A Trillion Photos

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Google

EPFL
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Facebook

>3 billion uploaded each month

~ trillion photos taken each year
What do you do with a trillion photos?

Digital Shoebox
(hard drives, iphoto, facebook...)
The wife and I at the Trevi fountain in 2006

Would you like to comment?
1,000,000 images of Rome
Comparing images

Detect features using SIFT [Lowe, IJCV 2004]
Comparing images

Extraordinarily robust image matching

- Across viewpoint (~60 degree out-of-plane rotations)
- Varying illumination
- Real-time implementations
Edges
Scale Invariant Feature Transform

Adapted from slide by David Lowe
NASA Mars Rover images
NASA Mars Rover images
with SIFT feature matches
Figure by Noah Snavely
1,000,000 images of Rome
Structure from motion

Matched photos  \rightarrow  3D structure
Structure from motion

aka “bundle adjustment” (texts: Zisserman; Faugeras)

minimize $f(R, T, P)$

Friday, June 17, 2011
Photo Tourism [with Noah Snavely, Rick Szeliski]
Reconstructing Rome

In a day...

From ~1M images
Using ~1000 cores

Sameer Agarwal, Noah Snavely, Rick Szeliski, Steve Seitz

http://grail.cs.washington.edu/rome
Rome 150K: Colosseum
Rome: St. Peters
Venice (250K images)
Venice: Canal
Dubrovnik
From Sparse to Dense

Sparse output from the SfM system
From Sparse to Dense

Furukawa, Curless, Seitz, Szeliski, CVPR 2010
St. Peter's Basilica
Modeling people
What’s the shape of George Bush’s face?

[Kemelmacher & Seitz, ICCV 2011]
Image alignment

Cropped

Warped to frontal pose:
The Matrix
Matrix approximation

rank-4 approximation (SVD)
Photometric Stereo

\[ M = L S \]

- Images: \((\text{#imgs} \times \text{#pixels})\)
- Light directions: \((\text{#imgs} \times 3)\)
- Normals \(*\) albedos: \((3 \times \text{#pixels})\)

> \(M\) should be rank 3
> SVD yields \(L, S\)
George W. Bush

Tony Blair

Colin Powell

Donald Rumsfeld

[Kemelmacher & Seitz, ICCV 2011]
[Kemelmacher & Seitz, ICCV 2011]
[Kemelmacher & Seitz, ICCV 2011]
Most of our photos don’t look like this
recognition + alignment
Your Life in 30 Seconds

0 years

path optimization
Picasa Integration

• As “Face Movies” feature in v3.8
  – Rahul Garg, Ira Kemelmacher
Conclusion

trillions of photos
+ computer vision breakthroughs

= new ways to see the world