

Multi-perspective Panoramas



Slides from a talk by Lihi Zelnik-Manor
at ICCV'07 3DRR workshop

Pictures capture memories



Panoramas



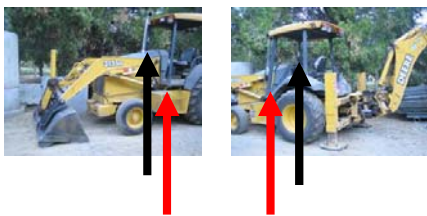
Registration: Brown & Lowe, ICCV'05
Blending: Burt & Adelson, Trans. Graphics, 1983
Visualization: Kopf et al., SIGGRAPH, 2007

Bad panorama?



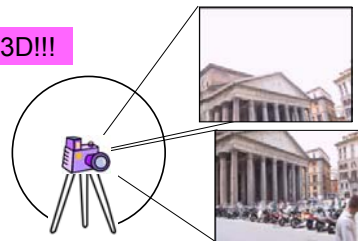
Output of Brown & Lowe software

No geometrically consistent solution



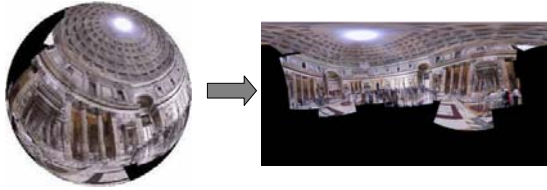
Scientists solution to panoramas: Single center of projection

No 3D!!!



Registration: Brown & Lowe, ICCV'05
Blending: Burt & Adelson, Trans. Graphics, 1983
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From sphere to plane



Distortions are unavoidable

Distorted panoramas

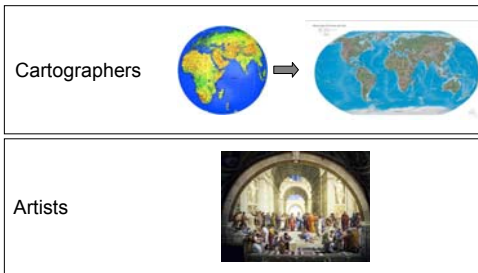


Output of Brown & Lowe software

Objectives

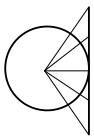
1. Better looking panoramas
2. Let the camera move:
 - Any view
 - Natural photographing

Stand on the shoulders of giants

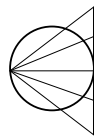


Common panorama projections

Perspective



Stereographic



projects a sphere onto a plane

Cylindrical



Global Projections

Perspective



Stereographic



Cylindrical

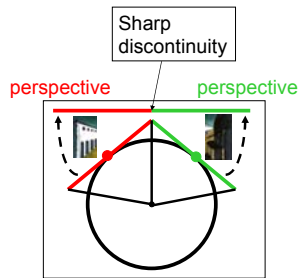


Learn from the artists

Multiple view points



De Chirico "Mystery and Melancholy of a Street", 1914



Renaissance painters solution



"School of Athens", Raffaello Sanzio ~1510

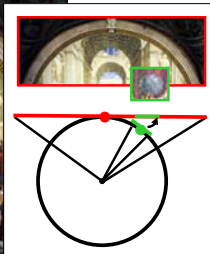
Give a separate treatment to different parts of the scene!!

Personalized projections



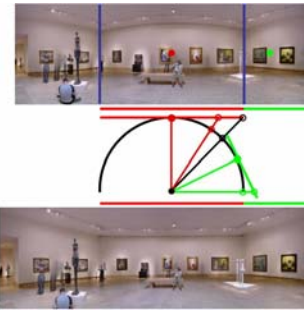
"School of Athens", Raffaello Sanzio ~1510

Give a separate treatment to different parts of the scene!!



Multiple planes of projection

Sharp discontinuities can often be well hidden



Single view



Our multi-view result

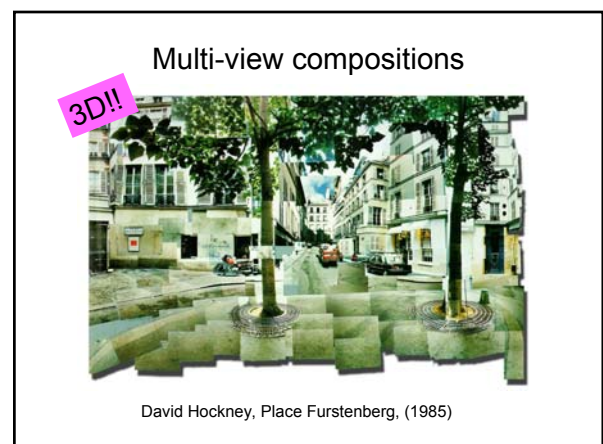
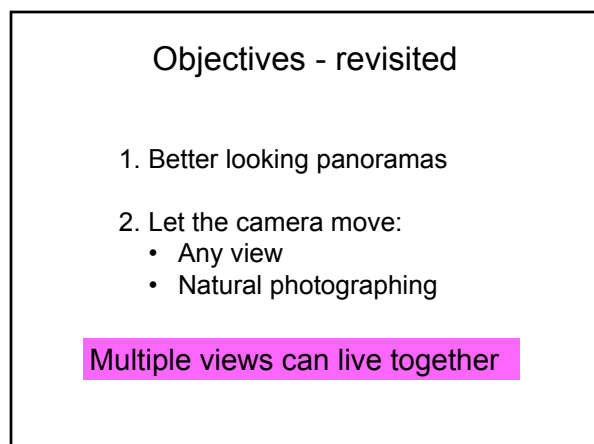
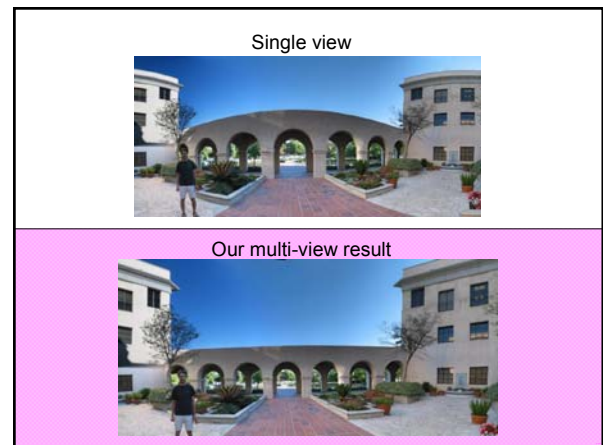
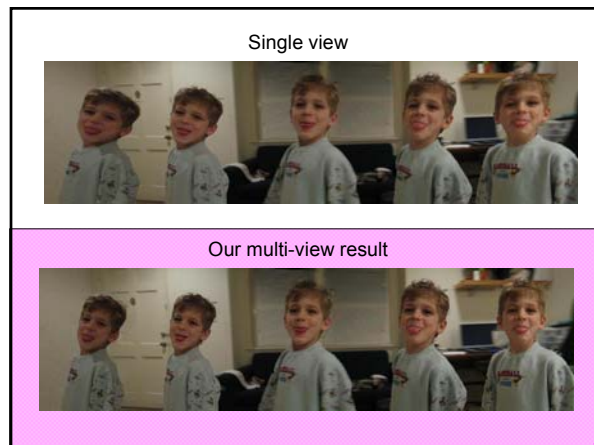
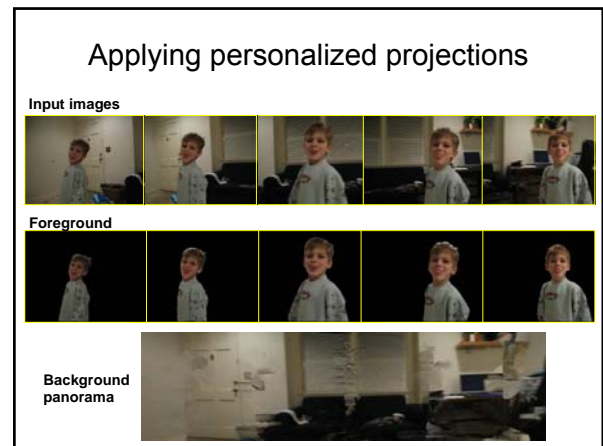
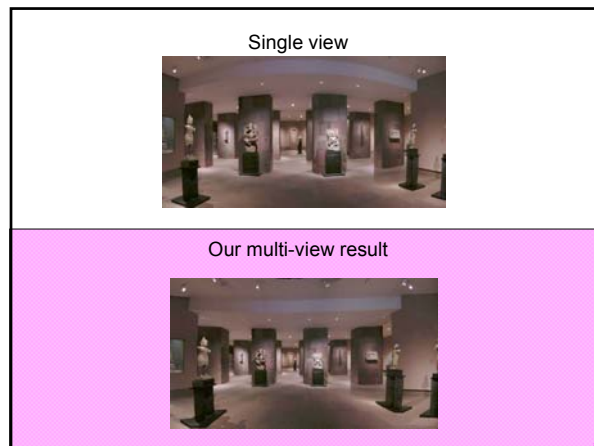


Single view



Our multi-view result





Why multi-view?

Multiple viewpoints



David Hockney,
Place Furstenberg, 1985

Single viewpoint



Melissa Slorain,
Place Furstenberg, 2003

Multi-view panoramas

Single view



Multiview



Zomet et al. (PAMI'03)

Requires video input

Long Imaging



Agarwala et al. (SIGGRAPH 2006)

Smooth Multi-View



Google maps

What's wrong in the picture?



Google maps

Non-smooth



Google maps

The Chair



David Hockney (1985)

Joiners are popular



Flickr statistics (Aug'07):

4,985 photos matching **joiners**.

4,007 photos matching **Hockney**.

41 groups about **Hockney**

Thousands of members

Main goals:

Automate joiners

Generalize panoramas to general
image collections

Objectives

- For Artists:
Reduce manual labor



Manual: ~40min.



Fully automatic

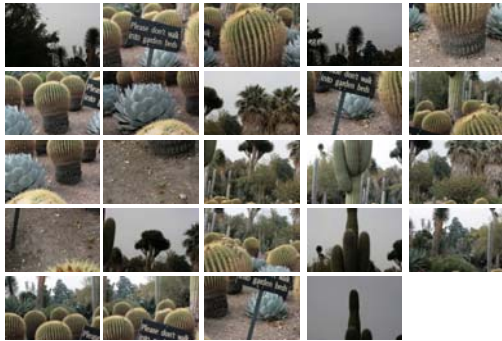
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- For non-artists:
Generate pleasing-to-the-eye joiners

Objectives

- For Artists:
Reduce manual labor
- For non-artists:
Generate pleasing-to-the-eye joiners
- For data exploration:
Organize images spatially

What's going on here?



A cacti garden



Principles

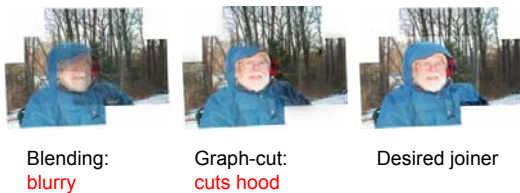
Principles

- Convey topology



Principles

- Convey topology
- A 2D layering of images



Principles

- Convey topology
- A 2D layering of images
- Don't distort images



Principles

- Convey topology
- A 2D layering of images
- Don't distort images
- Minimize inconsistencies



Algorithm

Step 1: Feature matching



Brown & Lowe, ICCV'03

Step 2: Align



Large inconsistencies

Brown & Lowe, ICCV'03

Step 3: Order



Reduced inconsistencies

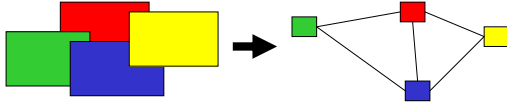
Ordering images

Try all orders: only for small datasets

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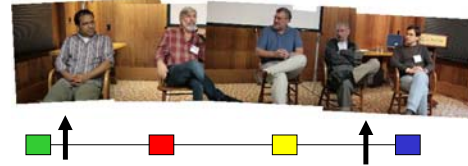
complexity: $(m+n)\alpha$
 m = # images
 n = # overlaps
 α = # acyclic orders



Ordering images

Observations:

- Typically each image overlaps with only a few others
- Many decisions can be taken locally



Ordering images

Approximate solution:

- Solve for each image independently
- Iterate over all images



Can we do better?



Step 4: Improve alignment



Iterate Align-Order-Importance



Iterative refinement

Initial



Final



Iterative refinement

Initial



Final



Iterative refinement

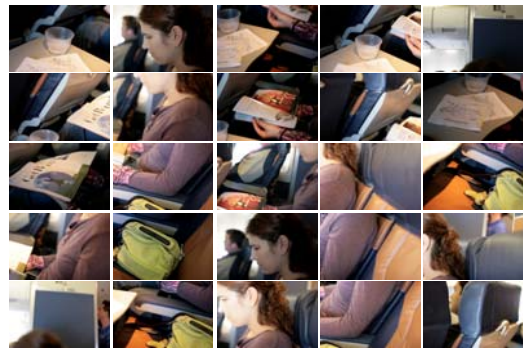
Initial



Final



What is this?



That's Lihi reading



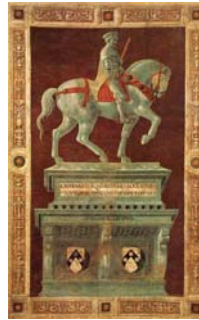
Anza-Borrego



Tractor



Art reproduction



Paolo Uccello, 1436

Art reproduction



Paolo Uccello, 1436



Zelnik & Perona, 2006

Art reproduction



Single view-point



Zelnik & Perona, 2006

Manual by Photographer



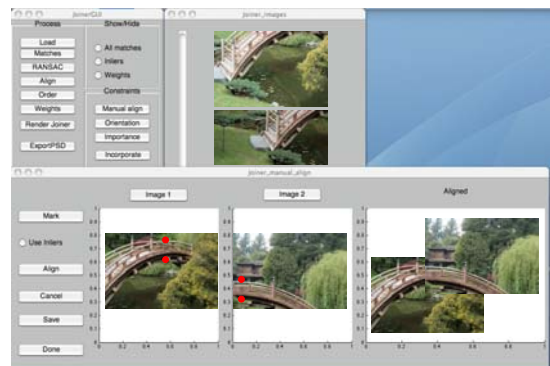
Our automatic result



Failure?



GUI



The Impossible Bridge



Homage to David Hockney



Take home



- Incorrect geometries are possible and fun!
- Geometry is not enough, we need scene analysis

- A highly related work:
"Scene Collages and Flexible Camera Arrays,"
Y. Nomura, L. Zhang and S.K. Nayar,
Eurographics Symposium on Rendering, Jun, 2007.



Thank You