Image Matching Using Scale Invariant Feature Transform (SIFT)

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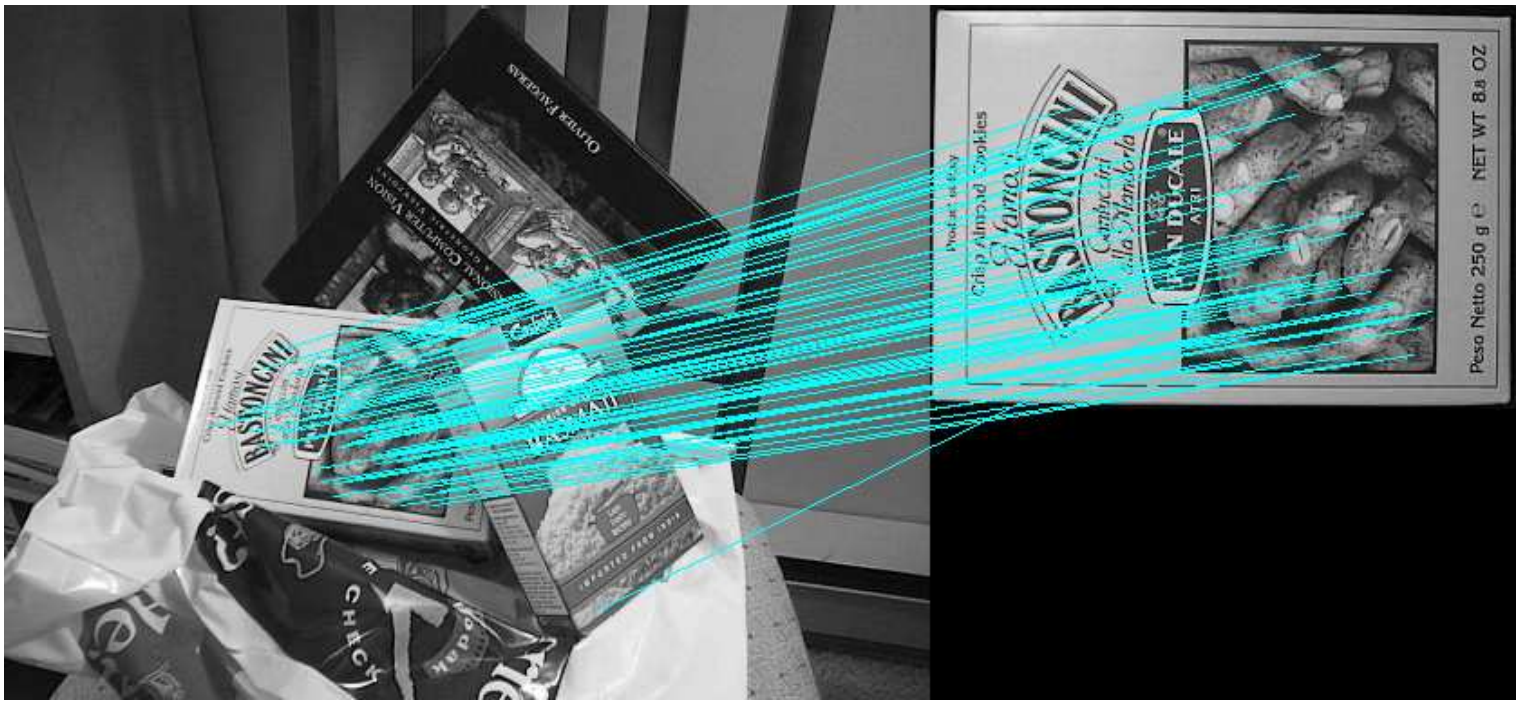
Image Matching

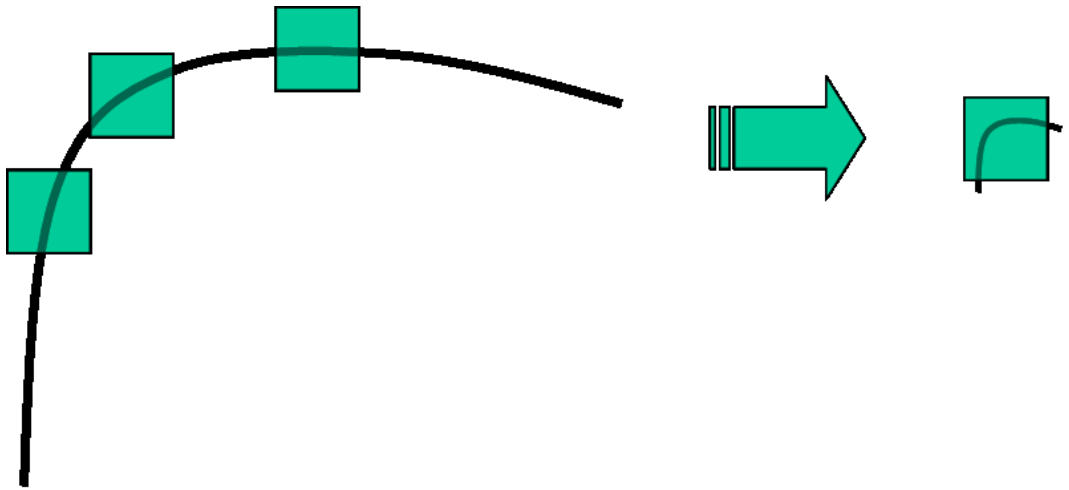


Interest point detector

Harris corner detector

Defect of corner detector

Non-invariant to image scale



Edges into Corner!

SIFT Overview

proposed by Lowe in 2004.

1. **Scale-space construction** - construction of Gaussian and difference-of-Gaussian pyramids.
2. **Keypoint localization** - keypoint candidates are chosen from the extrema in the scale space.
3. **Orientation assignment** - orientations are assigned to each keypoint based on histograms of gradient directions computed in a 16x16 window.
4. **Keypoint descriptor** - representation in a 128-dimensional vector.

Keypoint matching - the best candidate match is found by its nearest neighbor.

Scale Space Construction

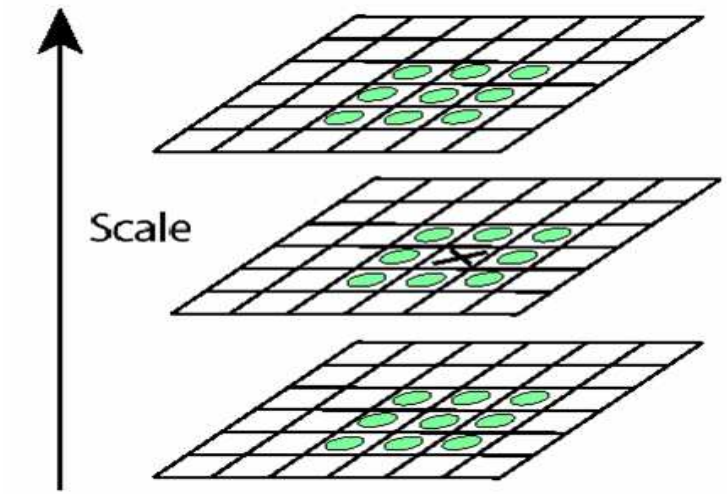
Gaussian Pyramid

Scale Space Construction (Cont.)

Difference-of-Gaussian (DoG) Pyramid

Keypoint Localization

Find exterema in DoG Pyramids



Keypoint Localization (Cont.)

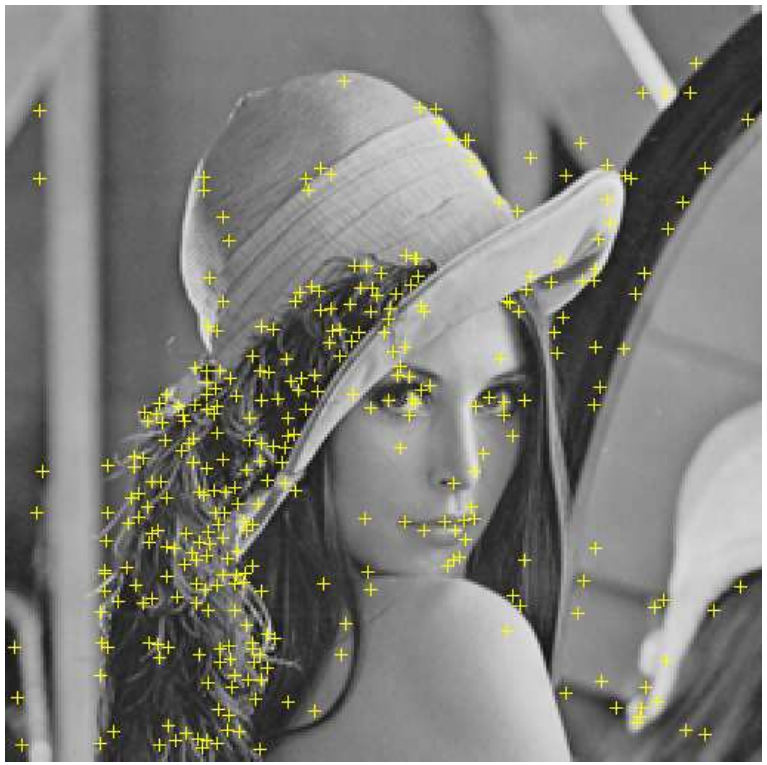
Result

Keypoint Localization (Cont.)

After removing low contrast points

Keypoint Localization (Cont.)

After removing edge responses



Orientation Assignment

Keypoint Descriptor

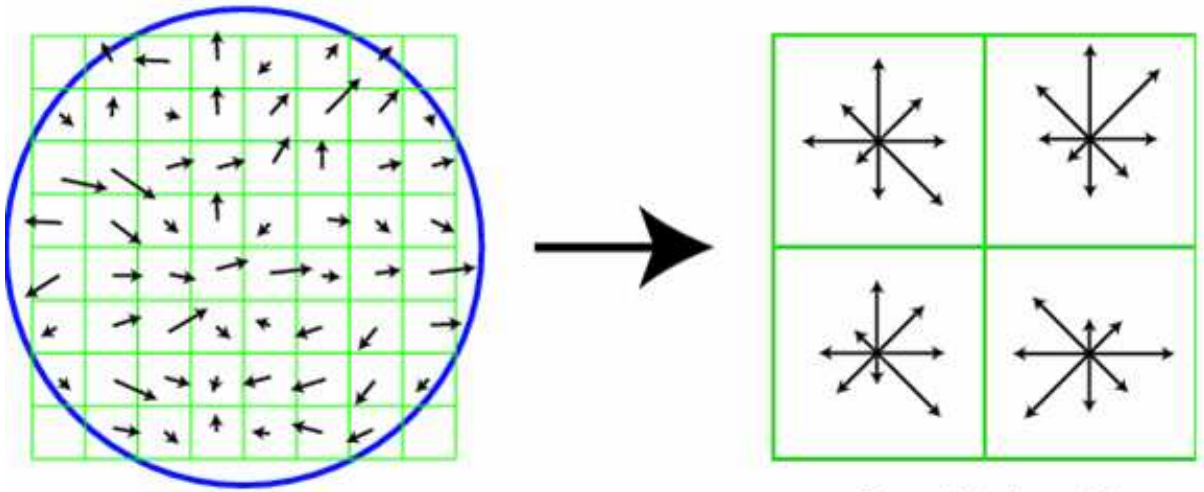
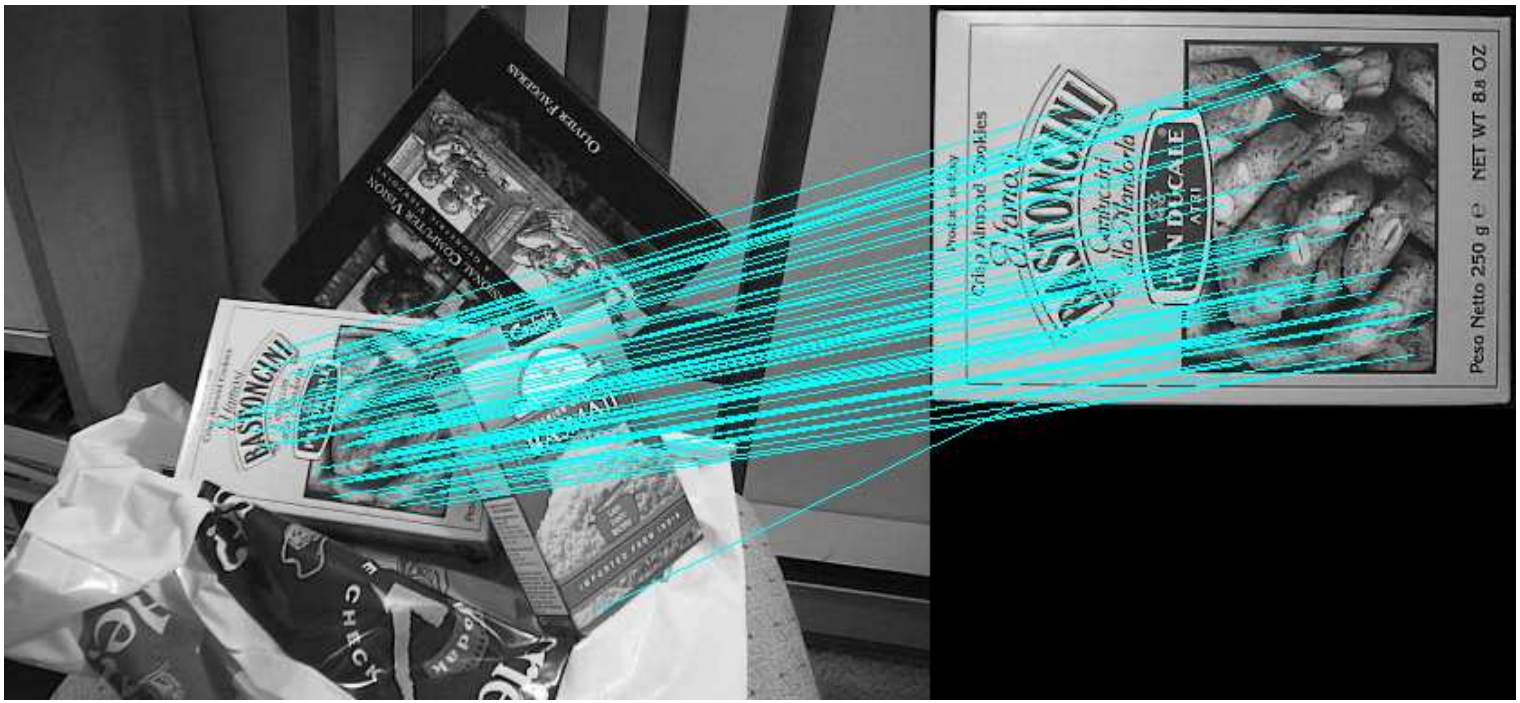
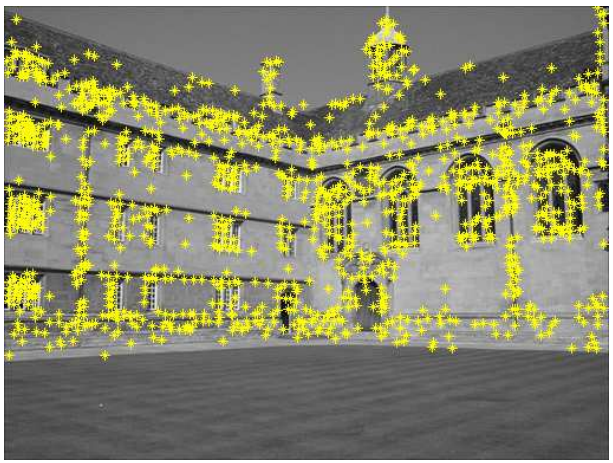


Image Matching



Comparison with Harris

Interest point detector



Comparison with Harris (Cont.)

Image matching

Harris

SIFT

Extension into Tracking

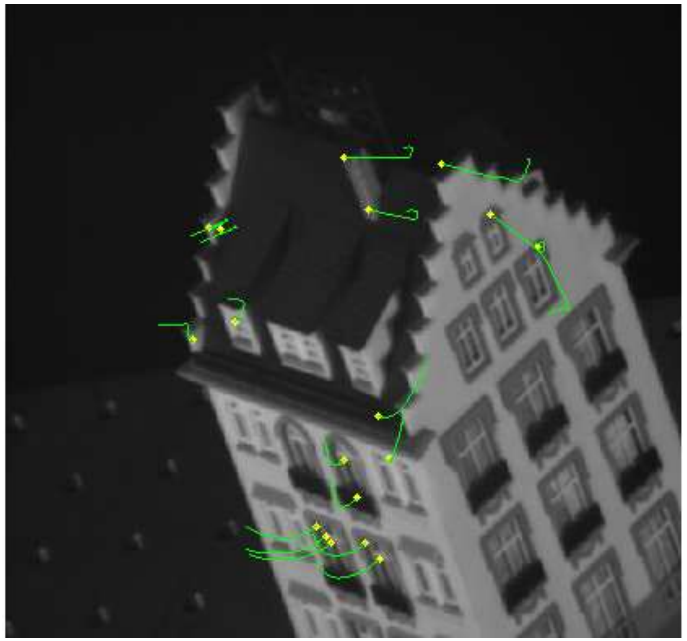
Input Images

The 1st frame

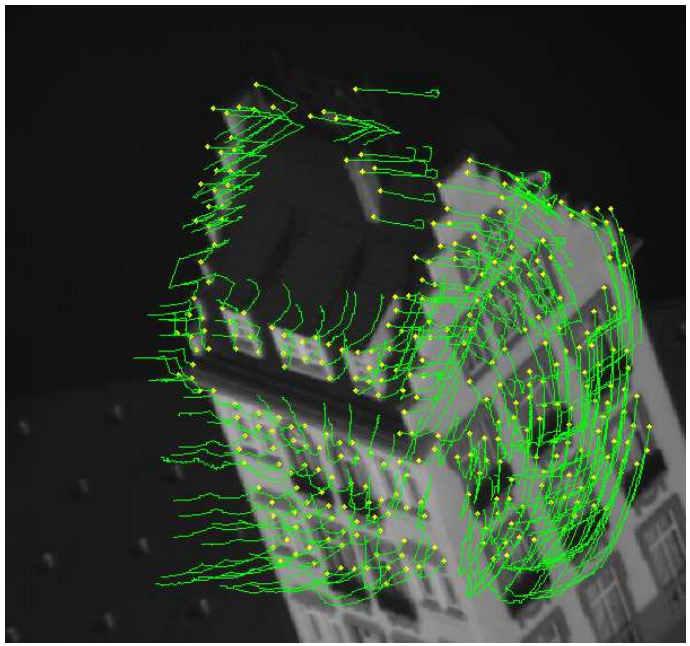
50th

100th

Result



SIFT



KLT

The 2nd Experiment

Input Images

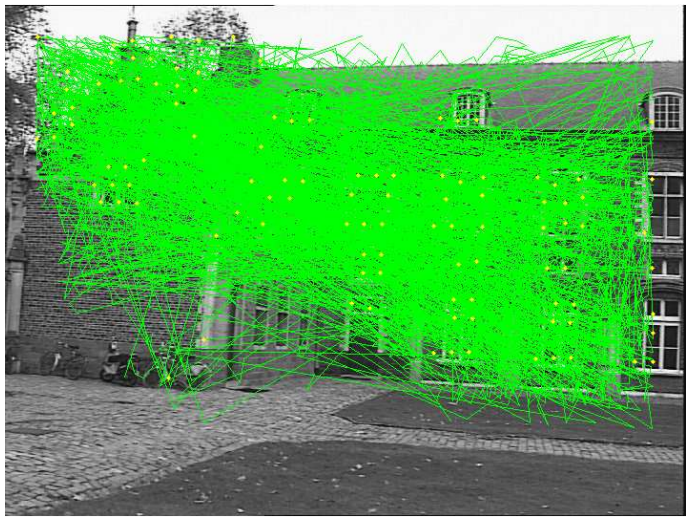
The 1st frame

2nd

13th

Result and comparison with KLT Feature Tracking

SIFT



KLT

Another example of interesting application

Panoramic Image Stiching

Another example of interesting application

Panorama Result

Selected References

(1) D. G. LOWE, *Distinctive image features from scale-invariant keypoints*, International Journal of Computer Vision, 60 (2004), pp. 91–110

(2) C. HARRIS AND M. J. STEPHENS, *A combined corner and edge detector*, In Alvey Vision Conference, (1988), pp. 147–152

(3) C. TOMASI AND T. KANADA, *Detection and tracking of point features*, Carnegie Mellon University Technical Report CMU-CS-91-132, (1991), pp. 1–10

(4) M. BROWN AND D. LOWE, *Recognising panoramas*, In Proceedings of IEEE International Conference on Computer Vision, (2003), p. 1