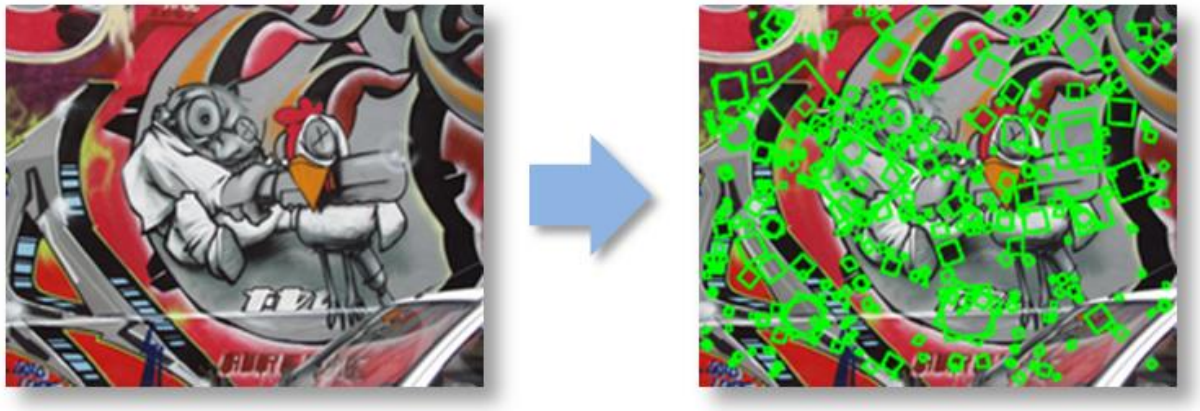
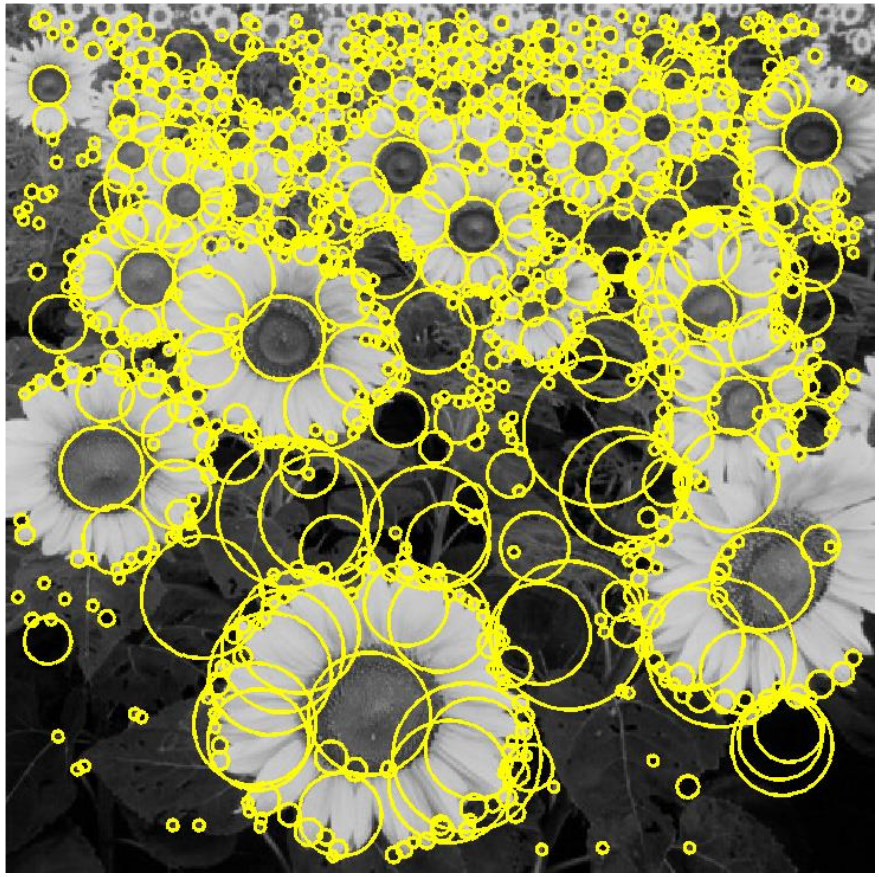
CS 231

Feature detection and matching

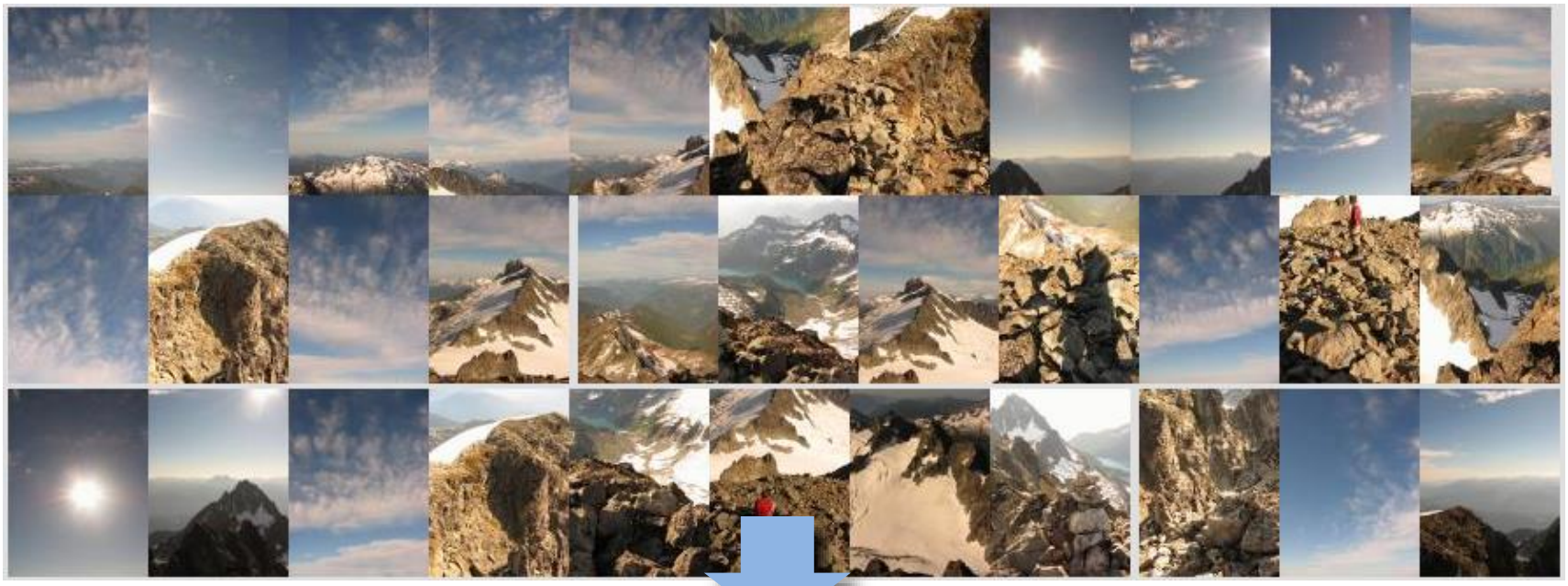


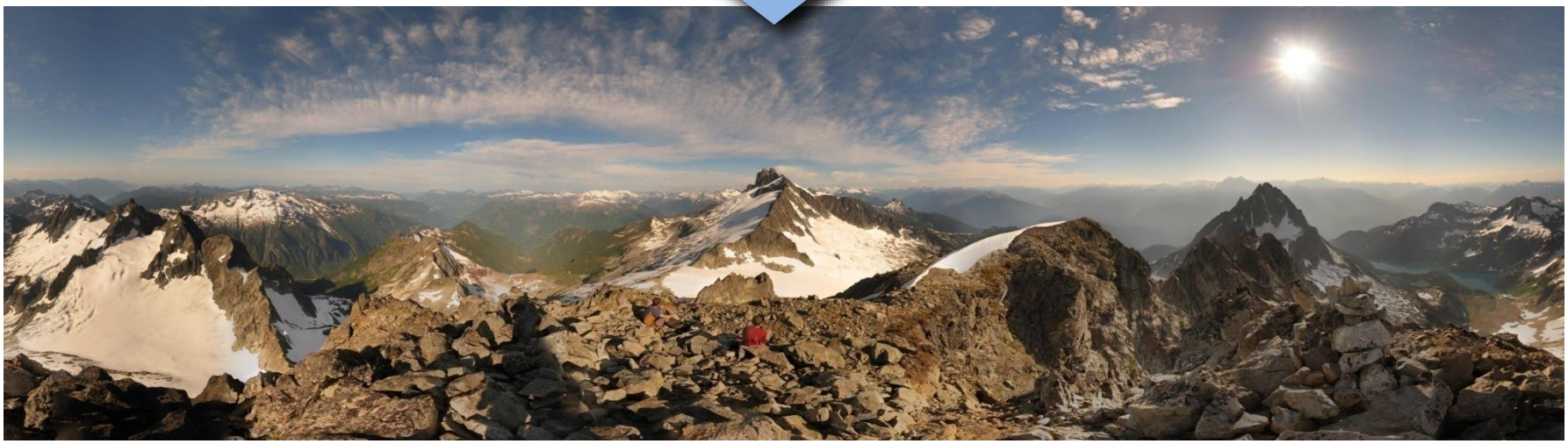
Slide credit: Noah Svaley @ Cornell Univ. – CS4670

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?

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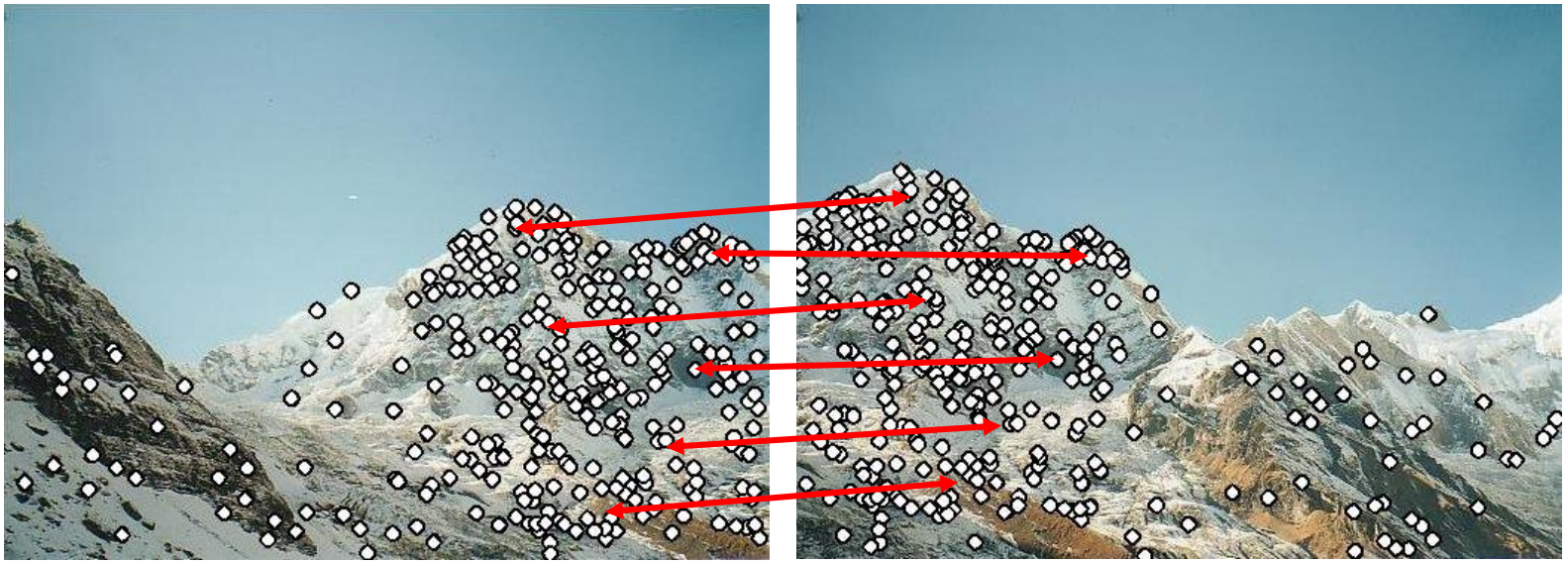


Step 1: extract features
Step 2: match features

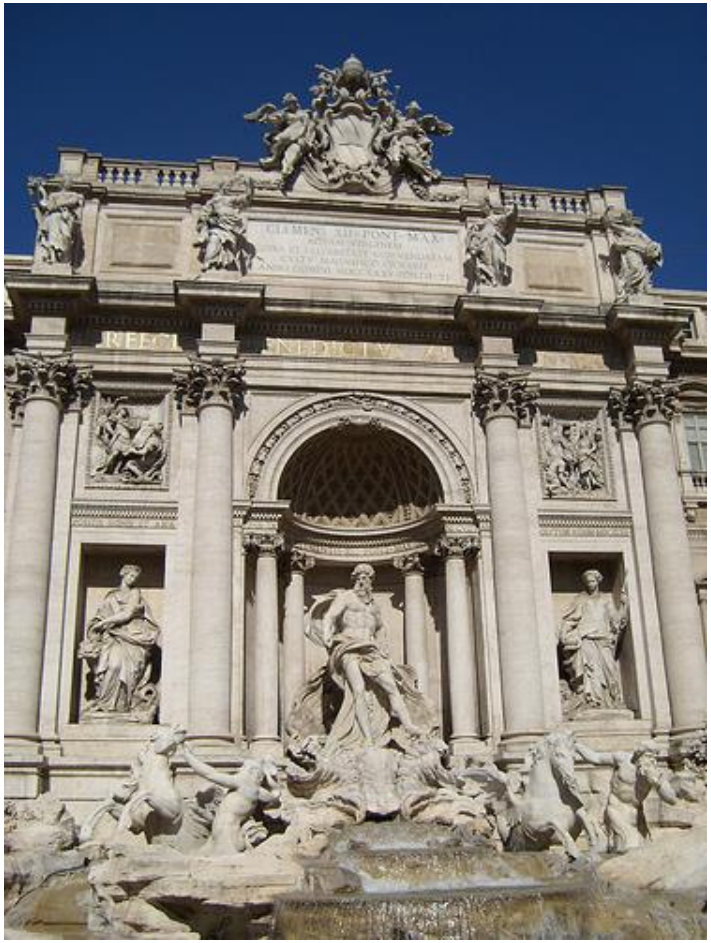
Why extract features?

- 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

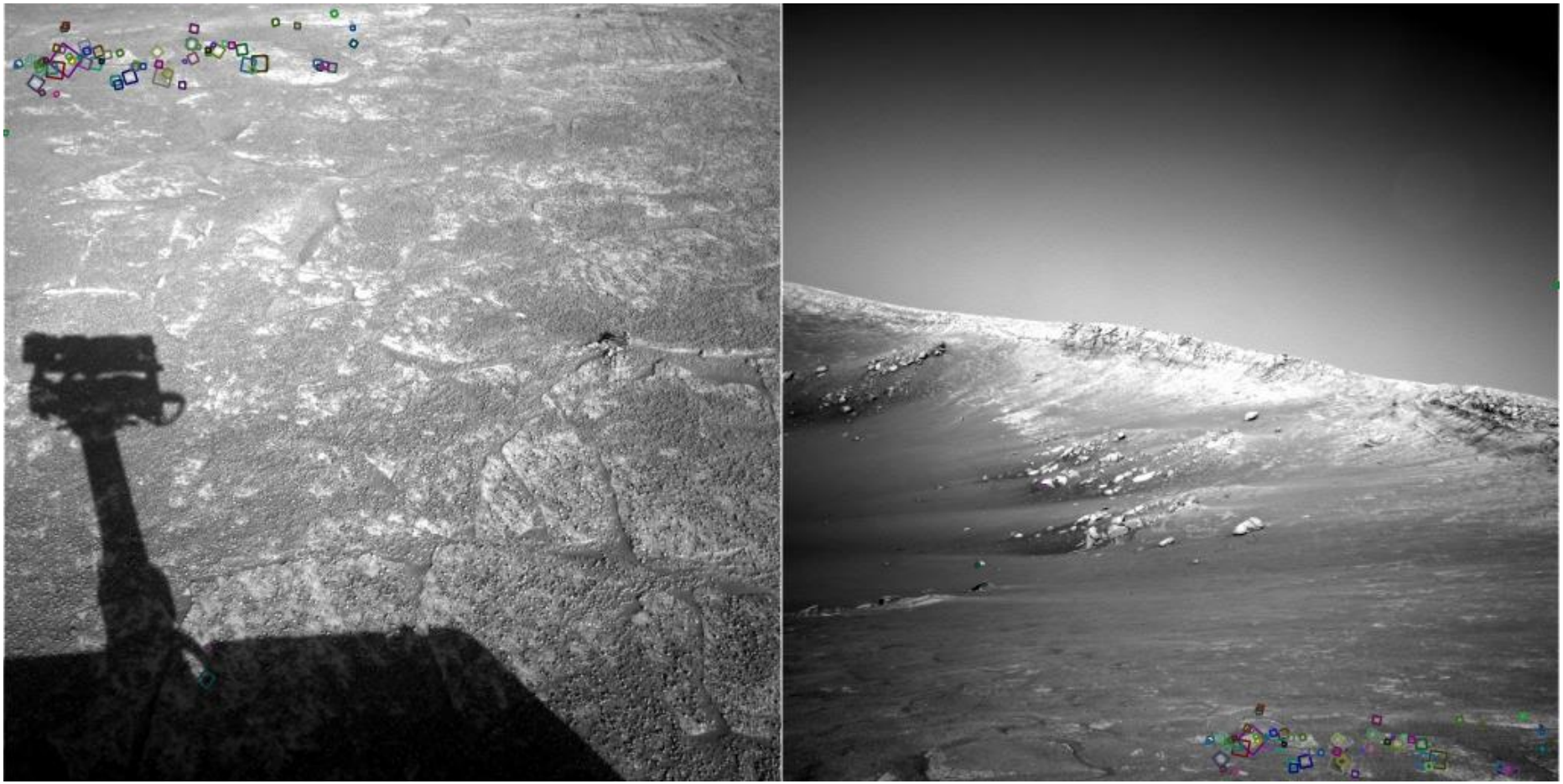
Harder case

by Diva Sian

by scgbt

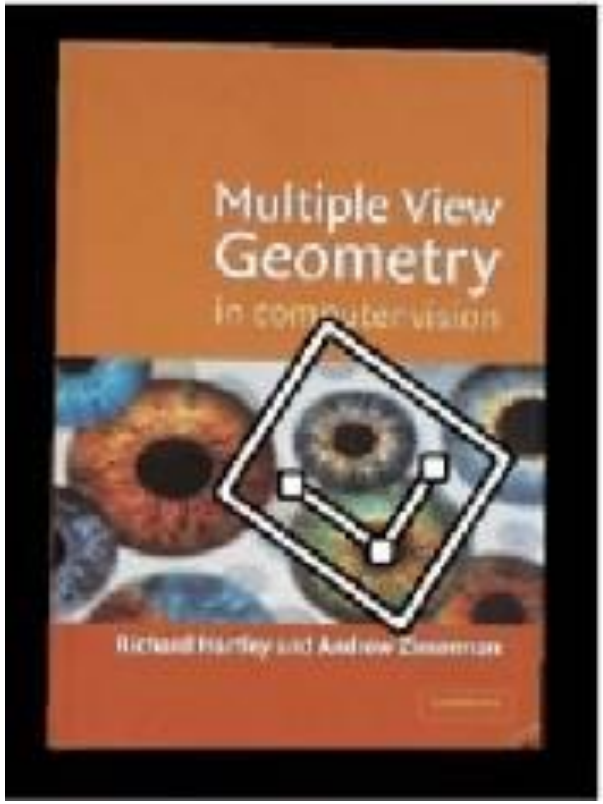
Harder still?

Answer below (look for tiny colored squares…)

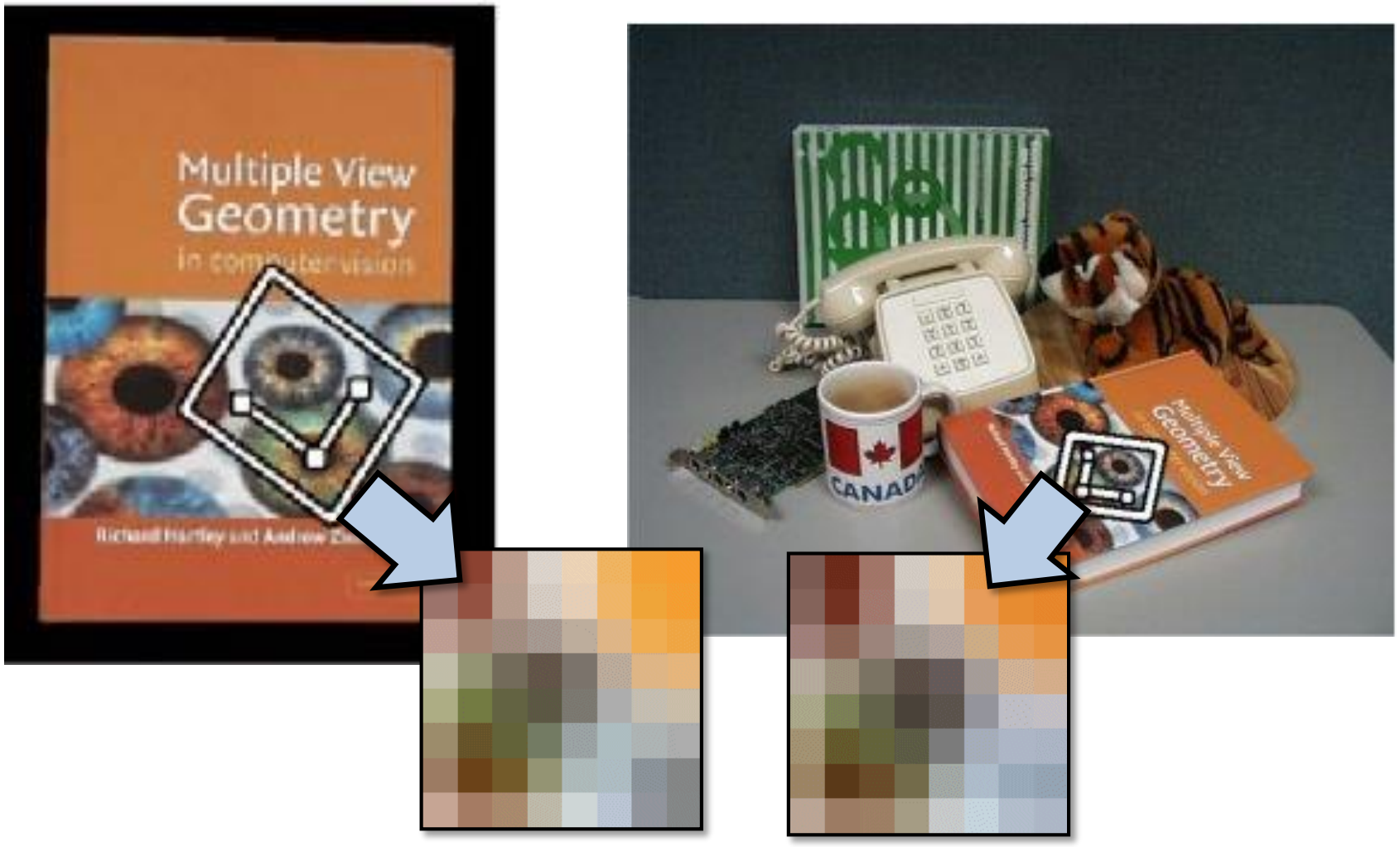


NASA Mars Rover images
with SIFT feature matches

Feature Matching



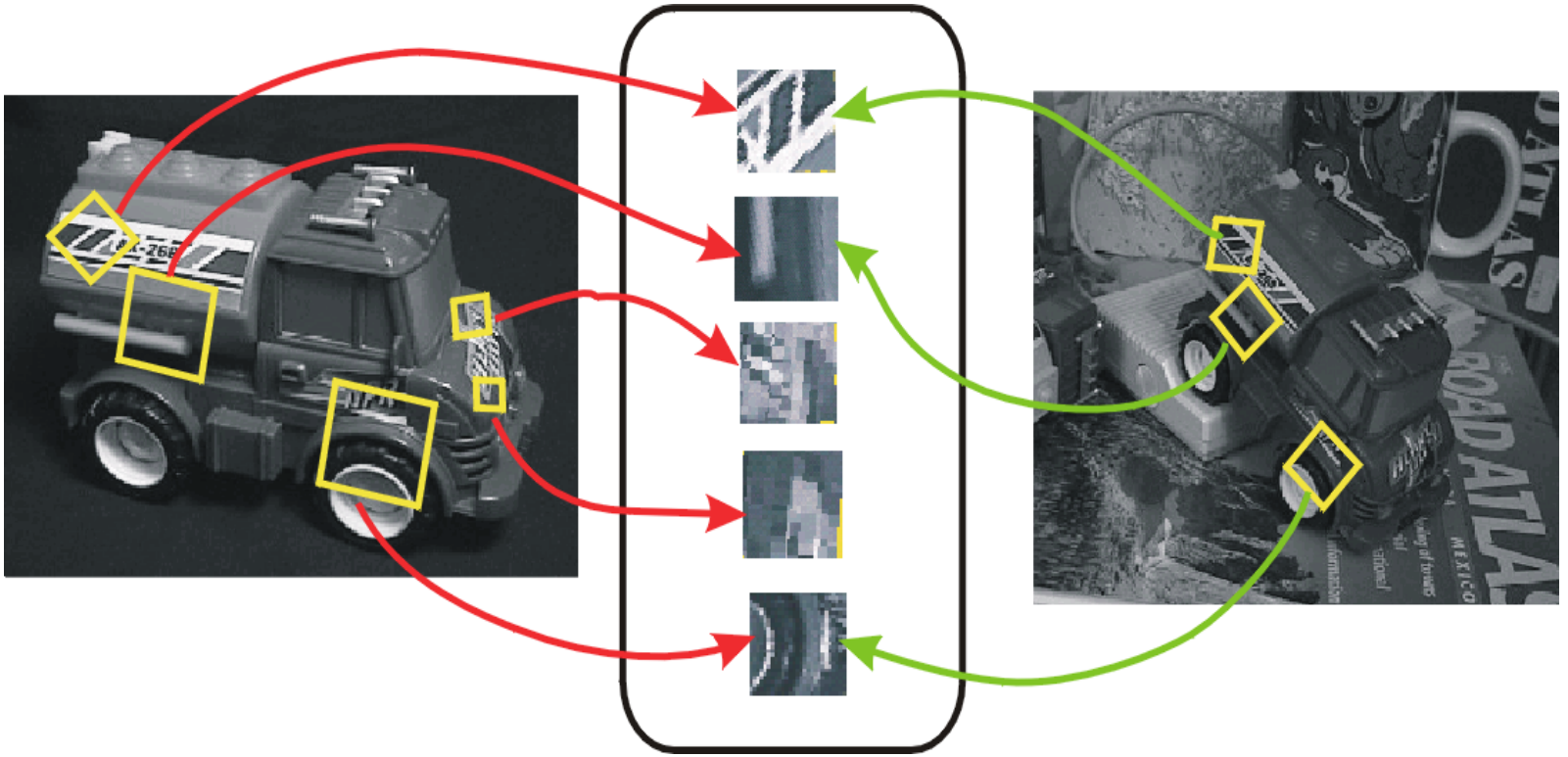
Feature Matching



Invariant local features

Find features that are invariant to transformations

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



Feature Descriptors

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

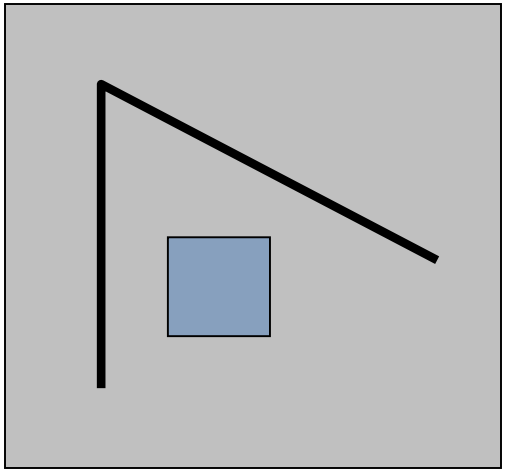
- Lead to unambiguous matches in other images

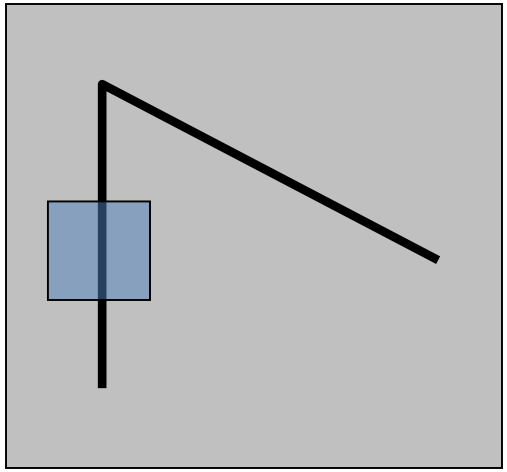
How to define “unusual”?

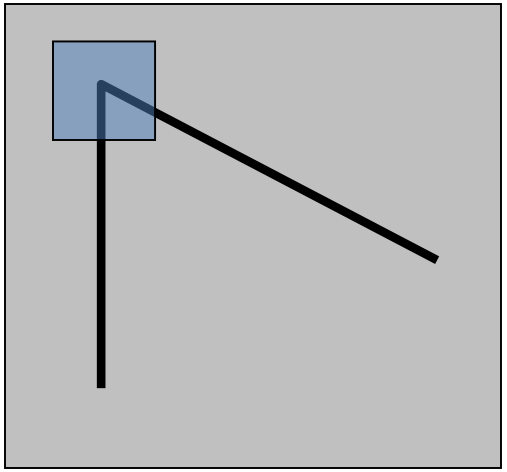
Local measures of uniqueness

Suppose we only consider a small window of pixels

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



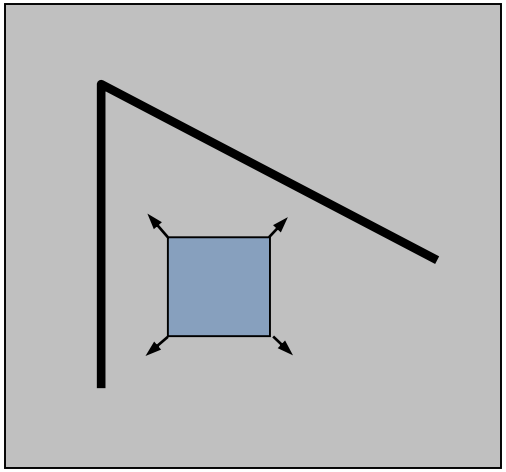




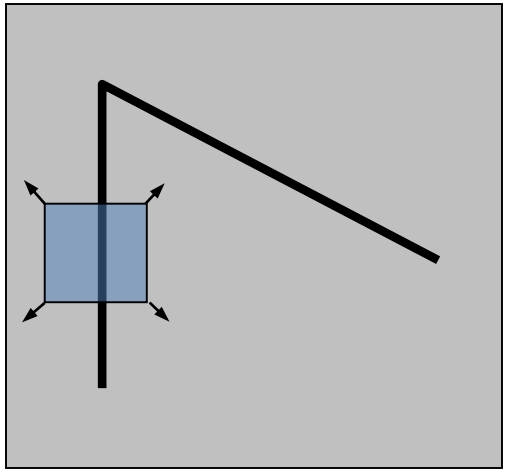
Credit: S. Seitz, D. Frolova, D. Simakov

Local measure of feature uniqueness

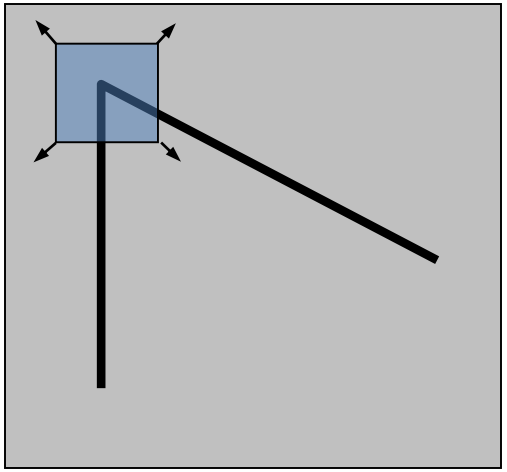
- How does the window change when you shift it?
- Shifting the window in any direction causes a big change



"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