Analysis of Visual Similarity in News Videos with Robust and Memory-Efficient Image Retrieval

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Vanderbilt Television News Archive

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The **Vanderbilt Television News Archive** is the world's most extensive and complete archive of television news. We have been recording, preserving and providing access to television news broadcasts of the national networks since August 5, 1968.

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KOLO (ABC) - Reno, NV
Good Morning America

+ Local Market Viewership: 18,336
Local Publicity Value: $868.96 per 30s

KOLO 11/01/2012 07:18:03: ...387,000 credit and debit card numbers. state officials say, like most other government agencies across the country, south carolina never encrypted that data to protect it from hackers because it's such an expensive and lengthy process. >>> and this morning another big bank could be in big trouble, this time for allegedly manipulating the price of electricity in california. regulators are threatening to fine barclays $470 million for allegedly gaming the market to lower prices just so it could make bigger profits later. the **bank** denies the scheme. >>> an unusual sight to bring you along the mexico/arizona border. instead of digging a tunnel, smugglers tried to build makeshift ramp to try to drive over the border fence. as you can see, they came up just a bit short. they did manage to run off, but they left their jeep teetering some 14 feet in the air. >> a balancing act. >> that is some balance there. >>> hey, sam, how about some national weather? >> as we do that, i want to thank wabc for giving us the flight yesterday. they're always in the air, by the way, and the best in the business. let me show you what's going on with this cold air that drops down in behind the storm. wait until you see these temperatures. it's what folks without power don't need are these temperatures. look at the high temperatures. they're close to the 40s by the time we get into sunday and maybe monday in new york city. we're going to see colder air dipping in after that. the possibility of all of this rain into the northwest, now drying out, is good news. it's been six days of heavy rain in seattle, also in the portland area. we've seen california begin to dry out a little bit. that will happen during the day. ...

SMUGGLERS' PLAN FAILS
JEEP STUCK ATOP BORDER FENCE
7:19 51°
STORM NEWS PRESIDENT OBAMA RETURNS TO CAMPAIGN
11/1/2012 7:18:25 AM

⏪ ⏸ ▶ ⏹ ⏩

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BREAKING NEWS
AT LEAST 30 DEAD IN EGYPT
ROCKS, FIRECRACKERS USED AS WEAPONS
ERS &NEWS   A WEAPON DESIGNED TO INTERCEPT NUCLEAR MISSILES FAILED TO H

01:20/02:27   cc

At Least 30 Dead in Egypt
Good Morning America
July 6, 2013, 4:01 a.m.
:0 :25 CNN:25 :40

Highlights: Subway Firecracker 250
Fox Sports
July 6, 2013, 10:28 a.m.
:0 :25 CNN:25 :0

Custody Battle Leads to Confiscated Passports
Good Morning America
July 6, 2013, 4:11 a.m.
:0 :25 CNN:25 :10

Celebrity Wines: Worth the Hype?
HLN Morning Express
July 6, 2013, 4:54 a.m.
:0 :25 CNN:25 :6

Dwight Howard Heading to Houston
HLN Morning Express
July 6, 2013, 4:13 a.m.
:0 :25 CNN:25 :6

Rip Currents Close Beaches
HLN Morning Express
July 6, 2013, 4 a.m.
:0 :25 CNN:25 :6

Superstar Brandy Headlines Event
Good Morning America
July 6, 2013, 4:40 a.m.
:0 :25 CNN:25 :0

The Lone Ranger Shot Down by Critics
HLN Morning Express
July 6, 2013, 4:24 a.m.

Related Videos

At Least 1,077 More Are Injured
CNN Newsroom
July 6, 2013, 8:04 a.m.

More on the Deadly Confrontations in Egypt
PBS News Hour
July 5, 2013, 3:13 p.m.

Deadly Confrontation as Supporters March to Free Morsi
NBC Nightly News
July 5, 2013, 5:33 p.m.

Street Battle Rages in Egypt
NBC Nightly News
July 5, 2013, 5:31 p.m.

< >

Plays 30 second clip around query phrase match

Would benefit from accurate segmentation of stories

Would benefit from reliable generation of summary clips

Applications of Anchor Detection

1. ## Provide strong cues for story segmentation

2. ## Extract news story summaries/previews

TURNING TO TECH, SHARES OF RESEARCH IN MOTION REBOUNDED FROM A ONE MONTH LOW. THE COMPANY'S NEXT GENERATION BLACKBERRY-10 PRODUCT LINE IS EXPECTED TO BE UNVEILED IN JUST A FEW WEEKS. YOU MAY REMEMBER SHARES SOLD OFF LAST WEEK AFTER THE COMPANY ISSUED A CAUTIOUS OUTLOOK FOR ITS FOURTH QUARTER RESULTS. BUT TODAY SHARES BOUNCED BACK: UP 11.5% TO A UNDER $12.

3. ## Identify anchors for general person recognition

 → Anchor Brian Williams

 → Anchor Susie Gharib

Don't confuse anchors with other people in the videos

Applications of Preview Matching

1. ## Provide strong cues for story segmentation

2. ## Extract news story summaries/previews

JUST A MESS. IN WASHINGTON, LAWMAKERS LEAVE TOWN FOR THE HOLIDAYS. THE CLOCK TICKS DOWN TO THE SO-CALLED FISCAL CLIFF. LATE TODAY, THE PRESIDENT HASTILY APPEARS TO ASK IF SOME OF THIS BUSINESS CAN BE FINISHED SOON.

3. ## Indicate the most important stories in a broadcast
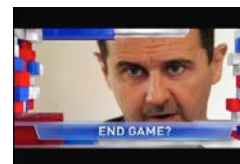
Outline

- Related work in news video analysis
- Long-range visual similarity
- Anchor detection algorithm
- Preview matching algorithm
- Experimental results

Related Work in News Video Analysis

- ## Model-based anchor detection

  [Zhang et al., 1998] [Hanjalic et al., 1998] [Liu et al., 2000]

- ## Model-free anchor detection

  [Gao et al., 2002] [De Santo et al., 2006] [D'Anna et al., 2007]
  [Ma et al., 2008] [Broilo et al., 2011]

- ## Spatio-temporal slices for reporter detection

  [Liu et al., 2007] [Zheng et al., 2010]

- ## Classification of news video shots

  [Bertini et al., 2001] [Xiao et al., 2010] [Lee et al., 2011]
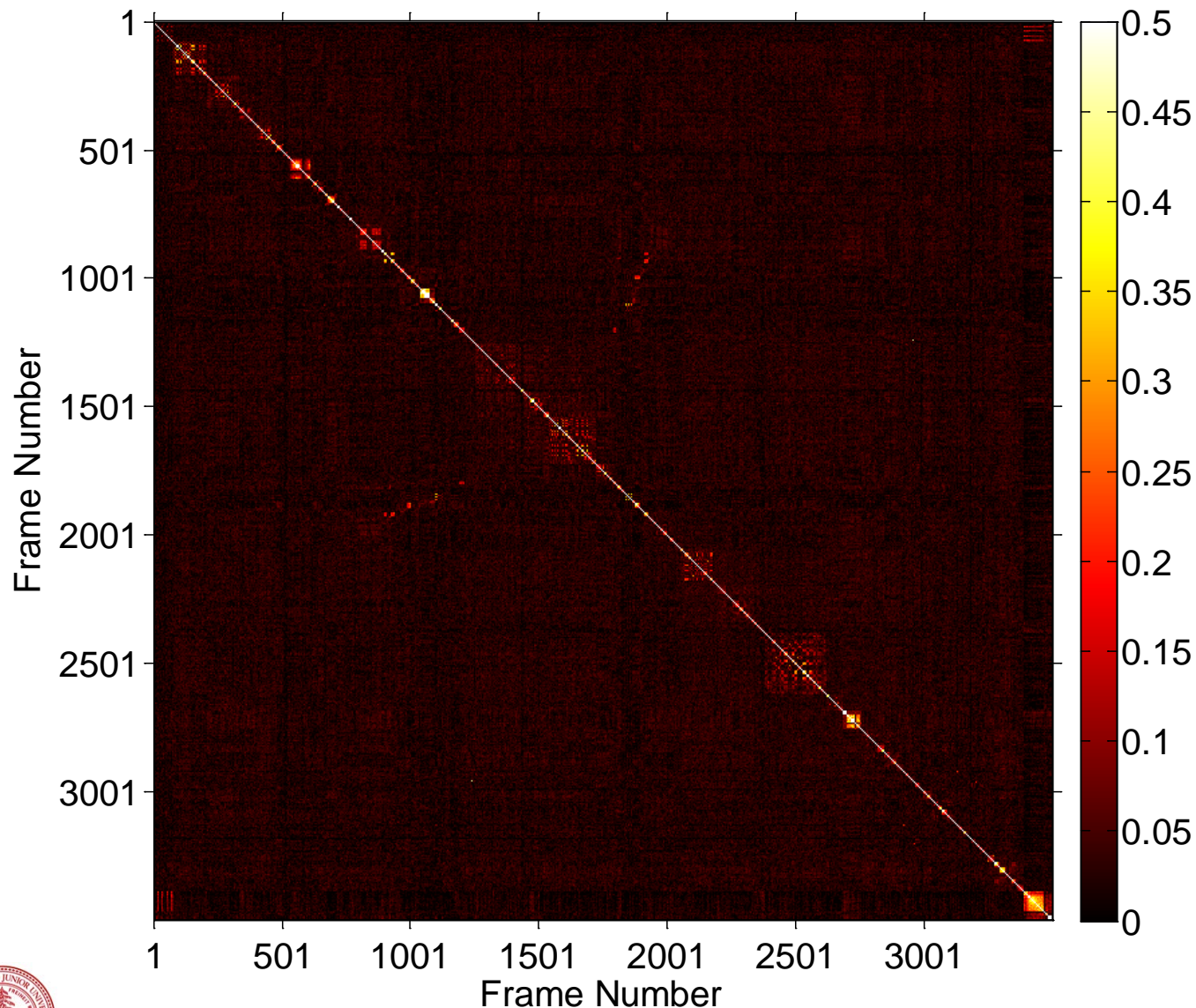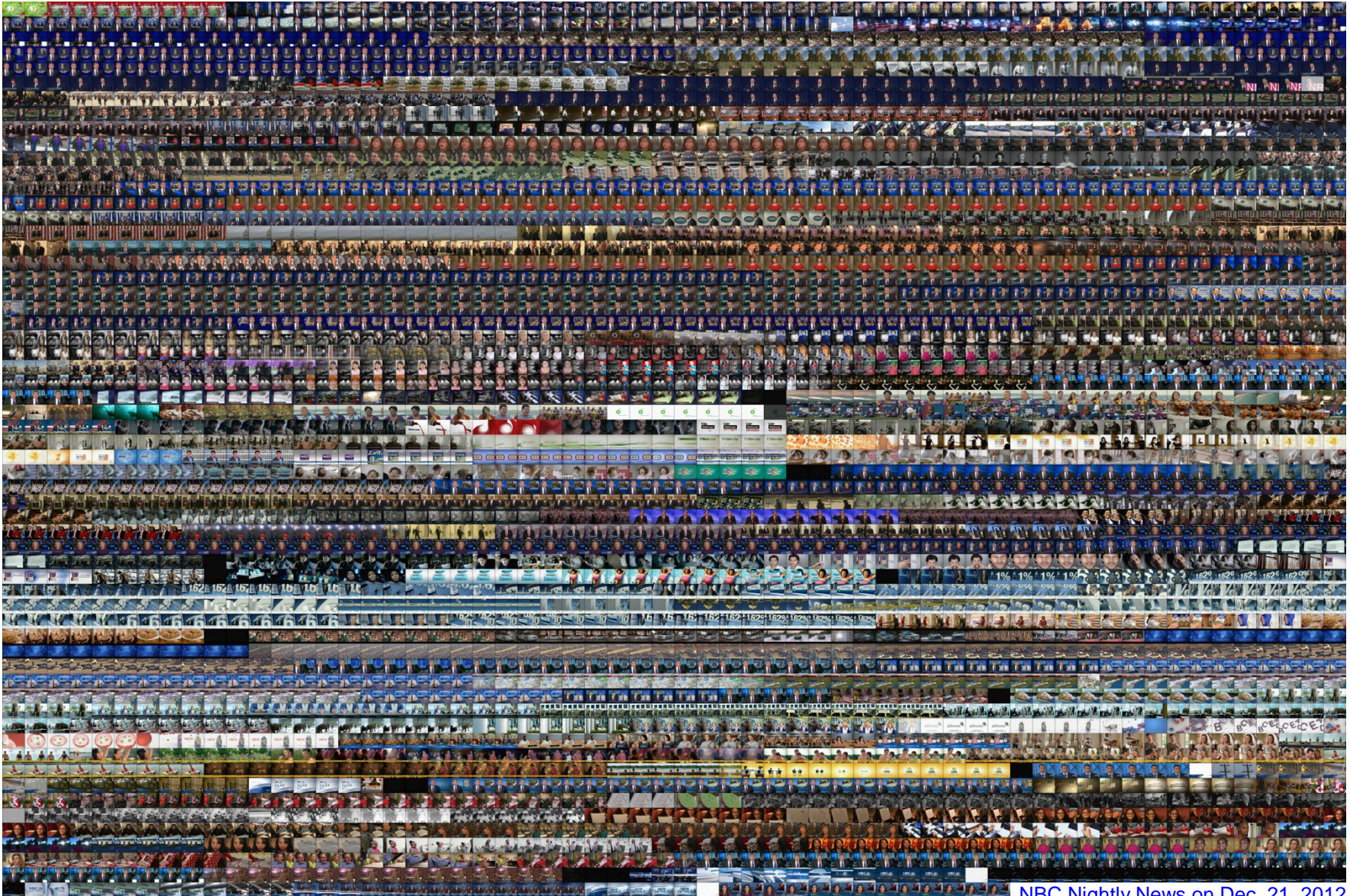
Long-Range Visual Similarity

Long-Range Visual Similarity

What causes these long-range visual similarities?
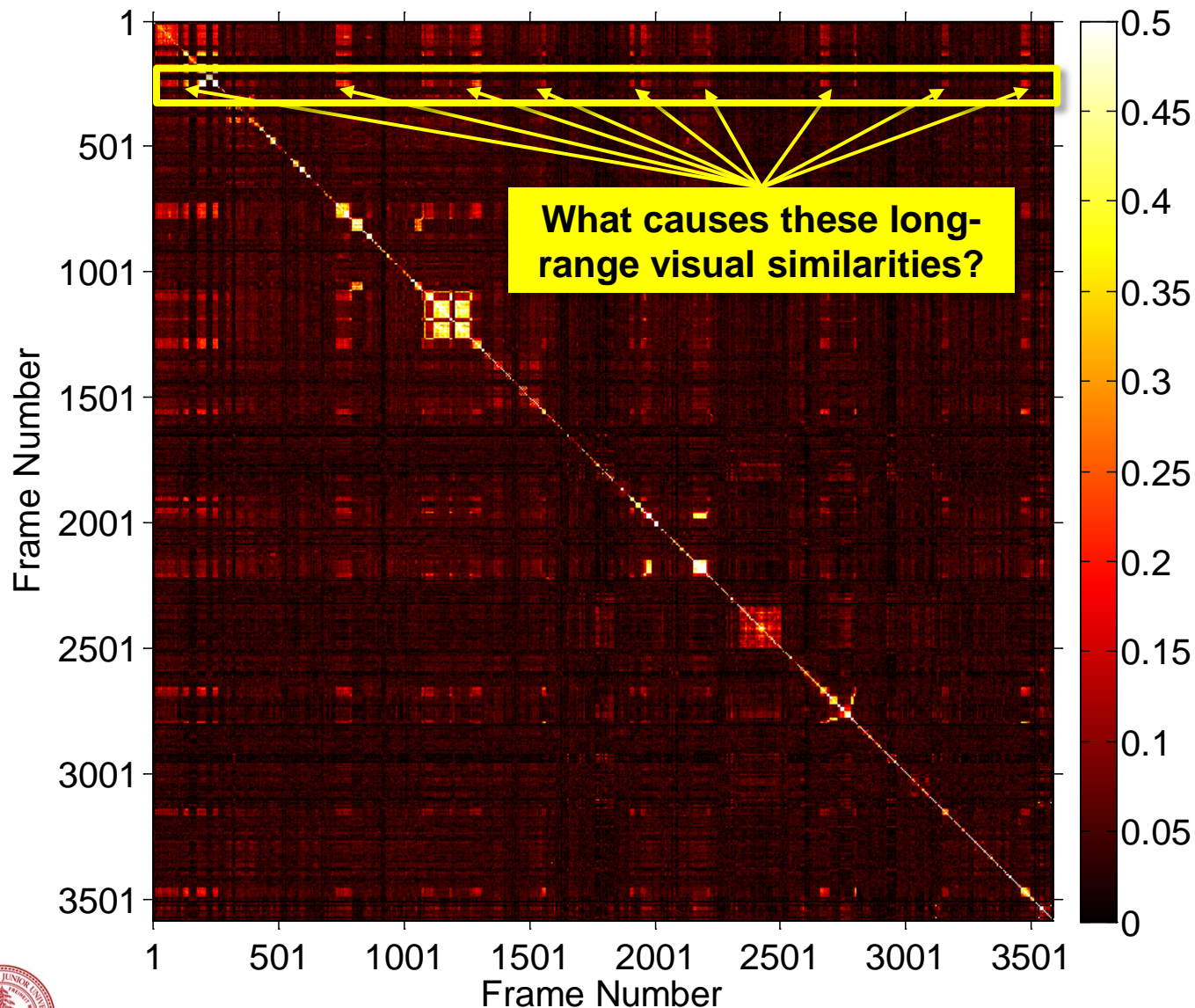
Long-Range Visual Similarity

NBC Nightly News on Dec. 21, 2012

Long-Range Visual Similarity

Anchor: Brian Williams

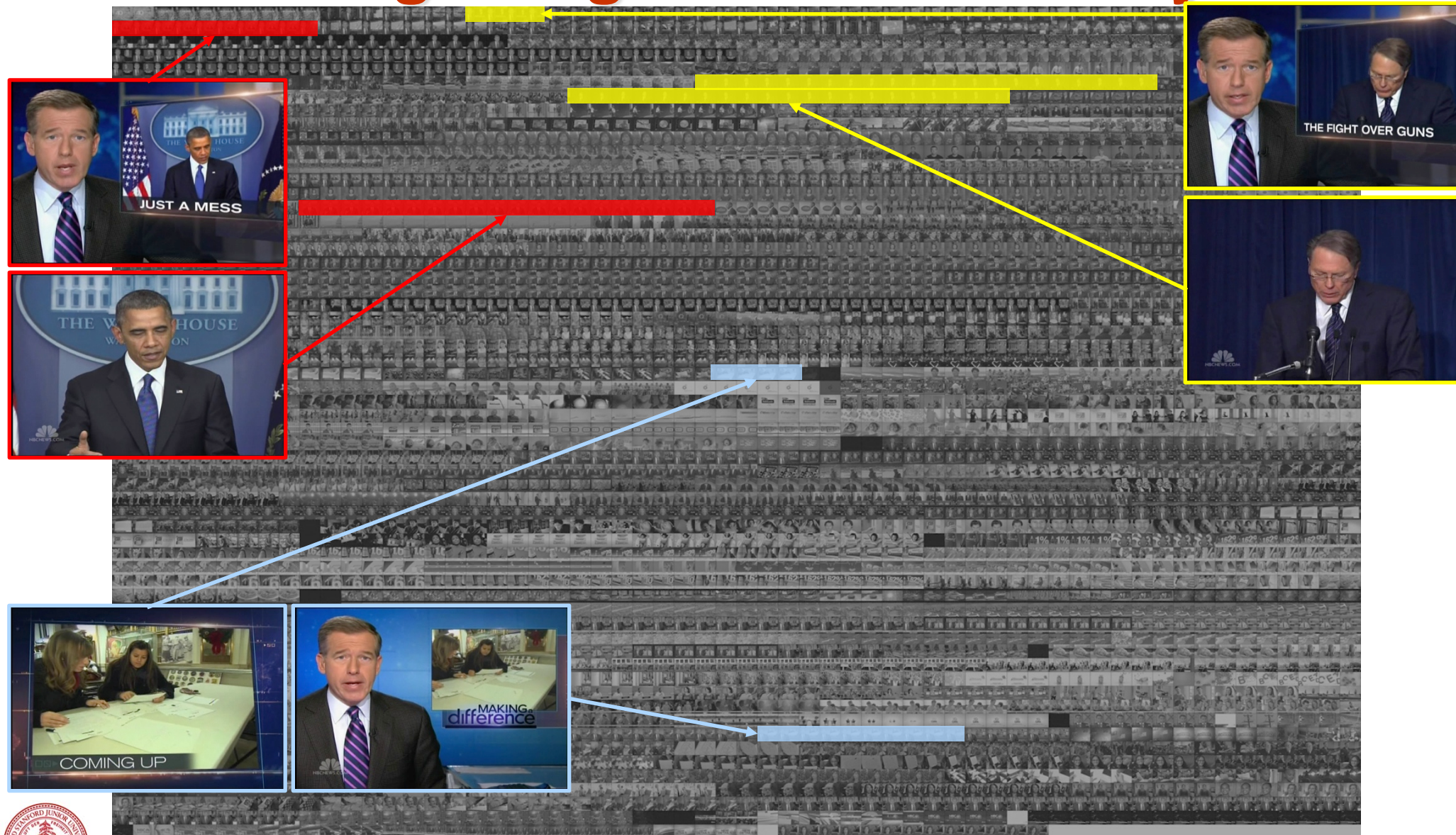**Reporter: Kelly O'Donnell**

Analyst: David Gregory
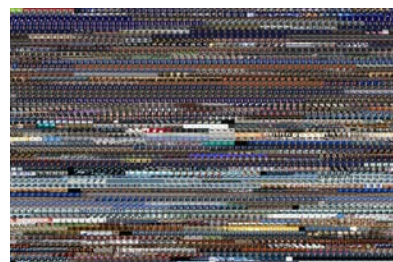
Reporter: Andrea Mitchell

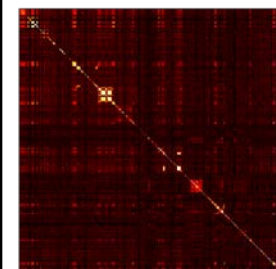# Long-Range Visual Similarity

Anchor Detection Pipeline

Keyframes

Exclude Frames Without Faces → Extract Image Signatures → Compare Image Signatures →

Similarity Matrix

Include Temporally Nearby Candidates ← Prune Away False Candidates ← Form Initial Anchor Candidates

Detections

From pruned set of candidates, expand to include temporally nearby candidates which are also very similar in appearance
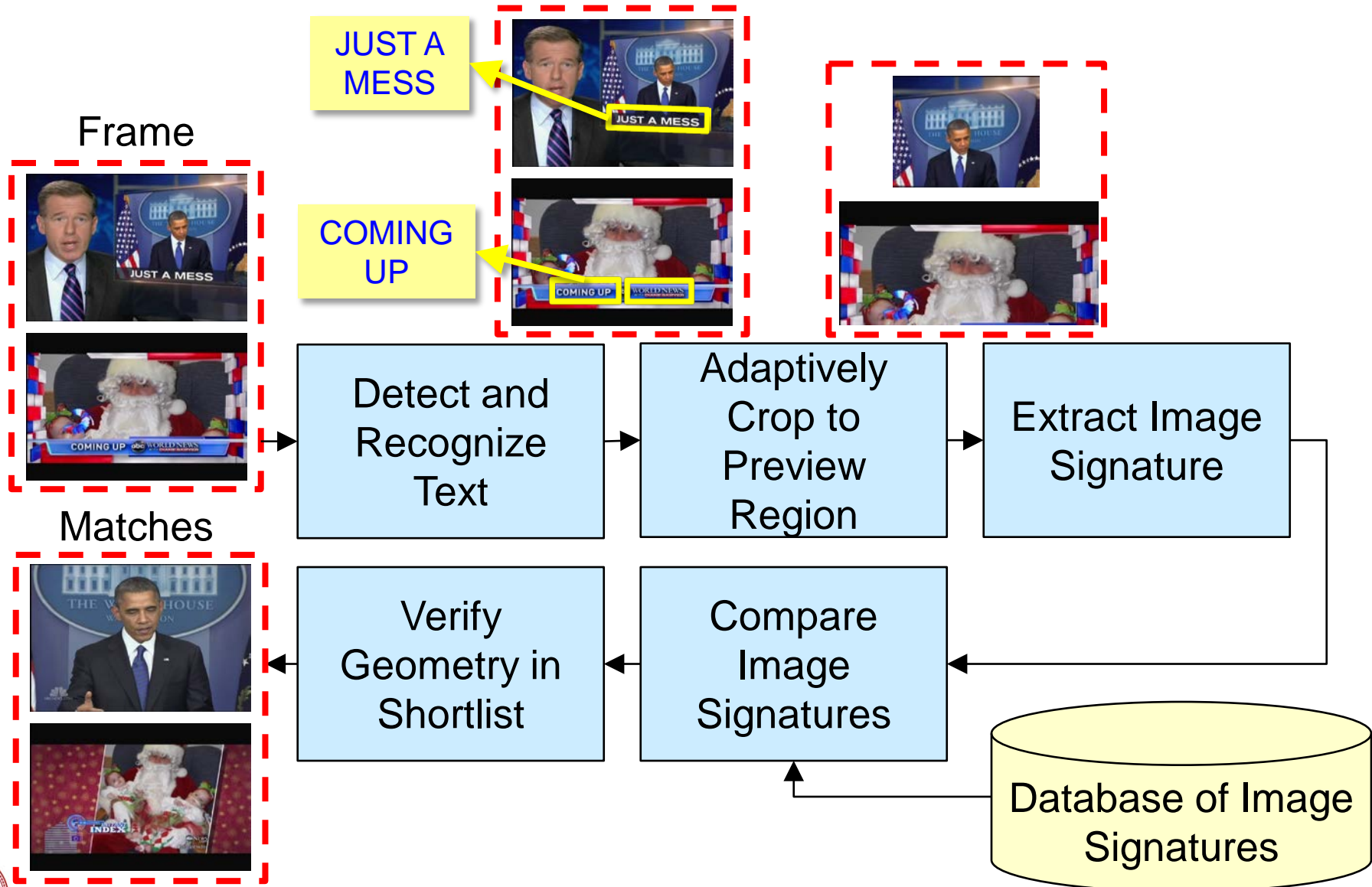
Intra-Episode vs. Inter-Episode

- Intra-episode: compare frames within a single episode of a news program

- Inter-episode: compare frames between different episodes of a news program
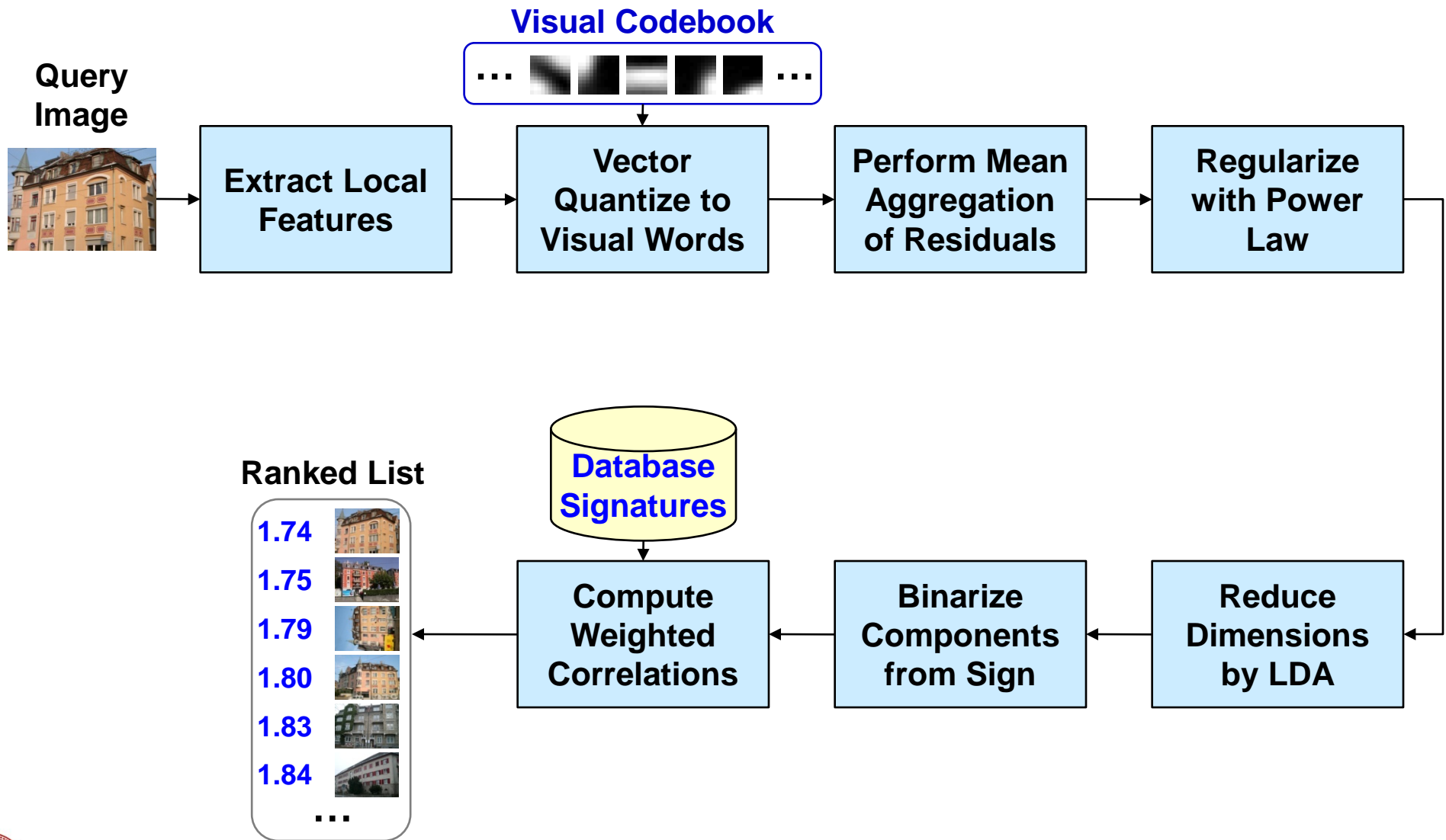
Preview Matching Pipeline

JUST A MESS

COMING UP

Frame

Matches

Detect and Recognize Text → Adaptively Crop to Preview Region → Extract Image Signature

Verify Geometry in Shortlist ← Compare Image Signatures ← Database of Image Signatures

REVV: Residual Enhanced Visual Vector

Experimental Setup

- ## Anchor detection
  - Training on 12 episodes of NBC Nightly News (1 anchor/episode), ABC World News (1 anchor/episode), Nightly Business Report (2 anchors/episode)
  - Testing on 21 episodes of same three programs
  - Measure precision / recall / F-score

- ## Preview matching
  - Testing on 10 episodes of NBC Nightly News and ABC World News
  - Measure precision / recall / F-score

- ## Comparison of two memory-efficient signatures
  - GIST: 66 MB/episode *[Oliva et al., 2001] [Douze et al., 2009]*
  - REVV: 10 MB/episode *[Chen et al., 2013]*

Anchor Detection Results

	Recall	Precision	F-Score
GIST Intra	0.53	0.84	0.65
REVV Intra	0.87	0.90	0.88

Anchor Detection Results

	Recall	Precision	F-Score
REVV Intra	0.87	0.90	0.88
REVV Intra + Inter	0.90	0.91	0.90

Preview Matching Results

Type A: Preview occurs
at beginning of broadcast

	Recall	Precision	F-Score
GIST	0.48	1.00	0.65
REVV	0.90	1.00	0.95

Preview Matching Results

Type B: Preview occurs prior to a commercial

	Recall	Precision	F-Score
GIST	0.62	1.00	0.77
REVV	0.93	1.00	0.96

Conclusions

- Long-range visual similarity in news videos provides a general and effective method for anchor detection and preview matching

- A robust image signature is required to handle challenging appearance variations throughout a newscast

- The image signature should be memory-efficient to enable parallelized processing of large video archives

Thank You

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