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Video-4-Video: Using Video for Searching, Classifying and Summarising Video

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Issues with video

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Many of the issues associated with video in digital form are solved

Capture, formatting, compression, storage, transmission, rendering on fixed and mobile

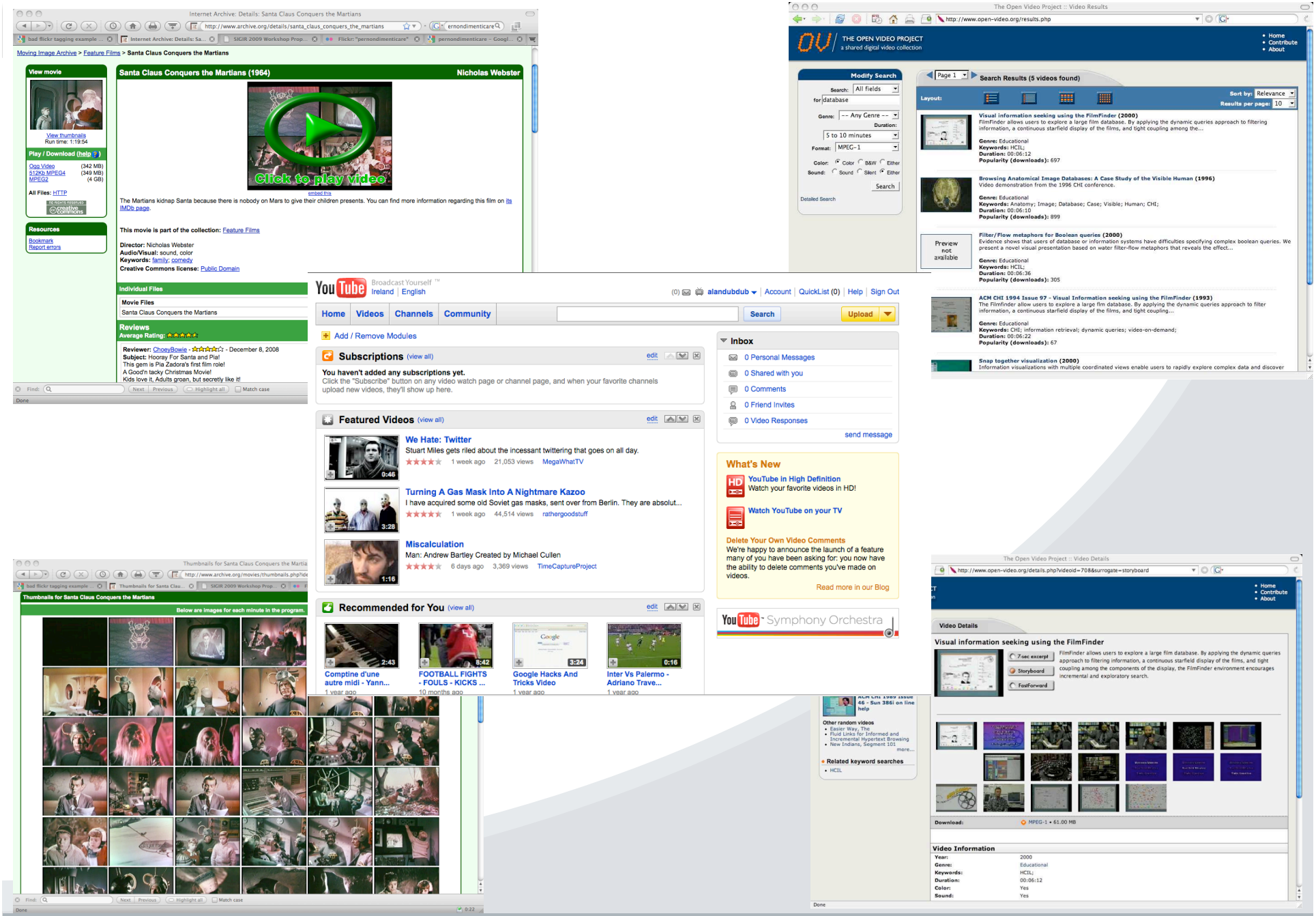
Outstanding challenges are in managing video content

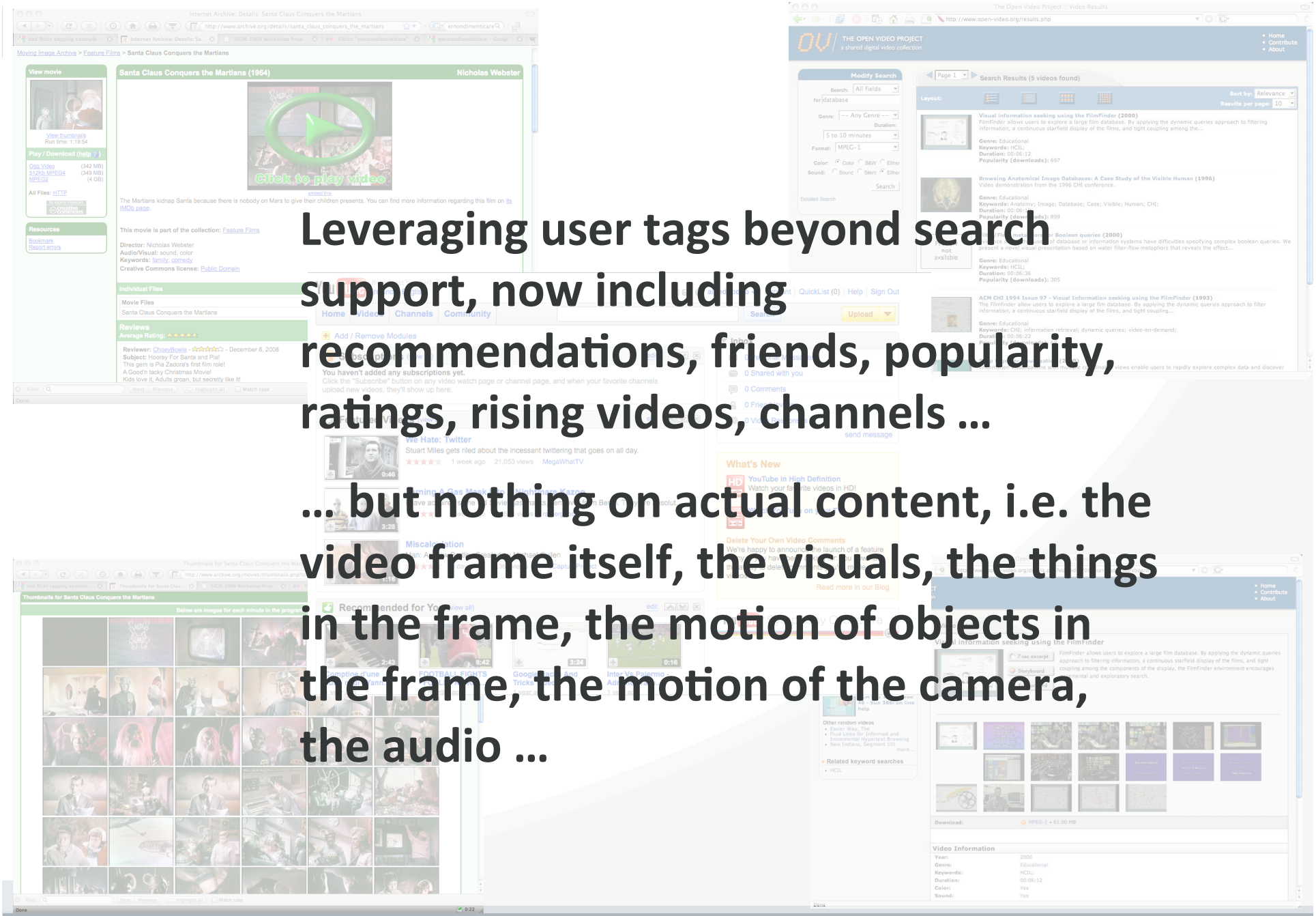
analysis, indexing, summarising, browsing and searching

Managing video is mostly done with metadata

… title, date, actor, producer, genre, running time, format, reviews, ratings, etc. … and **user-generated tags** (UGC).

Some of these are coupled with keyframe / storyboard previews


Santa Claus Conquers the Martians (1964)
Nicholas Webster
Click to play video
The Martians kidnap Santa because there is nobody on Mars to give their children presents. You can find more information regarding this film on its IMDb page.
Director: Nicholas Webster
Audio/Visual: sound, color
Keywords: family; comedy
Creative Commons license: Public Domain
Reviews
Average Rating:
Reviewer: ChoeyBowie - December 8, 2008
Subject: Hooray For Santa and Pia!
This gem is Pia Zadora's first film role!
A Good'n tacky Christmas Movie!
Kids love it, Adults groan, but secretly like it!
THE OPEN VIDEO PROJECT
a shared digital video collection
Modify Search
Search Results (5 videos found)
Visual information seeking using the FilmFinder (2000)
Browsing Anatomical Image Databases: A Case Study of the Visible Human (1996)
Filter/Flow metaphors for Boolean queries (2000)
ACM CHI 1994 Issue 97 - Visual Information seeking using the FilmFinder (1993)
Snap together visualization (2000)
YouTube
Broadcast Yourself
Ireland | English
Home | Videos | Channels | Community
Search
Upload
Add / Remove Modules
Subscriptions (view all)
You haven't added any subscriptions yet.
Click the "Subscribe" button on any video watch page or channel page, and when your favorite channels upload new videos, they'll show up here.
Inbox
0 Personal Messages
0 Shared with you
0 Comments
0 Friend Invites
0 Video Responses
send message
Featured Videos (view all)
We Hate: Twitter
Stuart Miles gets riled about the incessant twittering that goes on all day.
Turning A Gas Mask Into A Nightmare Kazoo
I have acquired some old Soviet gas masks, sent over from Berlin. They are absolut...
Miscalculation
Man: Andrew Bartley Created by Michael Cullen
What's New
YouTube in High Definition
Watch your favorite videos in HD!
Watch YouTube on your TV
Delete Your Own Video Comments
We're happy to announce the launch of a feature many of you have been asking for: you now have the ability to delete comments you've made on videos.
Read more in our Blog
Recommended for You (view all)
Comptine d'une autre midi - Yann...
FOOTBALL FIGHTS - FOULS - KICKS ...
Google Hacks And Tricks Video
Inter Vs Palermo - Adriano Trave...
Symphony Orchestra
Thumbnails for Santa Claus Conquers the Martians
Below are images for each minute in the program.
The Open Video Project :: Video Details
Visual information seeking using the FilmFinder
Video Information



Leveraging user tags beyond search support, now including recommendations, friends, popularity, ratings, rising videos, channels …

… but nothing on actual content, i.e. the video frame itself, the visuals, the things in the frame, the motion of objects in the frame, the motion of the camera, the audio …

Content based video navigation

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… is what we're interested in. There are approaches:

- Use text from speech - ASR/CC/in-video OCR
- Match keyframes vs. query images
- Use semantic video features
- Use video/image objects as queries

… and I could happily show examples of our systems in each class .. but AZ asked me to look at how video systems can be benchmarked, TRECVid;

TRECVid goals and strategy

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Promote progress in content-based analysis, detection, retrieval on large amounts of digital video

Measure systems against human abilities

Focus on relatively high-level functionality – near that of an end-user application like interactive search

Supplement with focus on supporting related automatic components:

Automatic search, high-level feature detection, shot bound detection, content-based copy detection, event detection

Do all this in a hugely collaborative and supportive framework, for 9 years

Evolution: data, tasks, participants, ...

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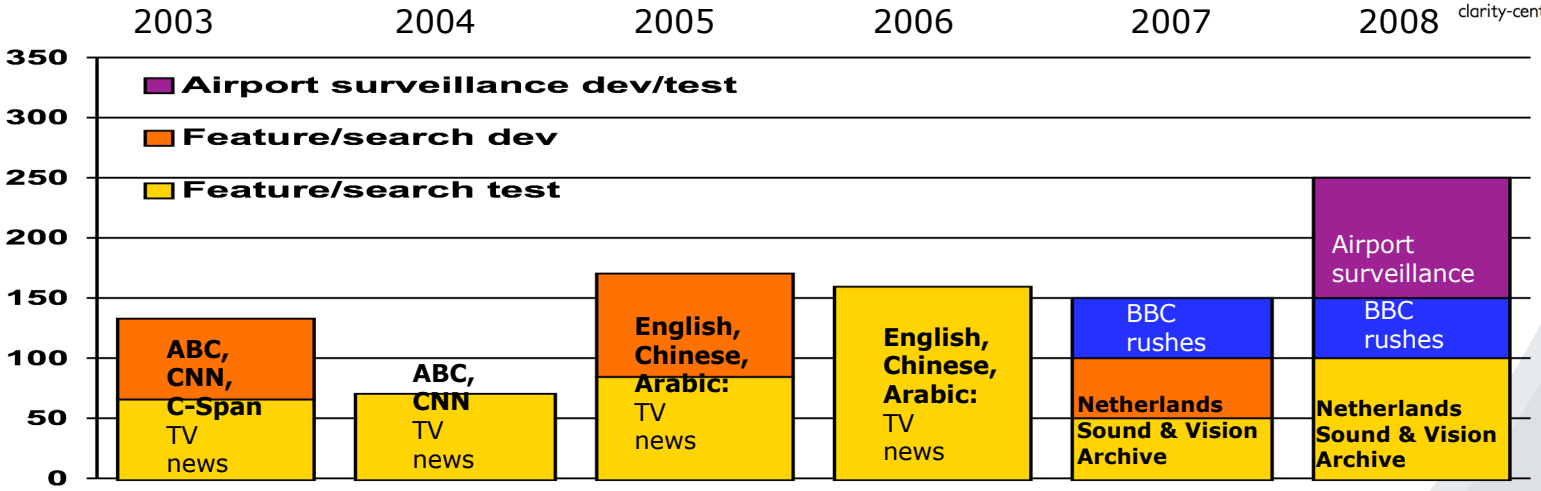
Data:

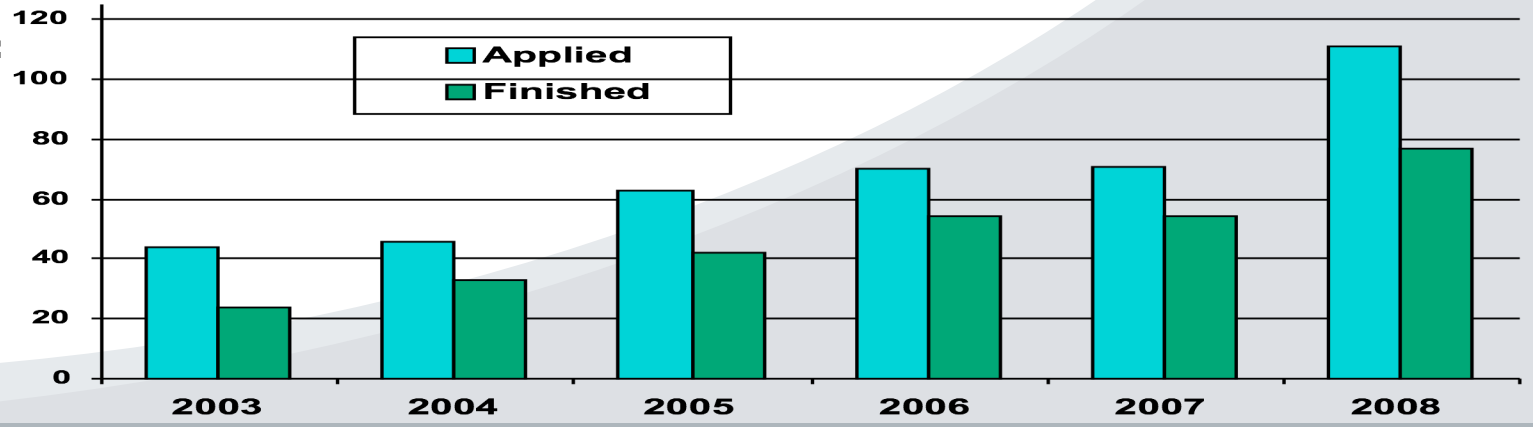


Tasks:

Shot boundaries ----------|
Search ---------- **Search**
Features ---------- **Features**
Stories ----------| **BBC rushes** ---------- **Summaries** ------ **Summaries**
Camera motion
Surveillance events
Copy detection

New pilot tasks

Participants:



TRECVid 2008: Details

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Data:

- 200 hrs - Netherlands Institute for Sound and Vision (S&V)
- 40 hrs - BBC rushes
- 100 hrs of airport surveillance data - UK Home Office

5 evaluated tasks

- Content-based copy detection – 2010 video queries,…
- High-level feature extraction - 20 features
- Search (automatic, manually-assisted, interactive) - 48 topics
- Video summarization
- Event detection on airport surveillance video
  (5 cameras * 2 hours * 10 days)

TV2008 Finishers

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Athens Information Technology
Asahikasei Co.
AT&T Labs - Research
Beckman Institute
Bilkent University
University of Bradford
Beijing Jiaotong University
Brno University of Technology
Beijing University of Posts and Telecommunications
Carnegie Mellon University
Columbia University
Computer Research Institute of Montreal
COST292 Team (Delft Univ.)
cs24_kobe (Kobe Univ.)
Dublin City University
ETIS Laboratory
EURECOM
Florida International Univ.
Fudan University
FX Palo Alto Laboratory
IBM T. J. Watson Research Center
INRIA-LEAR
INRIA-IMIA
IntuVision, Inc.
Ipan_uoi (University of Ioannina)
IRIM
ISM (The Institute of Statistical Mathematics)
Istanbul Technical University
IUPR-DFKI
JOANNEUM RESEARCH Forschungsgesellschaft mbH
KB Video Retrieval
K-Space
LIG (Laboratoire d'Informatique de Grenoble)
Laboratoire LIRIS (LYON)
University of Twente and CWI
LSIS_GLOT(CNRS LSIS)
Marburg
Chinese Academy of Sciences (MCG-ICT-CAS)
Mediamill (Univ. of Amsterdam)
MESH
MMIS (Open Univ.)
Microsoft Research Asia
NHKSTRL
National Institute of Informatics
National University of Singapore
National Taiwan University

TV2008 Finishers

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NTT Cyber Solutions Laboratories
Orange Labs - France Telecom Group
Osaka University
Oxford Univ.
PKU-ICST (Peking Univ.)
PicSom (Helsinki University of Technology)
Queen Mary University of London
Queensland University of Technology
REGIM
Shanghai Jiao Tong University (SJTU)
SP-UC3M (Universidad Carlos III de Madrid)
The Hong Kong Polytechnic University
Tsinghua University - Intel China Research Center
Tsinghua University
TNO-ICT
Toshiba Corporation
Tokyo Institute of Technology
University of Alabama
University of Electro-Communications
University of Glasgow
University of Karlsruhe (TH)
University of Ottawa - SITE
University of Sheffield
University of Southern California
Universidad Rey Juan Carlos
Universidad Autonoma de Madrid
Universite Pierre et Marie Curie - LIP6
VIREO (City University of Hong Kong)
vision@ucf (University of Central Florida)
VITALAS (CERTH-ITI (GR), CWI(NL), U.Sunderland (UK))
XJTU (Xi'an Jiaotong University)

Additional resources and contributions

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City University of Hong Kong, the Laboratoire d'Informatique de Grenoble, and the University of Iowa helped out in the **distribution of video data** by mirroring the them online.

Christian Petersohn at the Fraunhofer (Heinrich Hertz) Institute in Berlin provided the **master shot reference**

Roeland Ordelman and Marijn Huijbregts at the University of Twente donated the output of their **automatic speech recognition** system run on the Sound and Vision data

Christof Monz of Queen Mary, University London, who contributed **machine translation (Dutch to English)** for the Sound and Vision video.

INRIA's Nozha Boujemaa, Alexis Joly, and Julien.Law-to led the design of the **copy detection task**, in particular regarding the definitions of the video transformations. They provided an independent person, Laurent Joyeux, who created original queries and applied the 10 video transformations in a process blind to the ground truth.

Dan Ellis at Columbia University devised and applied the audio transformations to **produce the audio-only queries** for copy detection.

Additional resources and contributions

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Georges Quénot and Stéphane Ayache of LIG (Laboratoire d'Informatique de Grenoble) organized a **collaborative annotation of 2008 development data** for 20 features. 40 groups contributed a total of 1.2 million image x concept annotations.

The Multimedia Content Group at the Chinese Academy of Sciences provided full **annotation of test features** for 2008 training data including location rectangles for object features.

Columbia University and the City University of Hong Kong contributed **detection scores for the 2008 data**: CU-VIREO374.

The University of Amsterdam provided 2 benchmarks for assessing **mappings of topics to concepts** for video retrieval.

Phil Kelly at Dublin City University (DCU) assisted with the **assessment of the rushes** summaries.

Carnegie Mellon University created a **baseline summarization** run to help put the summarization results in context.

TRECVid Tasks …

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Varied throughout the years, lets look at …

- Shot Bound Detection;
- Feature Detection;
- Interactive Search;
- Video Summarisation;

1. Shot Boundary Detection

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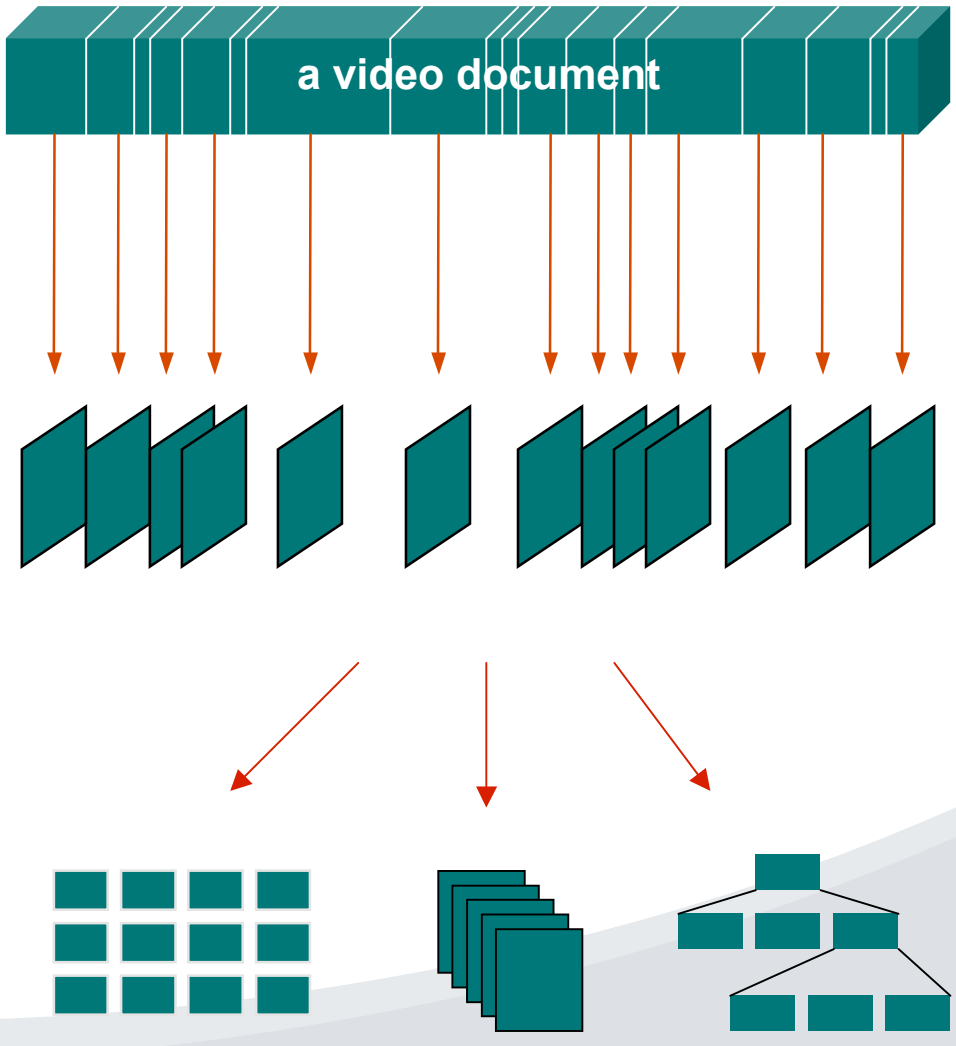

Shot Boundary Detection

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SBD was run for several years, manual annotation of 5/6 h ground truth each year, covering hard cuts and gradual transitions;

The task of SBD or automatic video segmentation is to segment video into its constituent shots … it's a solved problem for TRECVid applications … 95% P/R for hard cuts, 70% P/R for GTs, 1%-2% real time on standard desktops, not even using GPUs;

[CVIU paper Apr 09 summarises SBD]

2. Feature Detection

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20 LSCOM features evaluated

1 Classroom
2 Bridge
3 Emergency_Vehicle
4 Dog
5 Kitchen
6 Airplane_flying
7 Two people
8 Bus
9 Driver
10 Cityscape
11 Harbor
12 Telephone
13 Street
14 Demonstration_Or_Protest
15 Hand
16 Mountain
17 Nighttime
18 Boat_ship
19 Flower
20 Singing

General observations

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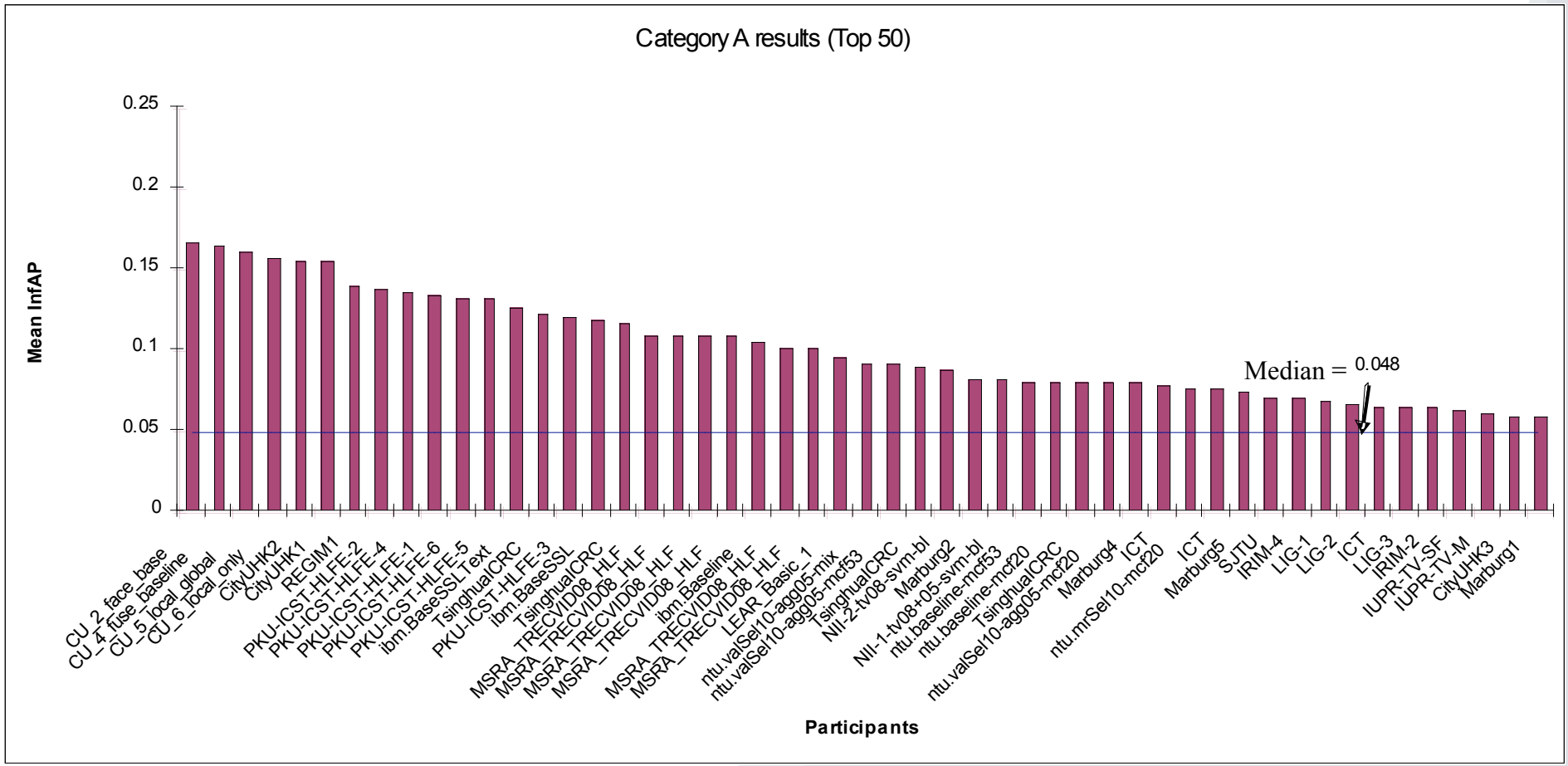
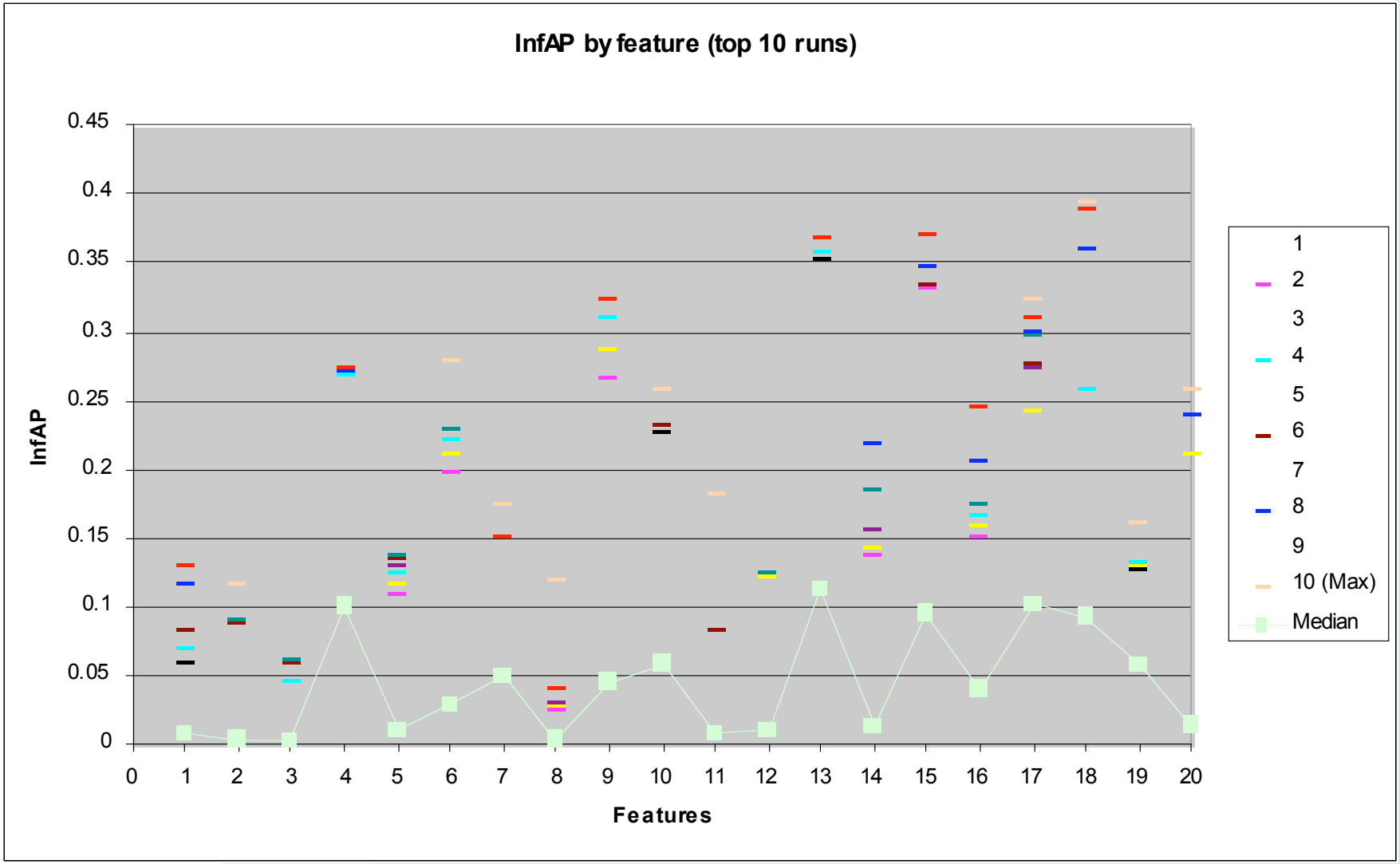
- Very popular task, participation still increasing;
- Hardly any feature-specific approaches;
- Large variety in classifier architectures and choices of feature representations;
- Usually a single, cpu, but some medium and larger clusters;
- No. classifiers used for fusion ranges 1 .. >1160
- Testing times vary between 10m and 150h per feature;
- 30% of the runs do some form of temporal analysis;
- 50% of the runs use salient/SIFT points;
- These are features PER SHOT, or per KF - not per scene !
- Shih-Fu will have more details in the next talk;


Category A results (Top 50)
Mean InfAP
0.25
0.2
0.15
0.1
0.05
0
Median = 0.048
CU_2_face_base
CU_4_fuse_baseline
CU_5_local_global
CU_6_local_only
CityUHK2
CityUHK1
REGIM1
PKU-ICST-HLFE-2
PKU-ICST-HLFE-4
PKU-ICST-HLFE-1
PKU-ICST-HLFE-6
PKU-ICST-HLFE-5
ibm.BaseSSLText
TsinghuaICRC
PKU-ICST-HLFE-3
ibm.BaseSSL
TsinghuaICRC
MSRA_TRECVID08_HLF
MSRA_TRECVID08_HLF
MSRA_TRECVID08_HLF
ibm.Baseline
MSRA_TRECVID08_HLF
MSRA_TRECVID08_HLF
LEAR_Basic_1
ntu.valSel10-agg05-mix
ntu.valSel10-agg05-mcf53
TsinghuaICRC
NII-2-tv08-svm-bl
Marburg2
NII-1-tv08+05-svm-bl
ntu.baseline-mcf53
ntu.baseline-mcf20
TsinghuaICRC
ntu.valSel10-agg05-mcf20
Marburg4
ICT
ntu.mrSel10-mcf20
ICT
Marburg5
SJTU
IRIM-4
LIG-1
LIG-2
ICT
LIG-3
IRIM-2
IUPR-TV-SF
IUPR-TV-M
CityUHK3
Marburg1
Participants

1 Classroom 2 Bridge 3 Emergency_Vehicle 4 Dog 5 Kitchen 6 Airplane_flying 7 Two people 8 Bus
9 Driver 10 Cityscape 11 Harbor 12 Telephone 13 Street 14 Demonstration_Or_Protest 15 Hand
16 Mountain 17 Nighttime 18 Boat_ship 19 Flower 20 Singing



3. TRECVid Search

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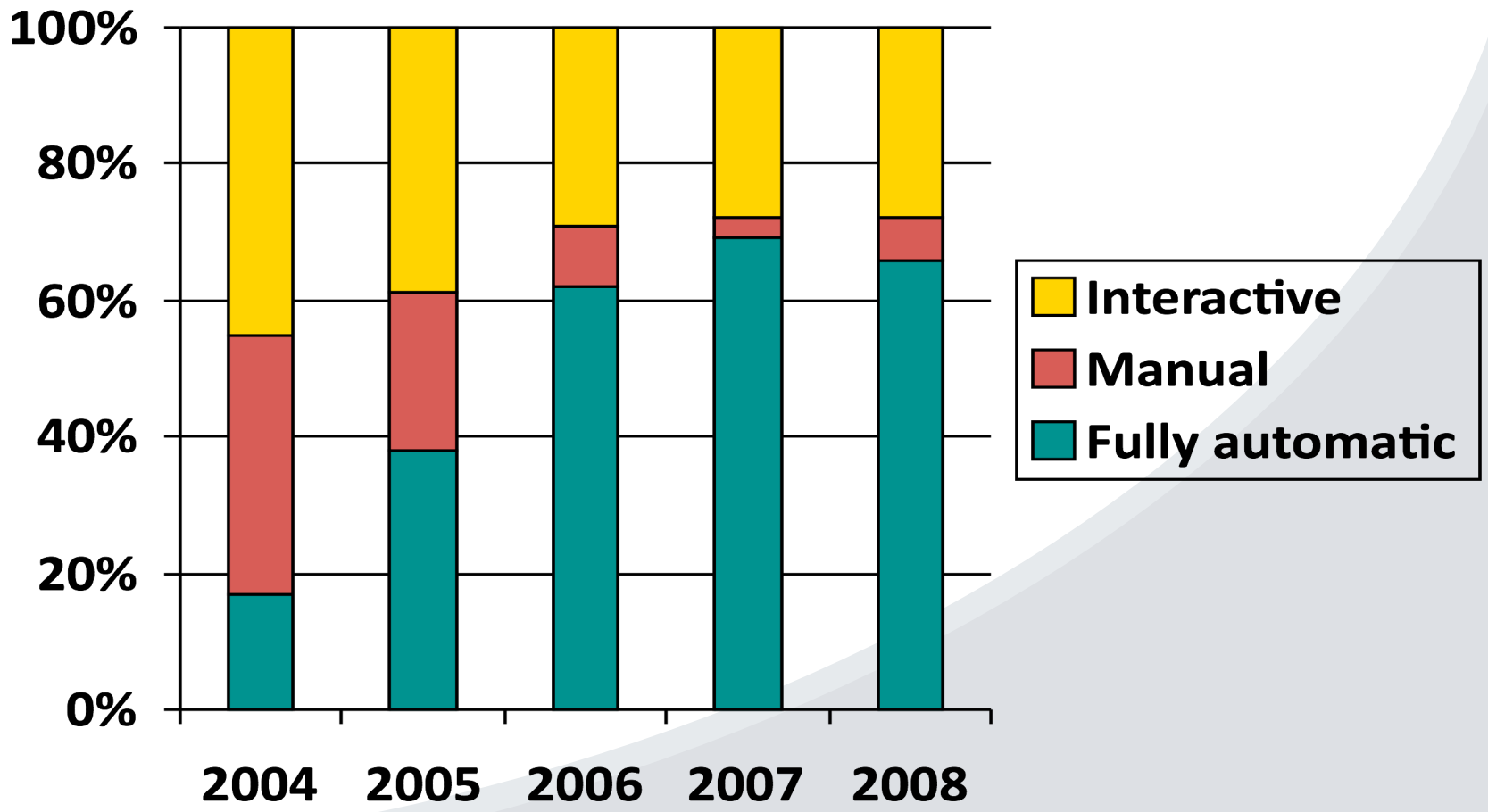

24 Topics (for all systems)

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Find shots of a person opening a door
Find shots of 3 or fewer people sitting at a table
Find shots of one or more people with one or more horses
Find shots of a road taken from a moving vehicle, looking to the side
Find shots of a bridge
Find shots of one or more people with mostly trees and plants in the background; no road or building can be seen
Find shots of a person's face filling more than half of the frame area
Find shots of one or more pieces of paper, each with writing, typing, or printing it, filling more than half of the frame area
Find shots of one or more people where a body of water can be seen
Find shots of one or more vehicles passing the camera
Find shots of a map
Find shots of one or more people, each walking into a building

Find shots of one or more black and white photographs, filling more than half of the frame area
Find shots of a vehicle moving away from the camera
Find shots of a person on the street, talking to the camera
Find shots of waves breaking onto rocks
Find shots of a woman talking to the camera in an interview located indoors - no other people visible
Find shots of a person pushing a child in a stroller or baby carriage
Find shots of one or more people standing, walking, or playing with one or more children
Find shots of one or more people with one or more books
Find shots of food and or drinks on a table
Find shots of one or more people, each in the process of sitting down in a chair
Find shots of one or more people, each looking into a microscope
Find shots of a vehicle approaching the camera

Some approaches

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University of Amsterdam (MediaMill)

- Optimal query mode (speech, detector, or example-based search) prediction by topic

Chinese Academy of Sciences (MCG-ICT-CAS)

- Distribution based concept selection method
- SIFT visual-keywords feature in low dimensional LDA semantic space
- Re-ranking based on the motion and face
- Dynamic fusion based on the Smoothed Similarity Cluster

K-Space

- Large multi-site interactive search experiment

FX Palo Alto

- Using program-based clustering to enhance search
- Collaborative search

Participant approaches

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Brno University of Technology

Automatic runs using ASR and HLFs

Columbia University

Interactive runs using CuZero browser exploring novice vs. expert, query formulation vs. full browser experience, story-based expansion

Cost292

A large multi-site group effort

Text, visual and HLF interactive search plus audio filtering, term recommendation and relevance feedback

cs24_kobe (Kobe Univ.)

Use multiple examples per topic, and rough set theory to “conceptualise” the topic, leading to interactive retrieval

Dublin City University

Automatic runs, focus on query time weights for fusion from different retrieval experts

Participant approaches

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Fudan University

Automatic runs to explore fusions of text, visual and HLF-based retrieval

IBM

Interactive runs varying the number of HLFs available and the impact of near-duplicate detection and shot clustering

KBVR (David Etter)

Using text and image features and exploring augmentation with knowledge from Wikipedia and form image clusters

U. Twente / CWI (Lowlands Team)

Automatic runs varying the set of concepts (M'Mill 101 and VIREO 374) and also Wikipedia articles for text expansion

MMIS (Open U, moved from Imperial College)

Another multi-site group, first timers. Submitted text-only plus automatic run based on MPEG-7 visual features

Participant approaches

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Microsoft Research Asia
Automatic runs with text and visual baselines, query-independent learning, and various reranking methods

National Institute of Informatics, Japan
Automatic runs with concept suggestion based on text query vs text descriptions of LSCOM 374 HLFs

National University of Singapore

National Taiwan University

Oxford University
Same system as 2007 (useful!), visual-only interactive search
System included additional external images from Google search and detection of near-duplicates, upper body and face

Participant approaches

Helsinki University of Technology (PicSOM)

Automatic runs focusing on text+HLFs only; when HLFs not possible, only then do visual based search; also included face detection and motion features

REGIM (ENIS, Tunisia)

Interactive search, fusion of text & HLFs plus detection of faces, vehicle, on-screen text and 1+ people

Shanghai Jiao Tong University, Shanghai

Automatic search using text, 20x HLFs and QBE using colour moments

SP-UC3M (Universidad Carlos III de Madrid)

Tsinghua University / Intel China

Automatic runs, use rich image features to build a SVM for each topic; also use user tags on Flickr images to locate extra images for example-based search; fuse all combinations

Participant approaches

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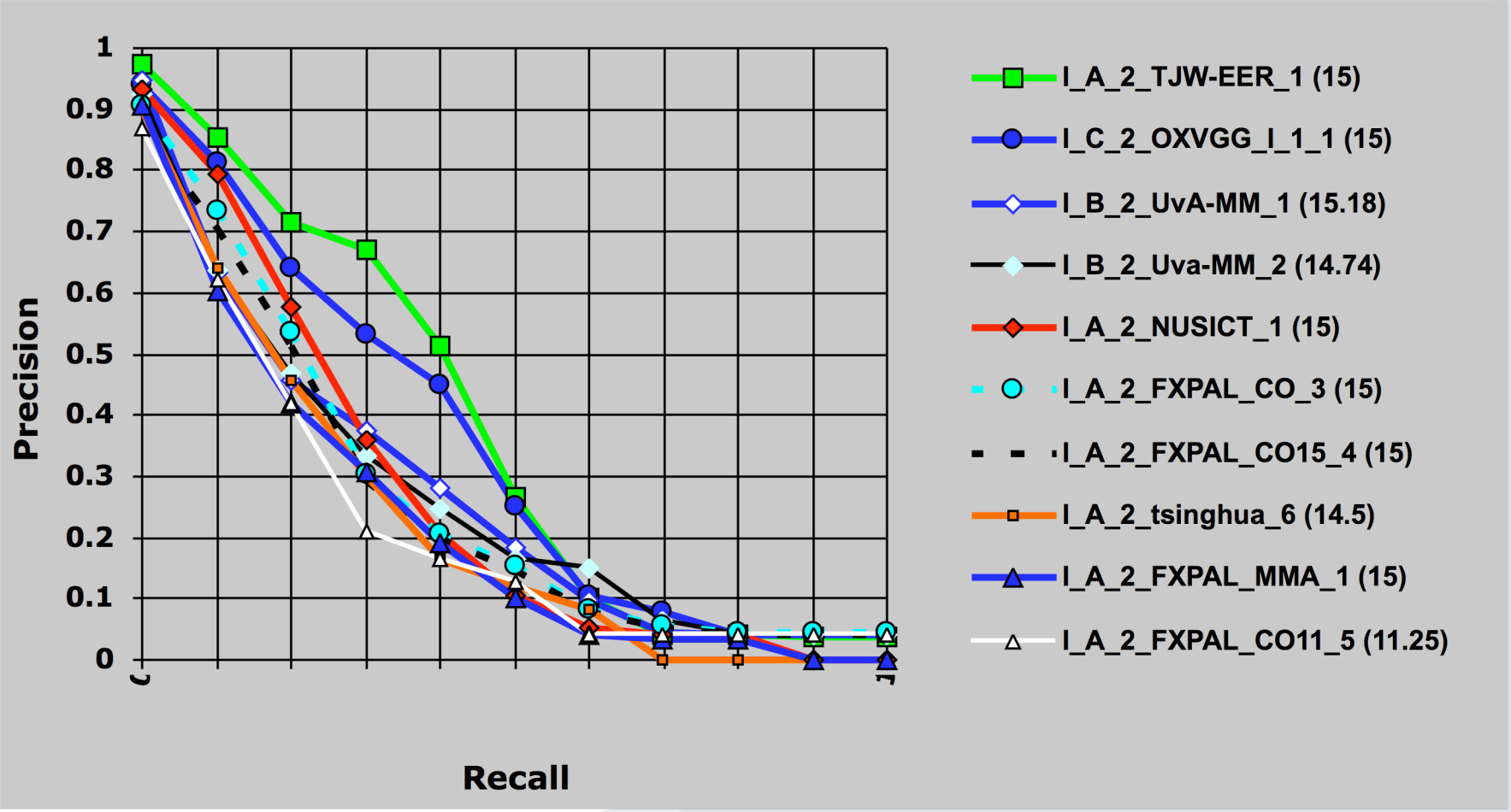
University of Alabama (with UNC)
Manual & interactive, text plus QBE using image features

University of Glasgow
Automatic runs using text, MPEG-7 visual features, HLFs and image classification using SVMs, and an interactive run which clusters/groups similar results

VIREO - City University of Hong Kong
Automatic search on HLFs only considering fusion of detectors using concept semantics, co-occurrence, diversity, and detector robustness

VITALAS (Thessaloniki, ITI Crete, CWI & Twente)
Focus on concept retrieval, combine text and HLFs merge (text) concept descriptors proportional to Prob of occurrence

‘07 Interactive runs - top 10 MAP



Another view: in highest scoring run, on average 8 of the top 10 shots returned contained the desired video

Average precision by topic (07)

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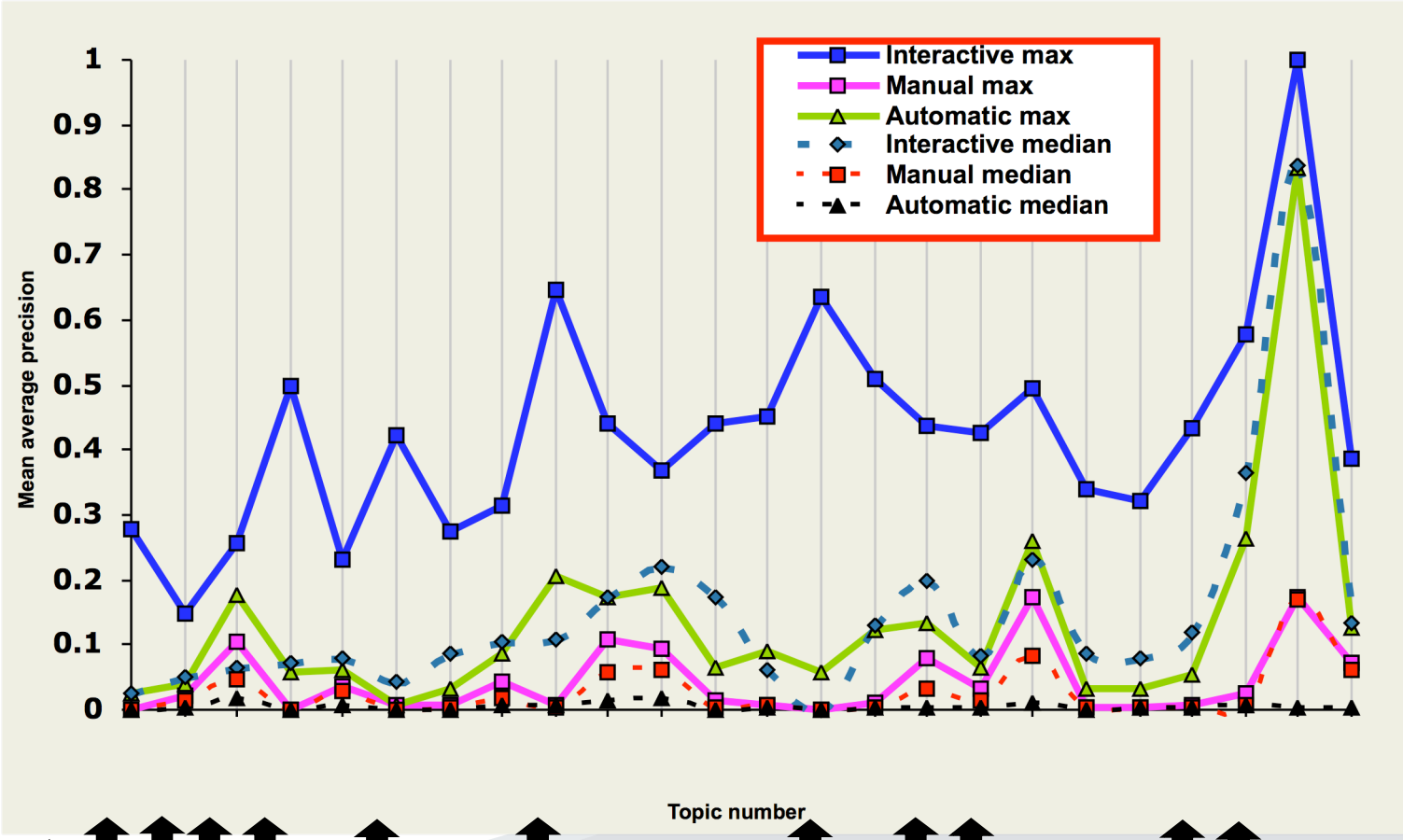
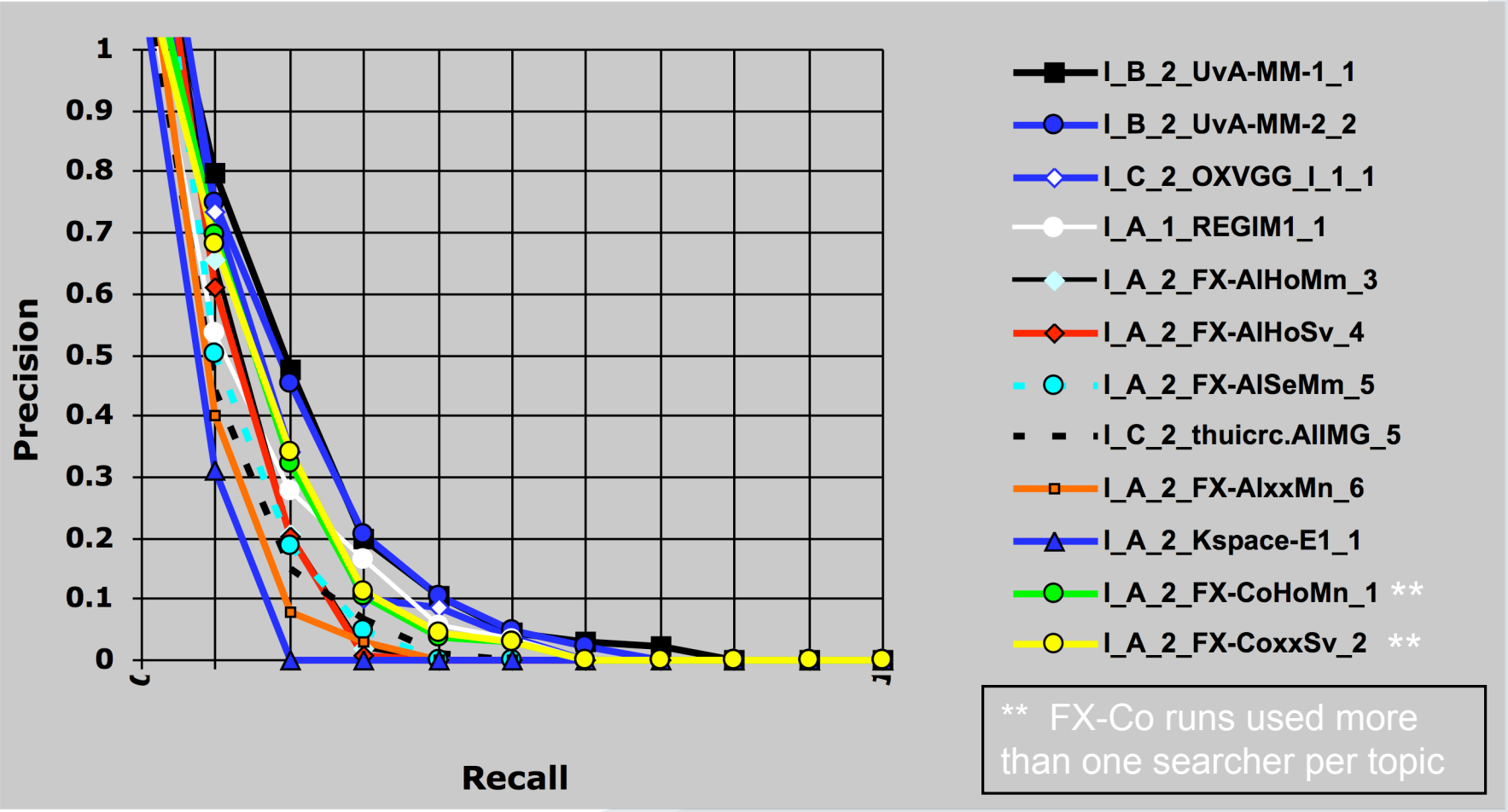


‘08 Interactive runs - top 10 MAP



Another view: in highest scoring run, on average an estimated 7 of the top 10 shots returned contained the desired video

Inf. Av. precision by topic (08)

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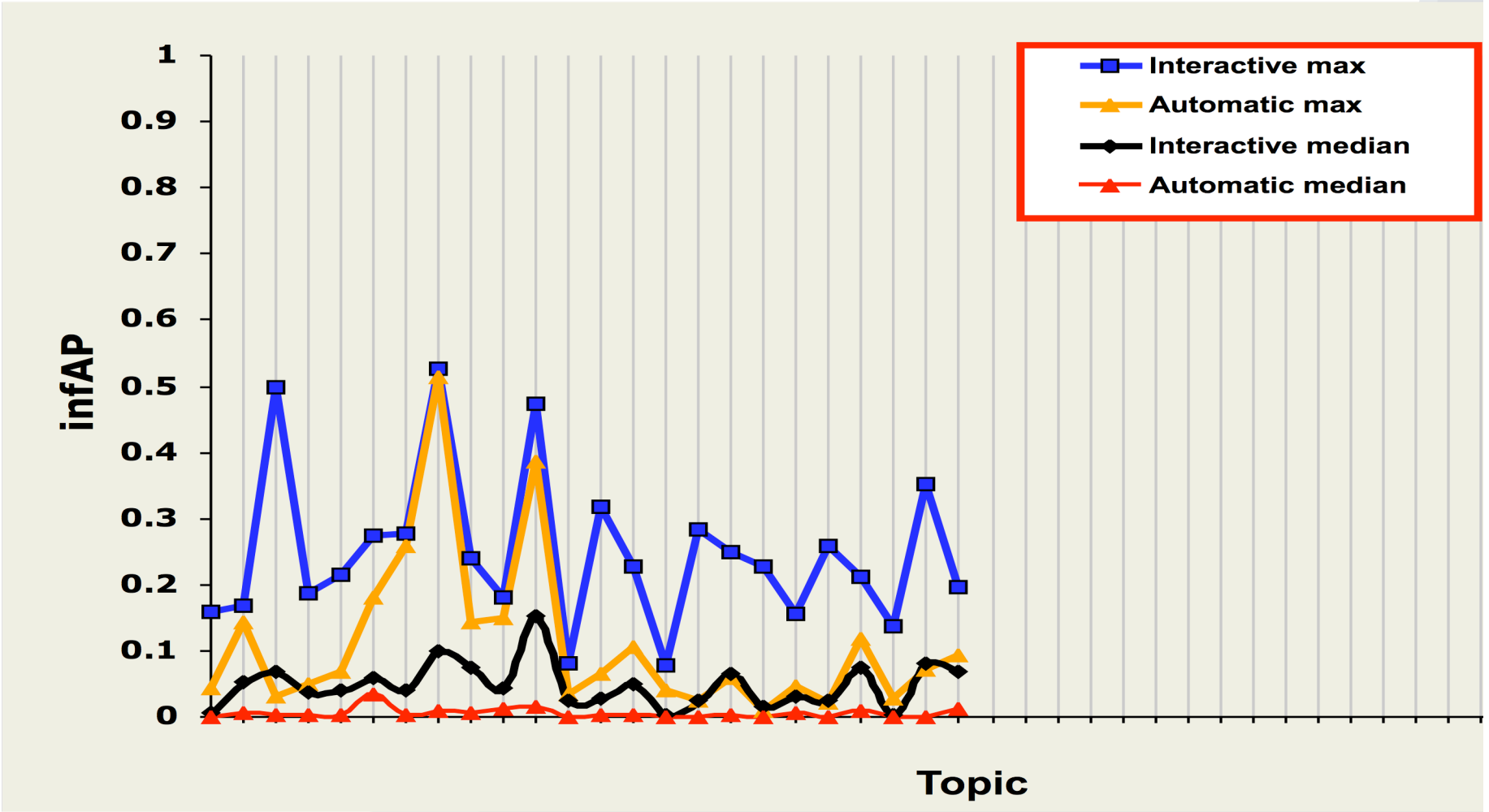
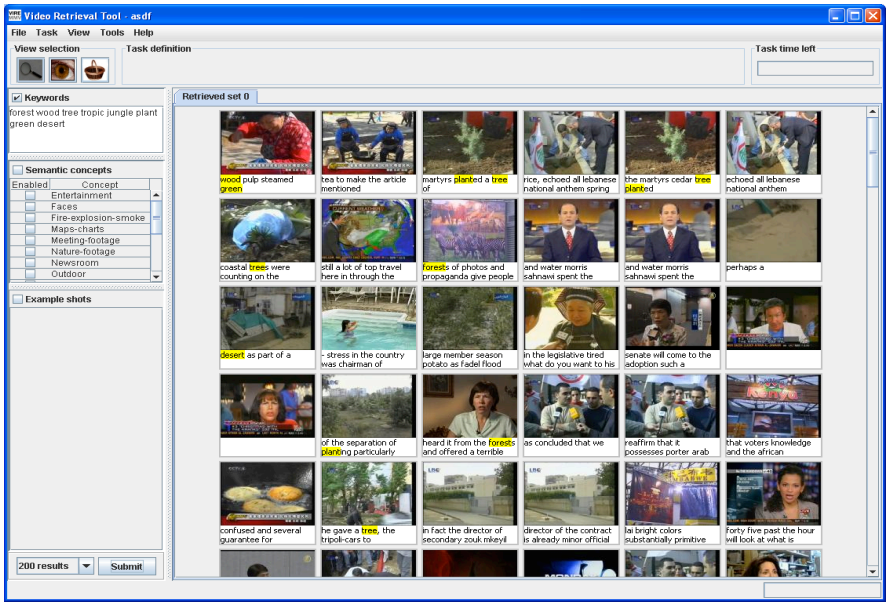
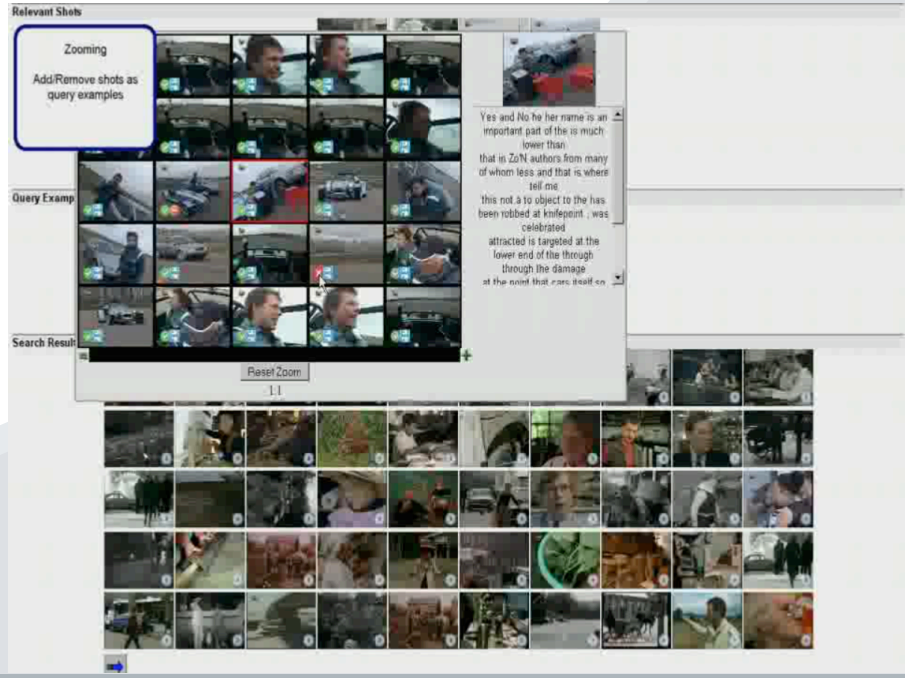



Video Retrieval Tool - asdf
File Task View Tools Help
View selection
Task definition
Task time left
Keywords
forest wood tree tropic jungle plant green desert
Semantic concepts
Enabled Concept
Entertainment
Faces
Fire-explosion-smoke
Maps-charts
Meeting-footage
Nature-footage
Newsroom
Outdoor
Example shots
200 results
Submit
Retrieved set 0


All data
Best building shots
562 marked shots, 344 segments
Filter
Collapse Mode
Shots shown:
76 / 562
no faces
only faces
no anchors
only anchors
no people
only people
no ads
only ads
no building
only building
no outdoor
only outdoor
OFF


00:00
Search Summary
Query Images
High Level Features
Crowd
Face
Outdoor
Person
Sky
Vegetation
Walking/Running
Building
Road
Additional Features
On-screen text
Motion
Number of speakers
Audio: vehicles
Audio: speech
Audio: emergency
Grayscale
UPDATE SEARCH
TrecVid 2007:
Viewing 98 of 98 Broadcasts with 951 Shots
RESET
SAVE ALL SHOTS
DON'T SHOW AGAIN
SAVE THIS SHOT


Relevant Shots
Zooming
Add/Remove shots as query examples
Query Examp
Search Result
Reset Zoom
1:1

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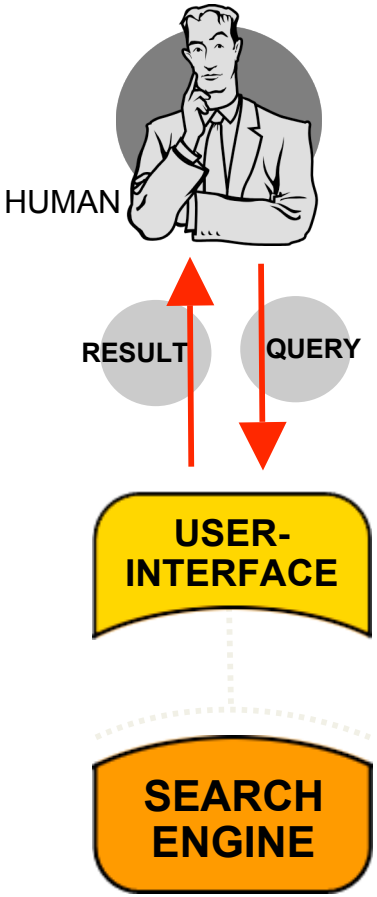
How easy are these systems to use, how good are they, how real are they ?

Each year we showcase interactive TRECVid video search at the CIVR conference … Amsterdam (07), Niagara Falls (08), Santorini (09)

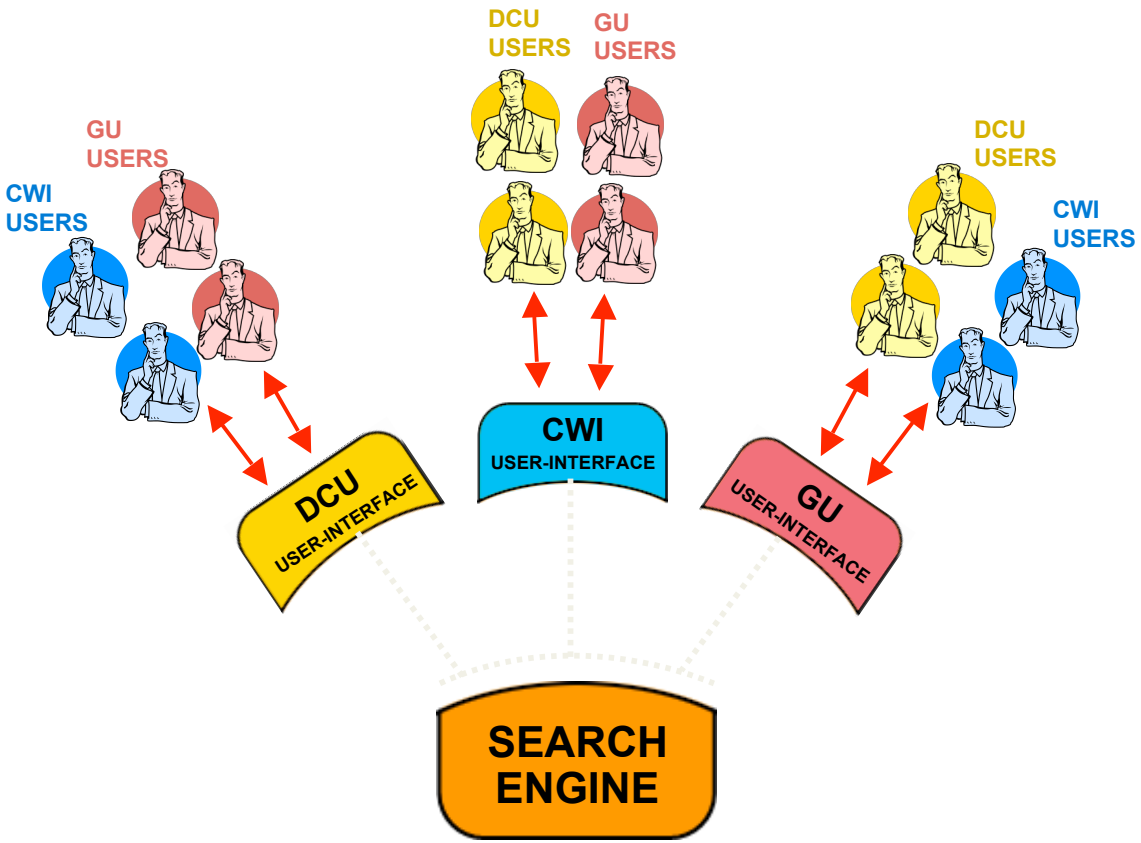
Called the VideOlympics …

What do participants do ?



K-Space participation 2008

What do participants do ?



K-Space participation 2008

TVid Search: state of the art ?

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On small, closed video libraries, content based video search works well; with metadata and UGC it would be even better …

We're still only doing keyframe/image and not video (with motion of objects and cameras), and we're purposely not using metadata or tags or UGC;

We're still doing shot retrieval, not scene, or clip;

Feature detection accuracy, scale-up to more features, relationships between features, move away from independent to ontology-based … need to progress this;

Combining features, keyframe match, text and objects in a natural and usable way … the learnability of the interface;

Dynamically adjusting retrieval to the query/video type;

4. TRECVid Summarisation

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TVS'07 and TVS' as workshops at ACM Multimedia;

BBC rushes tapes, 25min, 42 files as development data, 40 files as test data;
scripted dialogue, environmental sounds, repeating, wasted shots, clapboards and colourbars;

Task: create an MPEG-1 summary of each file <= 2% of the original;

Dual evaluation criteria - measure what viewers remember from summary - 81% agreement among judges
- Eliminate redundancy
- Maximise viewer efficiency at recognising objects & events, quickly

Interaction limited to single playback via mplayer in 125 mm x 102 mm window at 25 fps with unlimited optional pauses

Approaches to selection …

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Almost all groups explicitly searched for and removed junk frames;

Majority groups used some form of clustering of shots/scenes in order to detect redundancy;

Several groups included face detection as some component;

Most groups used visual-only, though some also used audio in selecting segments to include in summary;

Camera motion/optical flow was used by some;

Most groups used whole frame for selecting, though some also used frame regions;

Approaches to generation …

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Much more variety among techniques for summary generation than selection;

Many used FF or VS/FF video playback;

Several incorporated visual indicator(s) of offset into original video source, within the summary;

Some used an overall storyboard of keyframes;

Some used keyframe playback but most used the unaltered original video, some with sub-shots only;

Some used non-hard cut shot transitions, and one did progressive summary generation, on-the-fly;

Challenges …

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Participation, organisation, tasks, scientific rigour, enthusiasm, research topics … all sorted.

The problem … video data !

NIST cannot legally distribute data which it is not 100% © cleared to do so .. LDC, S&V, BBC .. but for 2010, we have 10,000 hours from Internet Archive.

Final issues …

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Too closed shop, not public enough ?

VideOlympics showcase, Summarisation workshop at ACM MM

Learnability of systems for non-experts ?

Most sites used expert searchers … recent paper showed searcher variability across sites to be a factor … VideOlympics '09 uses schoolchildren !

Too US DTO-centric ?

No way - see the list of contributors !

Can I get the video data ?

Find a buddy and sign the forms.

Can I get the other data (topics, assessments, donations) ?

Its all on the TRECVid website.

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Thank you

I'm funded by …