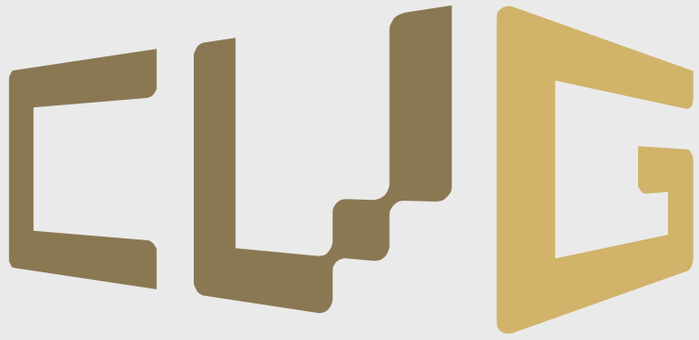


Computer Vision
and Geometry Lab

Computer Vision

Exercise Session 4

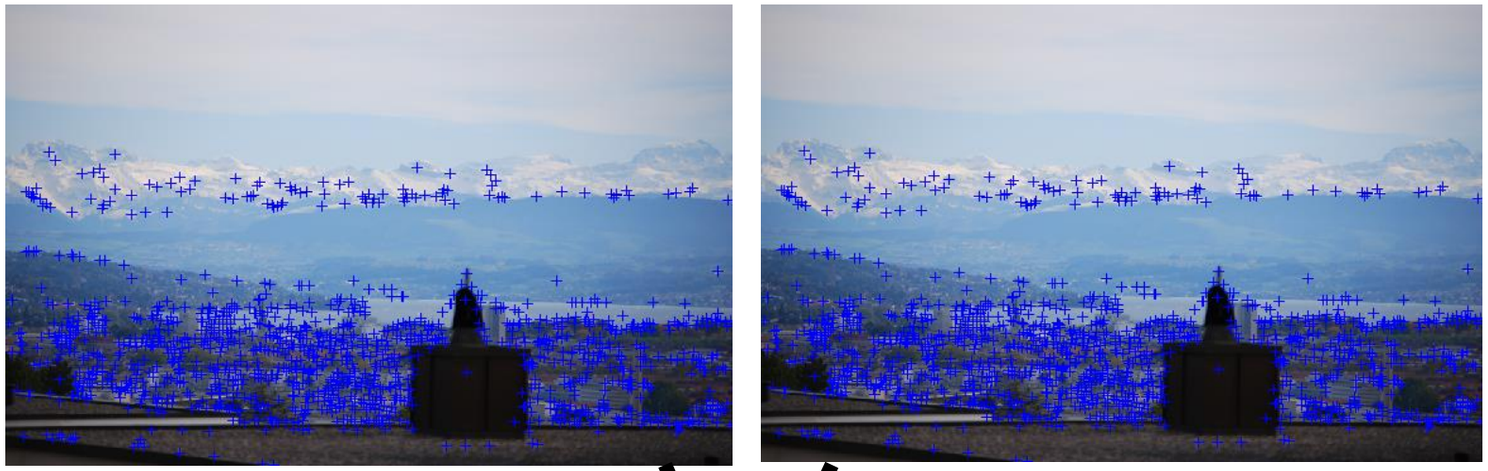
Assignment 4

- 3 Tasks:
  - Feature extraction and matching
  - RANSAC with fundamental matrix estimation (using 8 point correspondences)
  - RANSAC with essential matrix estimation (using 5 point correspondences)

RANSAC

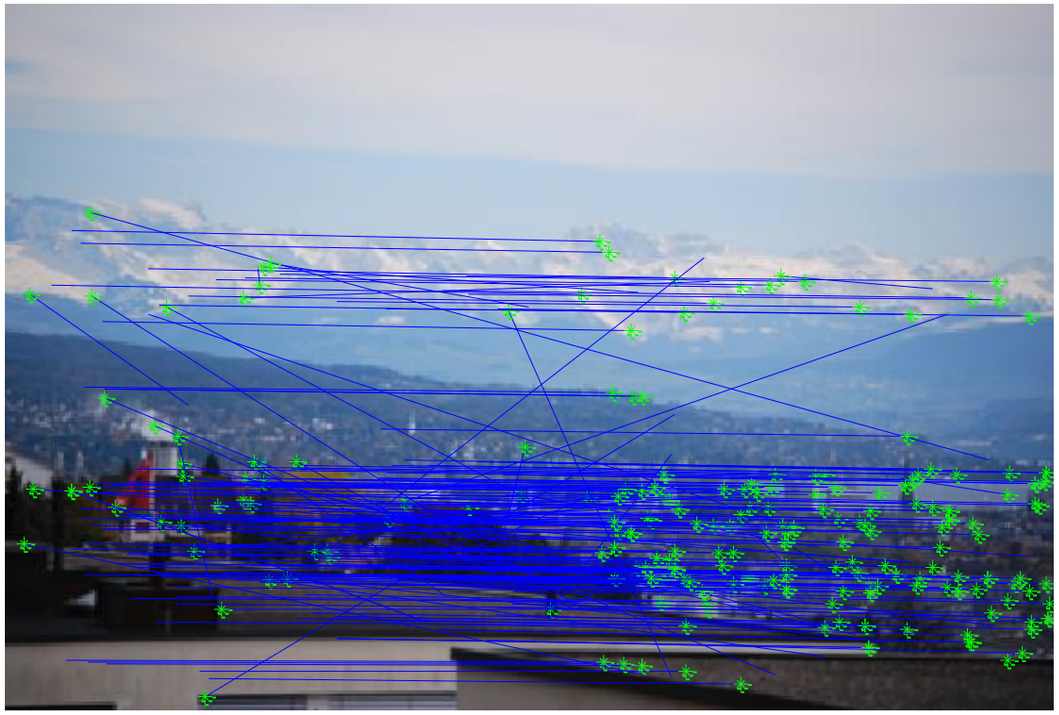
- Tired of clicking these stupid point correspondences?

RANSAC



Detected features

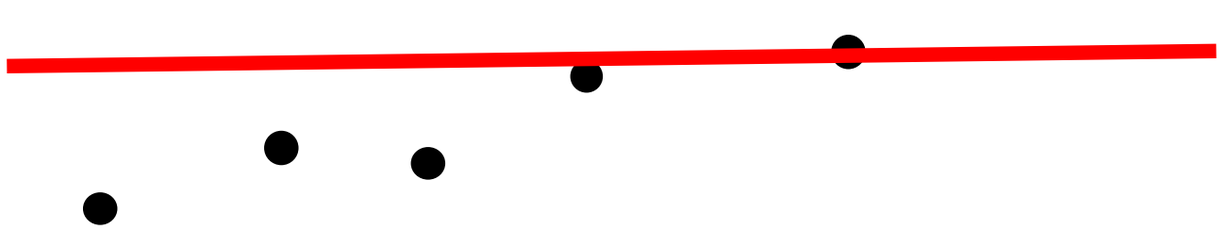
Matched features



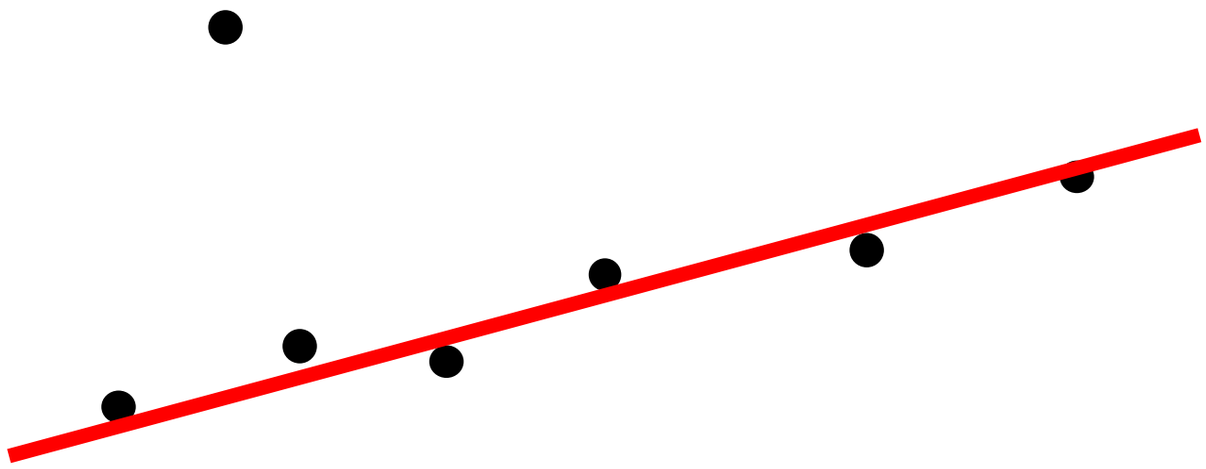
After RANSAC

RANSAC

- Least squares solution is dramatically effected by outliers:



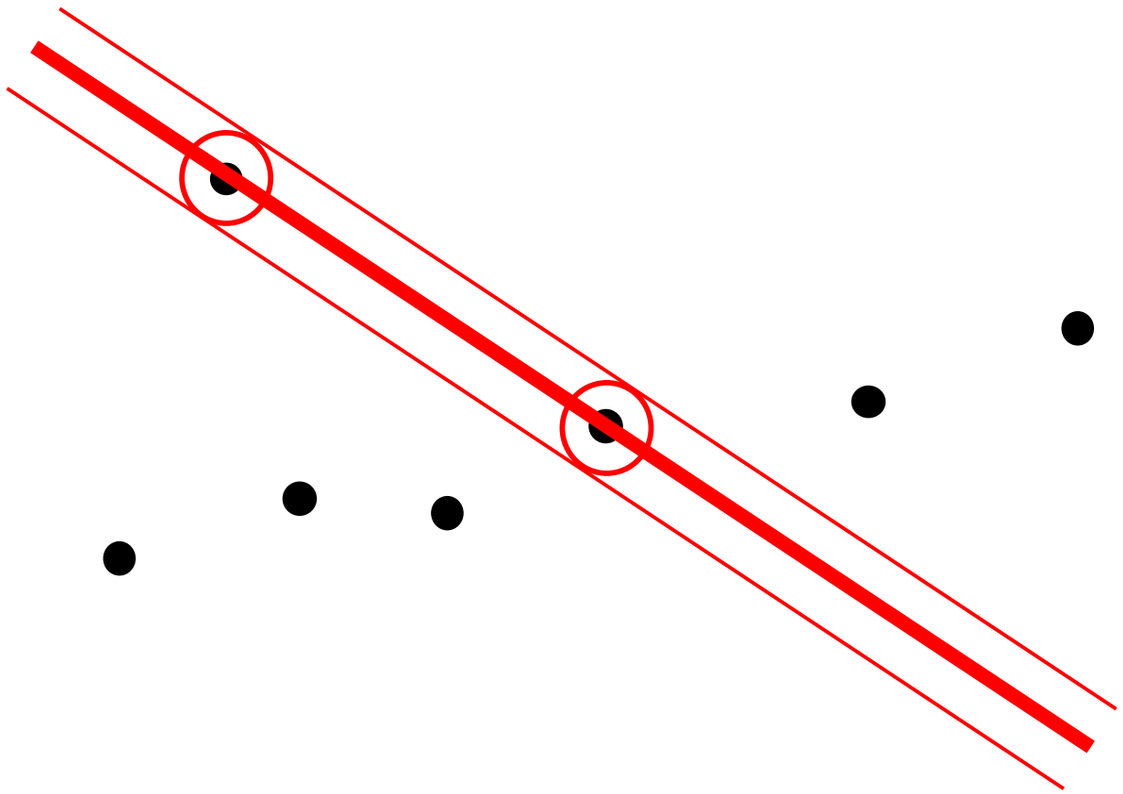
What we want to have:



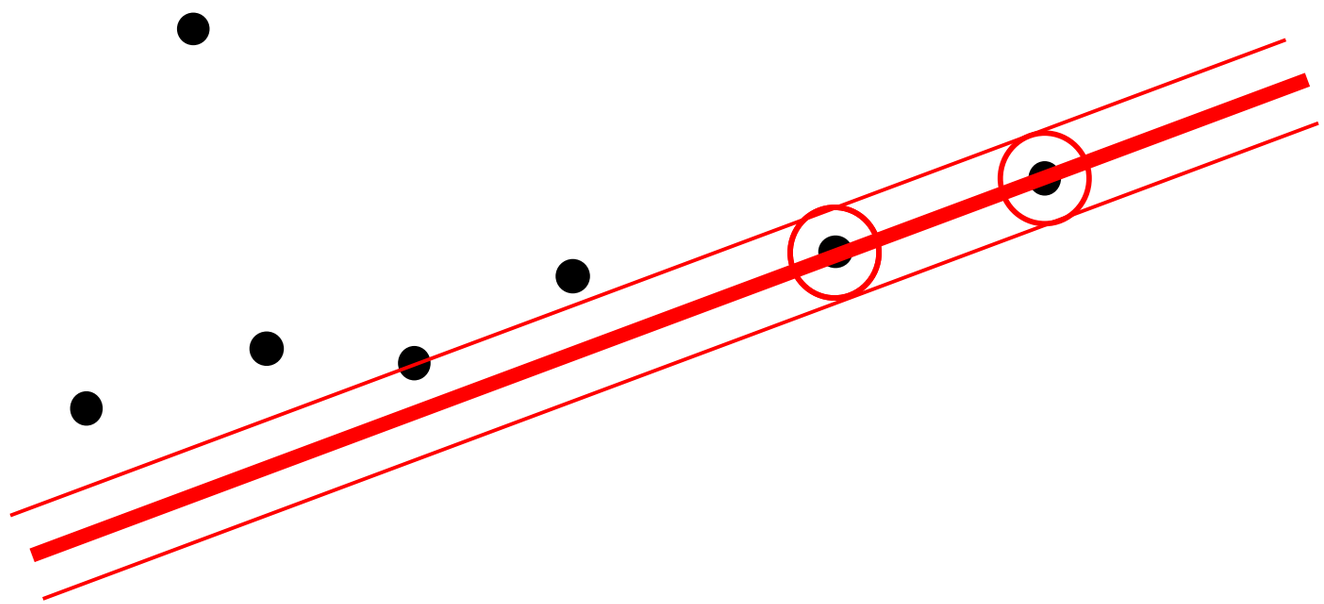
RANSAC

- Algorithm
  1. Guess N points that you hope are inliers.
  2. Compute the solution.
  3. Check how many other points fit within some threshold, i.e. are inliers.
  4. Repeat 1-3 until you're sure the solution has been found.
  5. Take the solution that has the most inliers, and compute least-squares solution from inliers.

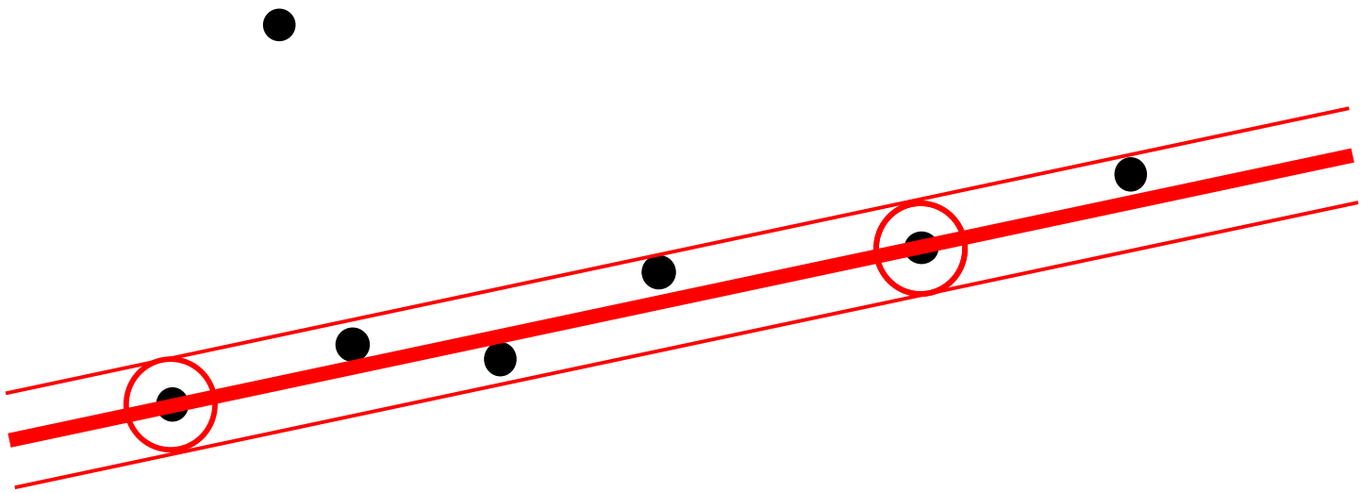
RANSAC



RANSAC



RANSAC



Error measure

- Simple: Point-Line-Distance to epipolar line in both directions
- Slightly better: Sampson distance

$$error = \frac{(\mathbf{x}'^T_i \mathbf{F} \mathbf{x}_i)^2}{(\mathbf{F}\mathbf{x}_i)^2_1 + (\mathbf{F}\mathbf{x}_i)^2_2 + (\mathbf{F}^T\mathbf{x}'_i)^2_1 + (\mathbf{F}^T\mathbf{x}'_i)^2_2}$$

RANSAC

- Probability of having found solution:

$$p = 1-(1-r^N)^M$$

  - r is inlier ratio
  - N is number of samples drawn (i.e. 8 for fundamental matrix)
  - M is number of iterations

- Adaptive RANSAC:
  - Use the largest number of inliers found so far as a lower bound on p
  - Stop iterating once the solution probability lower bound is above 0.99

Estimating the essential matrix

- 5-points algorithm
- Code from Henrik Stewenius
- One function in C
- Use Matlab mex command to compile
- (Binaries for Windows 32-bit and 64-bit are already included)

5-point algorithm

- Result is up to 10 essential matrices
- Chose the „most correct“:
- Compute error to all other point correspondences
- Sum up errors:
  if inlier: error_sum += error
  if outlier: error_sum += error_threshold
- The essential matrix with the smallest error wins

Hand-in

- Assignment 4 should be submitted latest by
  - 1400hrs, 23th Oct 2014
  - fede@inf.ethz.ch