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
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!!!
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

Cartographers

Artists

Common panorama projections

Perspective  Stereographic

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
Our multi-view result

Applying personalized projections

Single view

Input images

Foreground

Background panorama

Single view

Our multi-view result

Objectives - revisited

1. Better looking panoramas

2. Let the camera move:
   • Any view
   • Natural photographing

Multiple views can live together

Multi-view compositions

3D!!

David Hockney, Place Furstenberg, (1985)
Why multi-view?

Multiple viewpoints

Single viewpoint

David Hockney, Place Furstenberg, 1985

Melissa Slemin, 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

• 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

• Convey topology
• A 2D layering of images

Blending: blurry
Graph-cut: cuts hood
Desired joiner

Principles

• Convey topology
• A 2D layering of images
• Don’t distort images

Correct
Incorrect

translate rotate scale
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
Ordering images

Try all orders: only for small datasets

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

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

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

What is this?

Iterative refinement

Initial

Final

That's Lihi reading

Anza-Borrego
Failure?

The Impossible Bridge

GUI

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,

Thank You