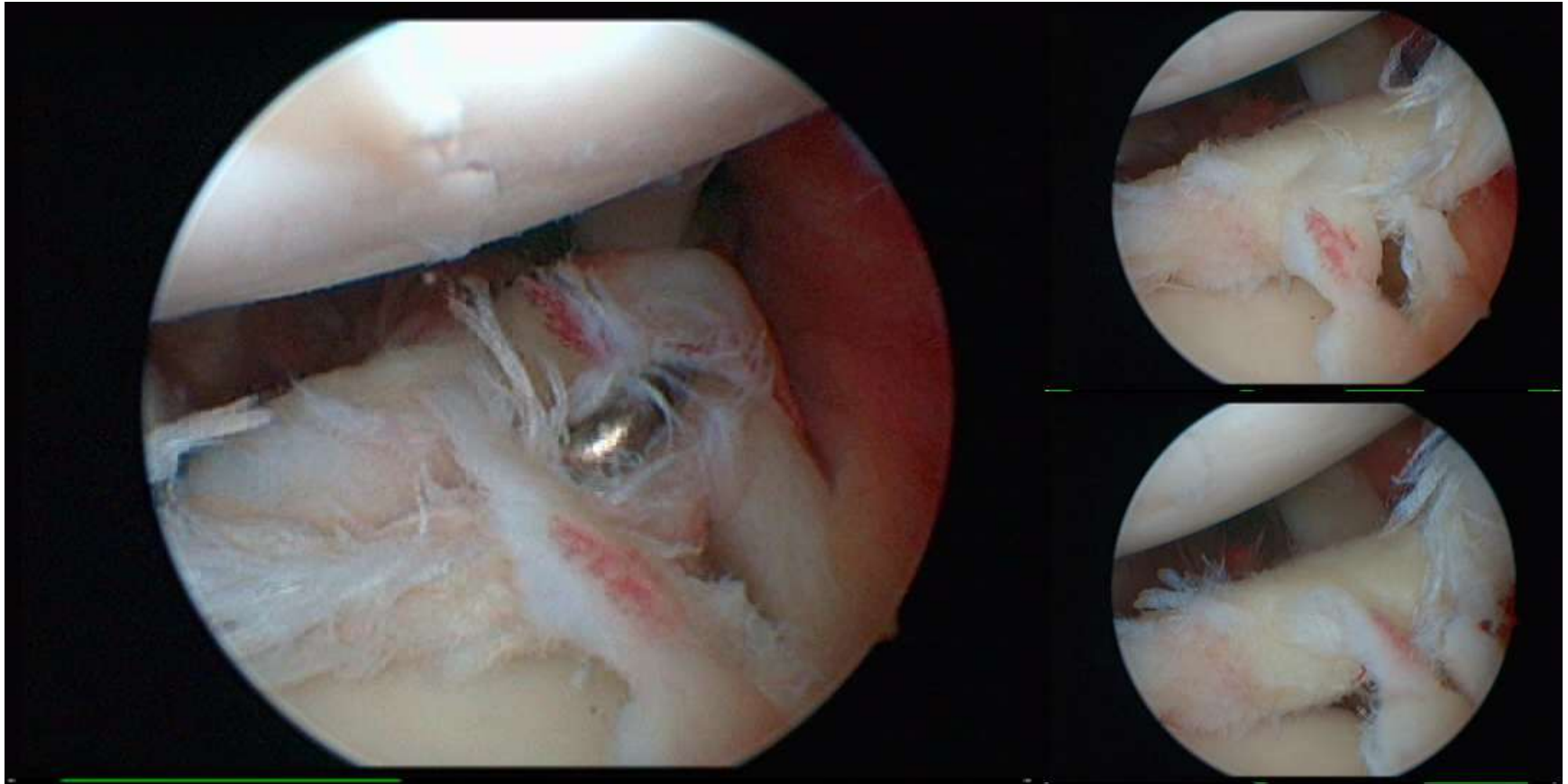
1	Scene 0	██
2	Scene 1	██
3	Scene 2	██
4	Scene 3	██
5	Scene 4	██
6	Scene 5	██
7	Scene 6	██
8	Scene 7	██

(c) 1992 by KRCUR-Centrum, JK

Medical Videos



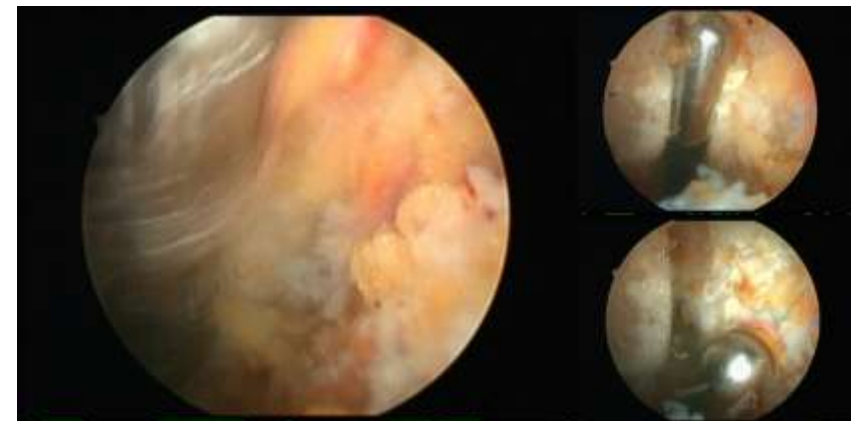
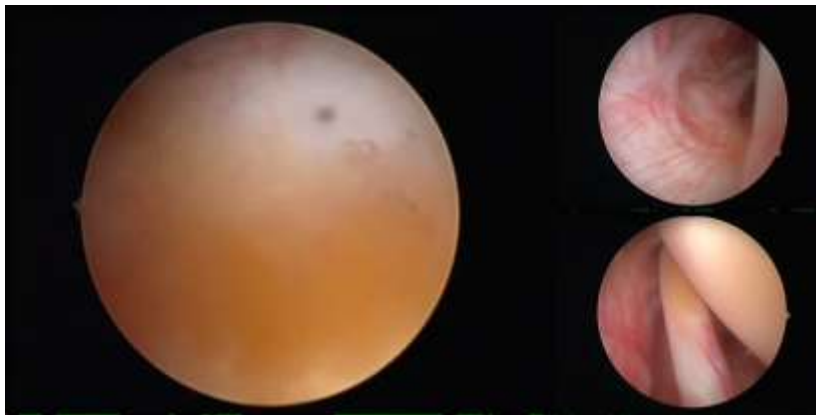
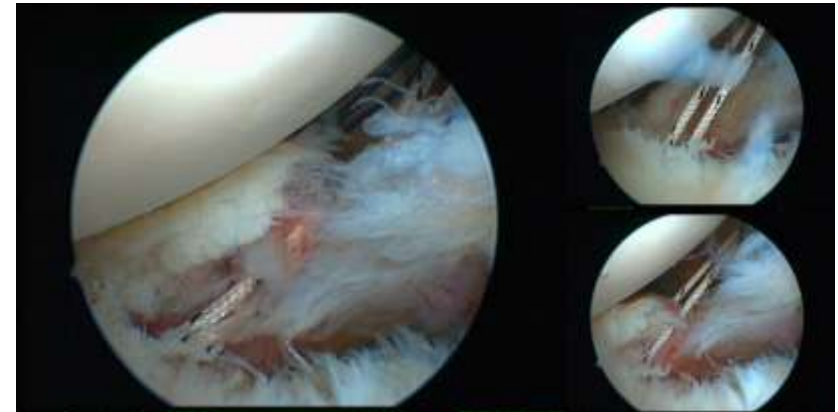
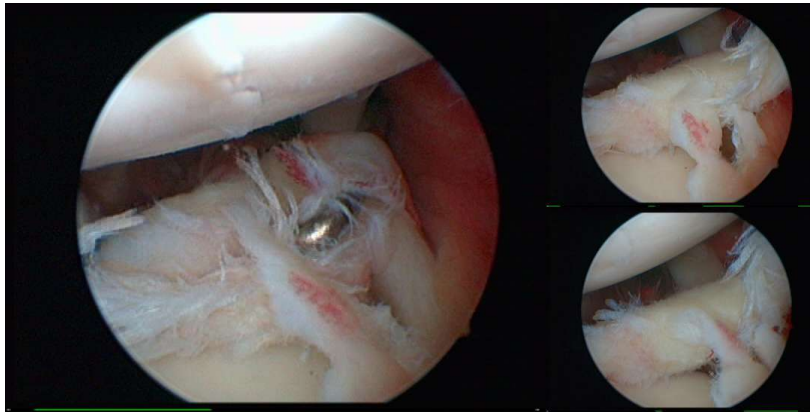
<http://www.uni-klu.ac.at>



Medical Videos



<http://www.uni-klu.ac.at>



Video Summaries



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- Video Skims
 - Short sequences
 - Cut from the video
 - Like a trailer
 - Eventually with audio
- Key frames
 - Selection of still images

Video Summaries: Key Frames



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Goals

- Select appropriate frames for a summary
- Weight frames according to relevance
- Visualize in an 'optimal' way

Problems

- Which are the most relevant frames?
 - Sort out transitions, motion blurred frames
- How many are there?

Video Summaries: Key Frames



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- Selection of key frames
 - Either visualized at once or
 - Rotated in a loop

<http://www.myvideo.de/watch/1544203>



Video Summaries: Stripe Images



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- Only one pixel column per frame
- Concatenate the pixel columns
 - frame height = stripe image height
 - frame number is stripe image width
- Visualization Benefits
 - Size of shots, Movement
- Visualization Disadvantages
 - No 'big picture'



Video Summaries: Stripe Images



<http://www.uni-klu.ac.at>

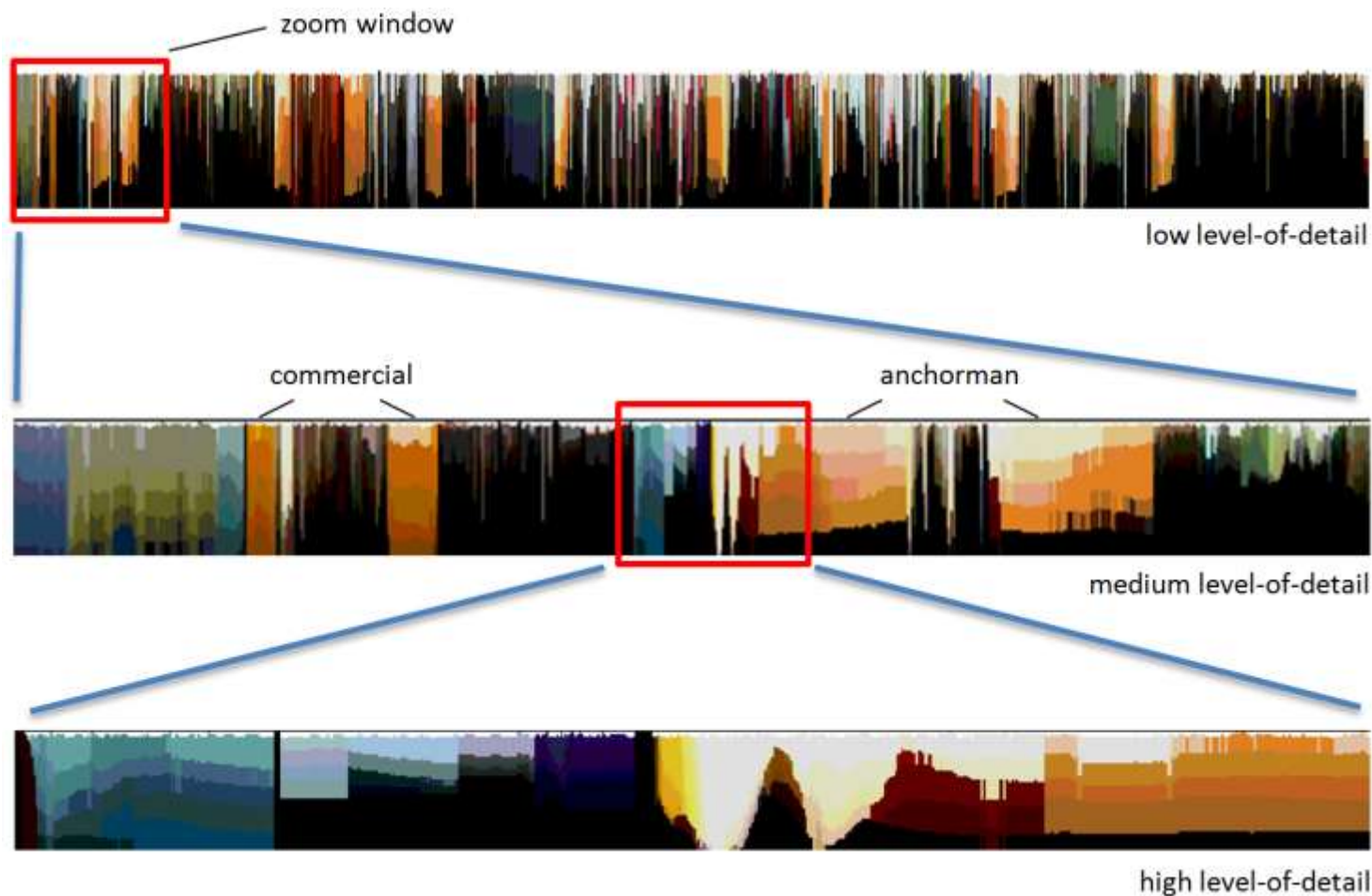


src. PhD Klaus Schöffmann

Video Summaries: Dominant Color



<http://www.uni-klu.ac.at>

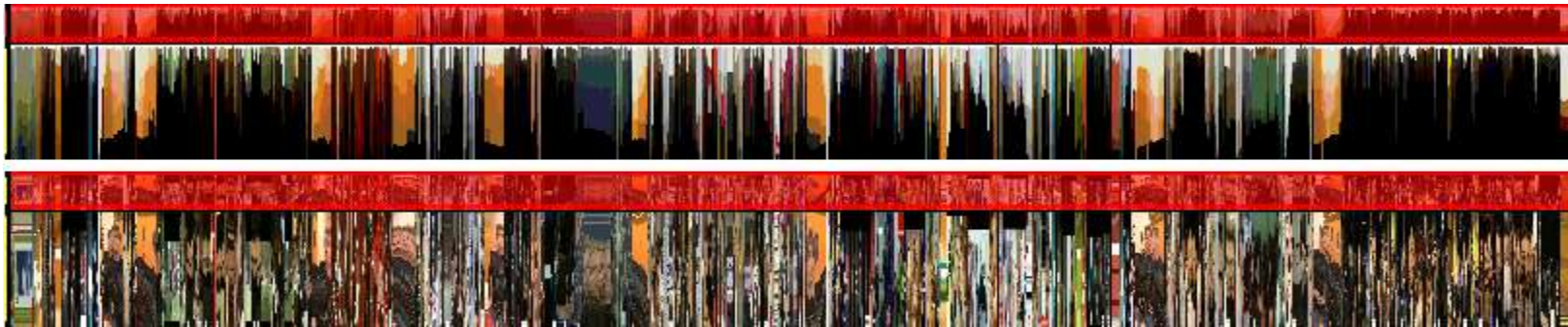


src. PhD Klaus Schöffmann

Dominant Color vs. Stripe Images



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src. PhD Klaus Schöffmann

Sliding Storyboard



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Figure 8.7: Sliding Storyboard at lowest level-of-detail.



Figure 8.8: Sliding Storyboard at medium level-of-detail.



Figure 8.9: Sliding Storyboard at higher detail.

src. PhD Klaus Schöffmann

Motion Histograms

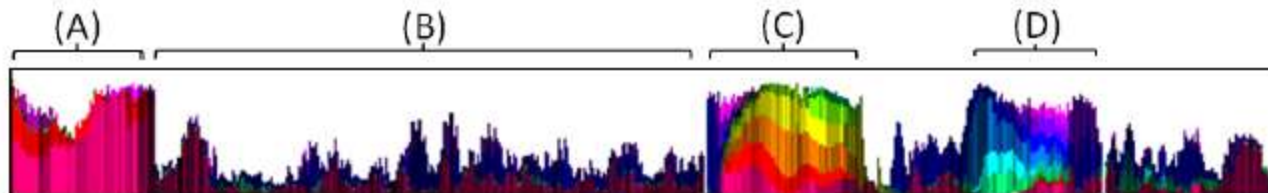


Figure 8.4: Motion visualization ($K = 12$) for 25 seconds of a news video. The letters denote scenes as follows: (A) fast approaching car from the right, (B) an interview (with small amount of slow motion), (C) fast zoom originating from right above, (D) fast zoom originating from bottom left. Adapted from [SLTB09, STB09]

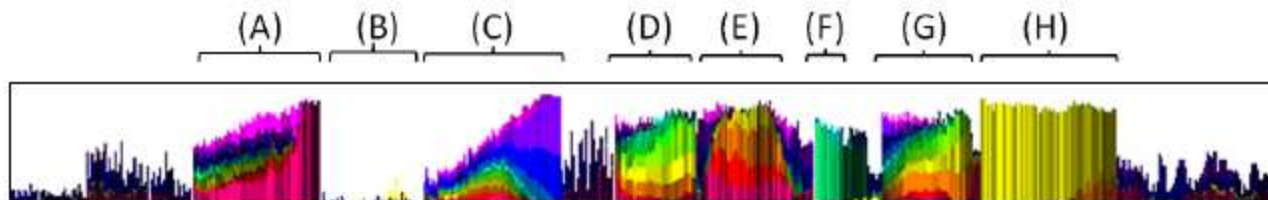


Figure 8.5: Motion visualization ($K = 12$) for 24 seconds of a news video. The letters denote scenes as follows. (A) zoom-in from bottom right, (B) still scene, (C) zoom-in, (D) zoom-out, (E) zoom-out, (F) pan-right (background moves left), (G) zoom-out, (H) pan-down (background moves up)

Key Frames Video Summary Generation



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- Approaches use most salient frames
 - Based on user attention models
 - Motion, static shots, faces, etc.
 - Clustering & SVD
 - Employ dimensionality reduction
 - Find groups and take representative group members
 - The bigger the group the more important
 - Optimization
 - Minimizes sum of distances to all other frames.
 - While maximizing the distances between key frames

Exercise



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- Create a video summary
 - e.g. of the “Uncharted 2 Trailer”
 - <http://www.youtube.com/watch?v=69EBDlnDw2k>
- Use e.g. Javascript to grab video
 - <http://googlesystem.blogspot.com/2008/04/download-youtube-videos-as-mp4-files.html>
- Decide yourself which visualization you want to implement ...
 - Do not use frames displaying text
- Send me the resulting image / document

Exercise Option: Stripe Image



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- Use **FFMPEG** to grab frames
 - e.g. the windows binary
 - `ffmpeg -i [invideo] -f image2 -ss frame%6d.png`
 - see e.g.
<http://wiki.cs.sfu.ca/vml/DigitalVideoHowTo>
- Use e.g. **Irfanview** to put them together
 - Batch Processing -> Crop images ...
 - Image -> Panorama image ...

Thank you ...



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... for your attention