Image Mosaicing

COSC 470: Special Topic
Computer Vision | 3D Reconstruction
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Image Mosaicing

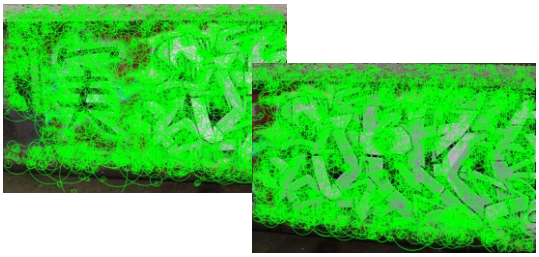
- In general images are not related by simple homographies
- In specific cases they are
  - If the camera just rotates (no translation)
  - If the scene is (roughly) planar
- In these cases we can compute homographies and mosaic the images together

Pairwise Image Mosaicing

- We start with two images

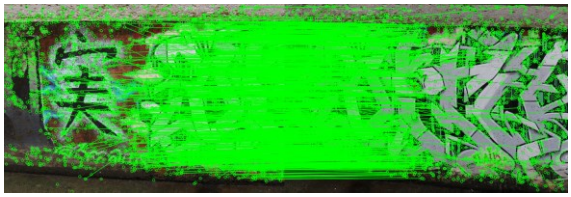
Pairwise Image Mosaicing

- We detect and describe features



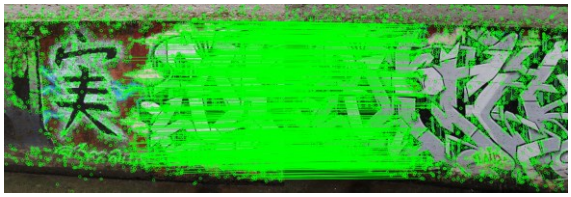
Pairwise Image Mosaicing

- Then estimate correspondences



Pairwise Image Mosaicing

- And compute homography with RANSAC



Pairwise Image Mosaicing

- Finally, warp one image to the other using the estimated homography

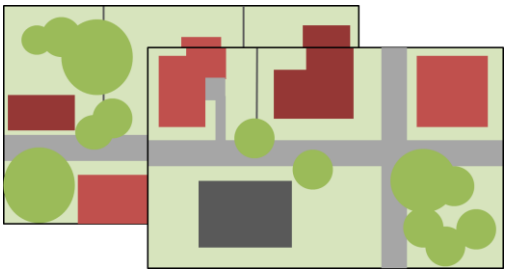
Pairwise Image Mosaicing

- Issues still arise
  - Changes in brightness between images
  - Residual errors in the Homography
  - Deviations from planar-world or rotating-camera assumptions
  - Moving objects between images
  - Etc.
- These cause seams and artefacts in the mosaic

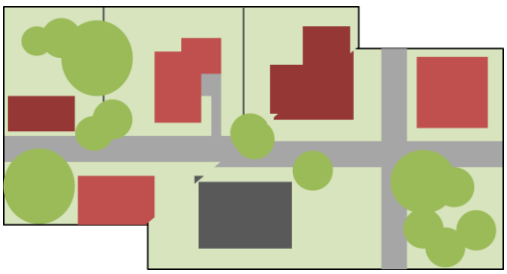
Reducing Seam Visibility

- First, put effort into estimating Homography
- Then use image processing techniques to merge the images more intelligently
  - Altering the overall brightness/contrast of images so that they match
  - Finding seams that aren't as obvious
  - Blending between images rather than having a sharp transition (can cause blurring)

Seamline Detection



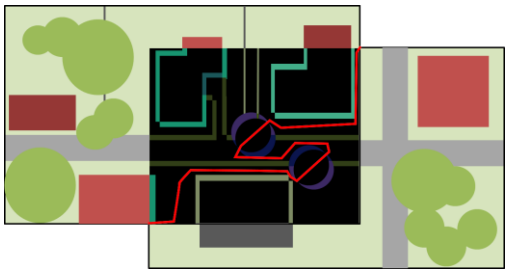
Seamline Detection



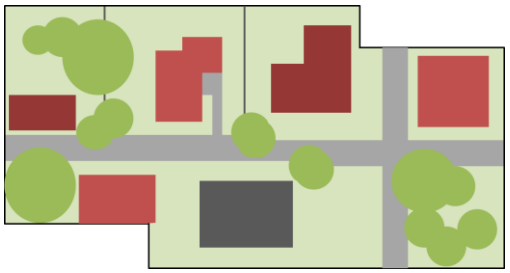
Seamline Detection

- Finding optimal paths
  - Form a graph from the image
    - Pixels become vertices
    - Edge weights measure image difference
  - Worst error at a single point
    - Find the maximum weight you have to pass through
    - Minimum spanning tree problem (Kruskal, Prim)
  - Lowest total weight path
    - Find a shortest path (Dijkstra)

Seamline Detection



Seamline Detection



Mosaicing Multiple Images

- Simple method: Add one image at a time
  - Can compose Homographies by multiplication
    $$H_{1\to n} = H_{(n-1)\to n} \cdots H_{2\to 3} H_{1\to 2}$$
  - This can lead to accumulation of errors
    - This will come up again in 3D reconstruction
  - Also causes problems with seamline estimation
    - See my recent paper and departmental seminar

Mosaicing Multiple Images

Mosaicing Multiple Images

- We can partially overcome this by estimating the homography to all overlapping images
  - We warp feature locations as well as images
  - We can then correspond the new images' features with features in the current mosaic, even if they come from different original images
  - This gives us a homography between the new image and the mosaic directly
- What about closing a circle?

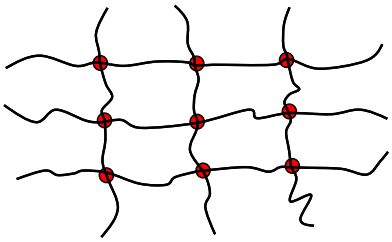
Mosaicing Multiple Images

- Ideally we want to account for all overlapping image pairs at the same time
- This gives rise to a non-linear optimisation problem similar to that for estimating *H*
  - The parameters are the set of homograpies from each image to the mosaic and the ideal 2D point locations in the mosaic
  - We can use the incremental approach to give an initial estimate

Multi-Image Seamline Detection

- Can do a sequential approach
  - Find seam between first two images
  - Mosaic them together
  - Find seam between next image and the mosaic
  - Add the new image to the mosaic
  - Repeat
- This is order-dependent
- Want to solve for a network of seamlines

Seamline Networks



Seamline Network Estimation

- Seamline network as a graph problem
  - The vertices are junctions of 3 or more images
  - The edges are paths between the junctions
  - These paths can be found using graph search through the mosaic image
- This risks a combinatorial optimisation task
- But can avoid this by using an appropriate cost function (see JPRS paper)