

CS4670 / 5670: Computer Vision

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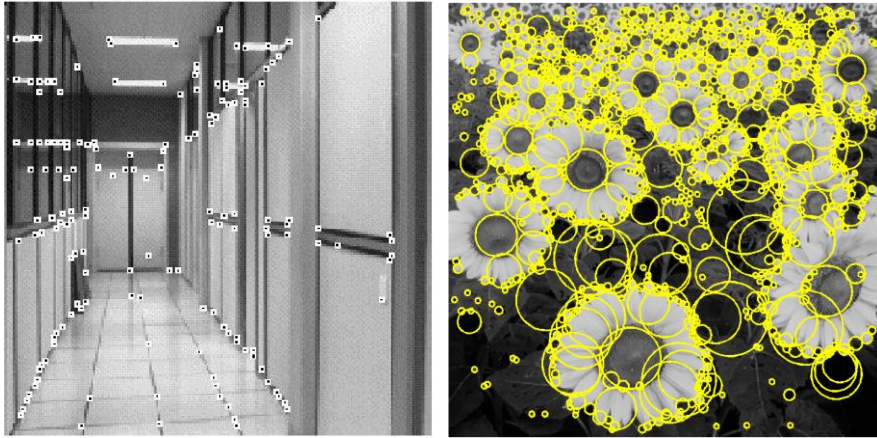
Lecture 5: Feature detection and matching



Reading

- Szeliski: 4.1

Feature extraction: Corners and blobs



Motivation: Automatic panoramas



Credit: Matt Brown

Motivation: Automatic panoramas



HD View

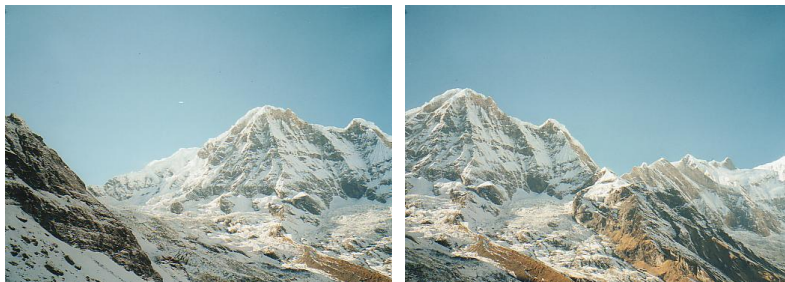
<http://research.microsoft.com/en-us/um/redmond/groups/ivm/HDView/HDGigapixel.htm>

Also see GigaPan:

<http://gigapan.org/>

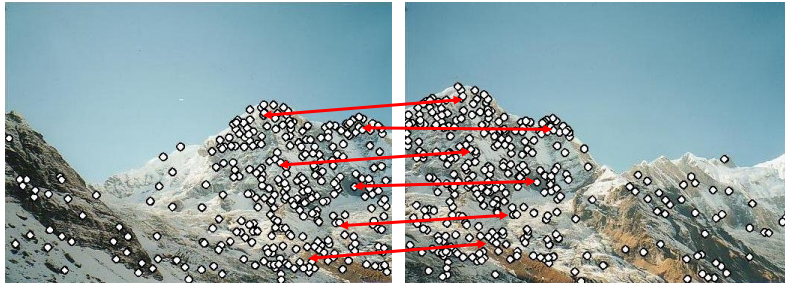
Why extract features?

- Motivation: panorama stitching
 - We have two images – how do we combine them?



Why extract features?

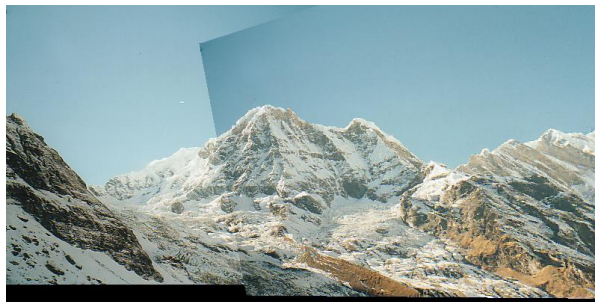
- Motivation: panorama stitching
 - We have two images – how do we combine them?



Step 1: extract features
Step 2: match features

Why extract features?

- Motivation: panorama stitching
 - We have two images – how do we combine them?



Step 1: extract features
Step 2: match features
Step 3: align images

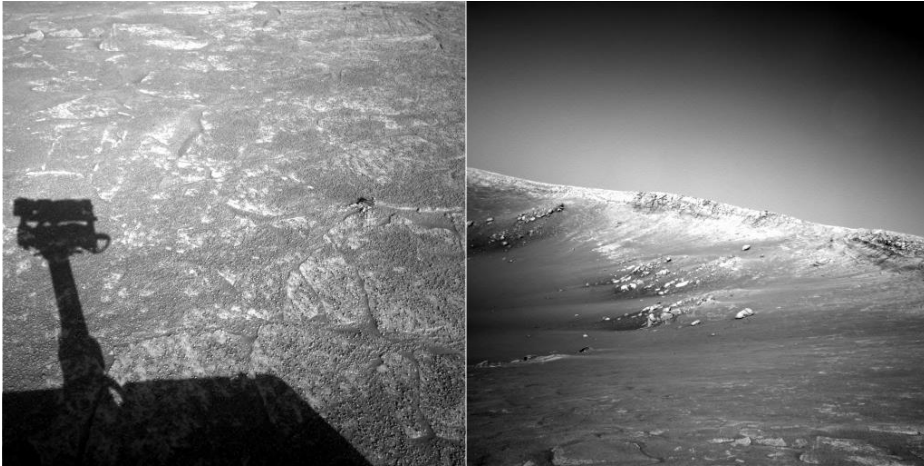
Image matching

by [Diva Sian](#)by [swashford](#)

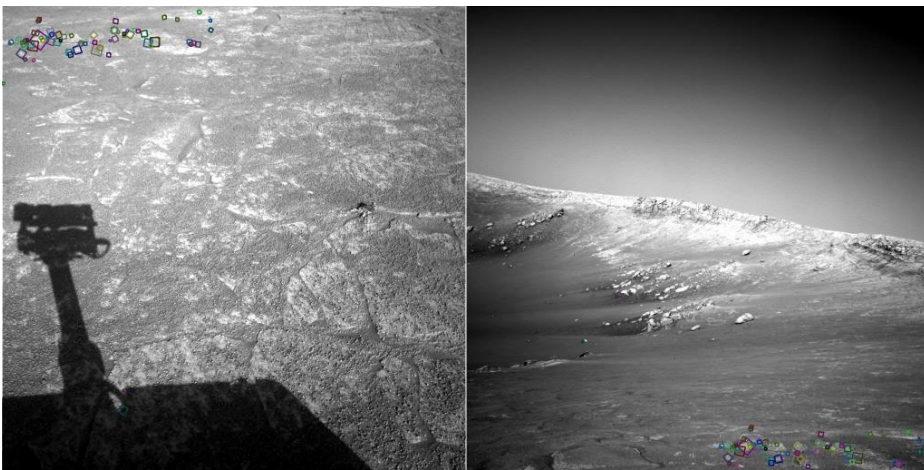
Harder case

by [Diva Sian](#)by [scgbt](#)

Harder still?

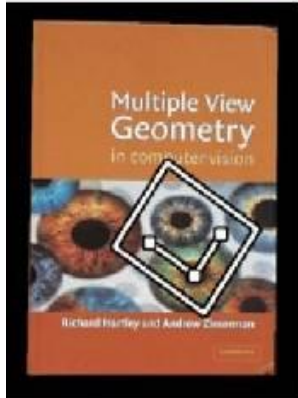


Answer below (look for tiny colored squares...)

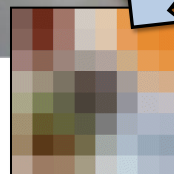
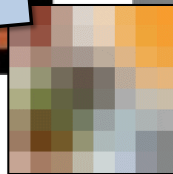
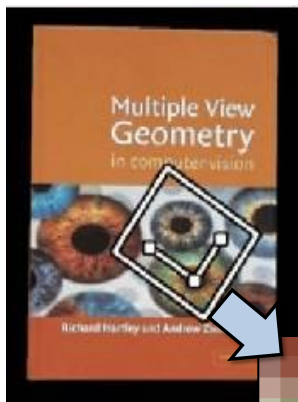


NASA Mars Rover images
with SIFT feature matches

Feature Matching



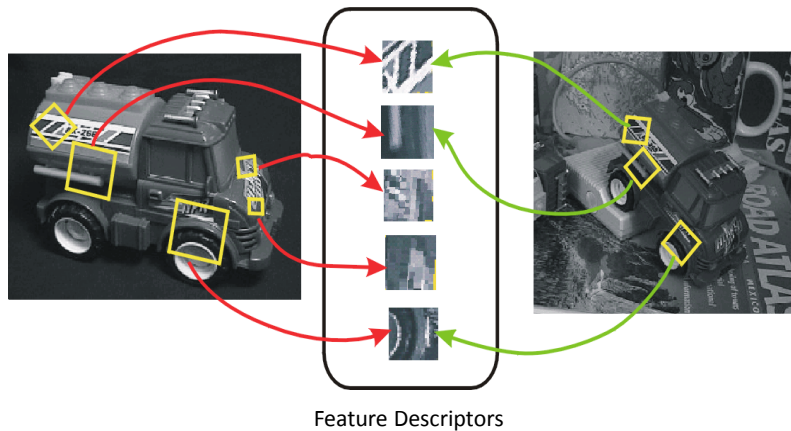
Feature Matching



Invariant local features

Find features that are invariant to transformations

- geometric invariance: translation, rotation, scale
- photometric invariance: brightness, exposure, ...



Advantages of local features

Locality

- features are local, so robust to occlusion and clutter

Quantity

- hundreds or thousands in a single image

Distinctiveness:

- can differentiate a large database of objects

Efficiency

- real-time performance achievable

More motivation...

Feature points are used for:

- Image alignment (e.g., mosaics)
- 3D reconstruction
- Motion tracking
- Object recognition
- Indexing and database retrieval
- Robot navigation
- ... other

What makes a good feature?



Want uniqueness

Look for image regions that are unusual

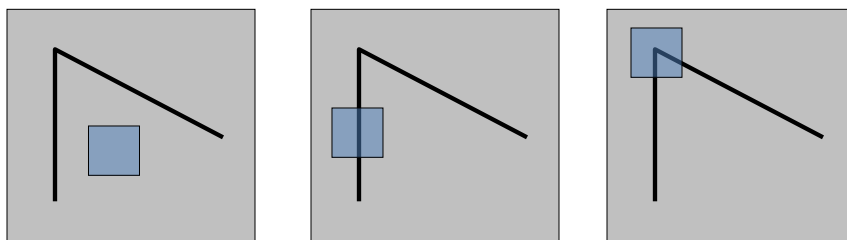
- Lead to unambiguous matches in other images

How to define “unusual”?

Local measures of uniqueness

Suppose we only consider a small window of pixels

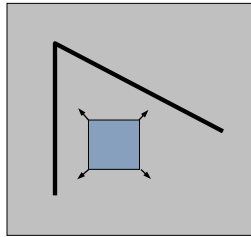
- What defines whether a feature is a good or bad candidate?



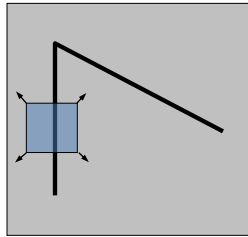
Credit: S. Seitz, D. Frolova, D. Simakov

Local measure of feature uniqueness

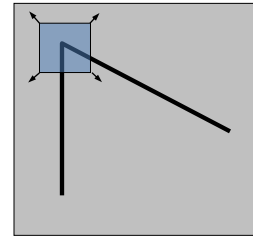
- How does the window change when you shift it?
- Shifting the window in any direction causes a big change



"flat" region:
no change in all
directions



"edge":
no change along the
edge direction



"corner":
significant change in
all directions

Credit: S. Seitz, D. Frolova, D. Simakov