

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

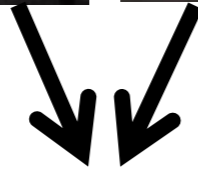
- Tired of clicking these stupid point correspondences?

RANSAC



Detected features

Matched features

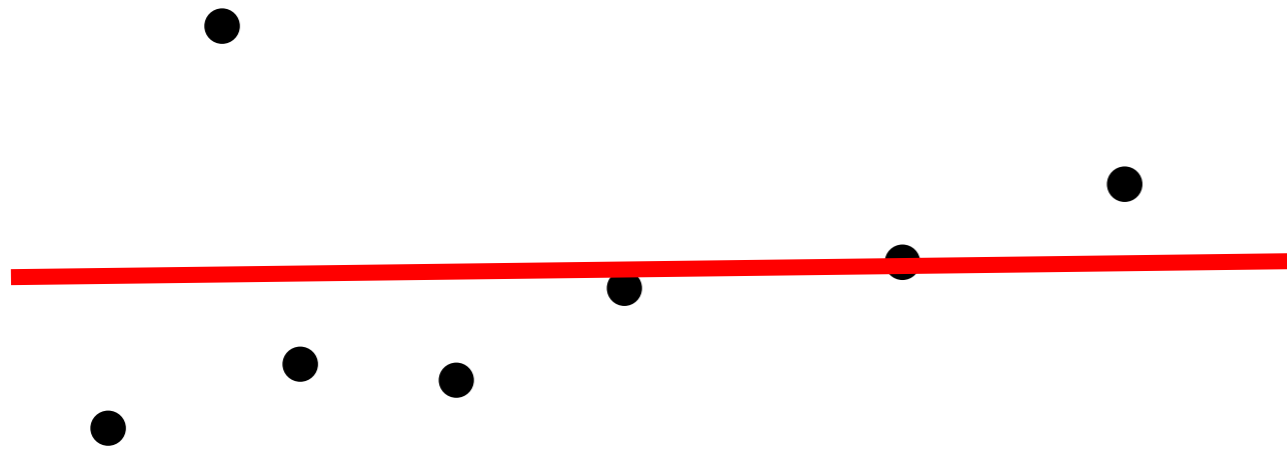


After RANSAC

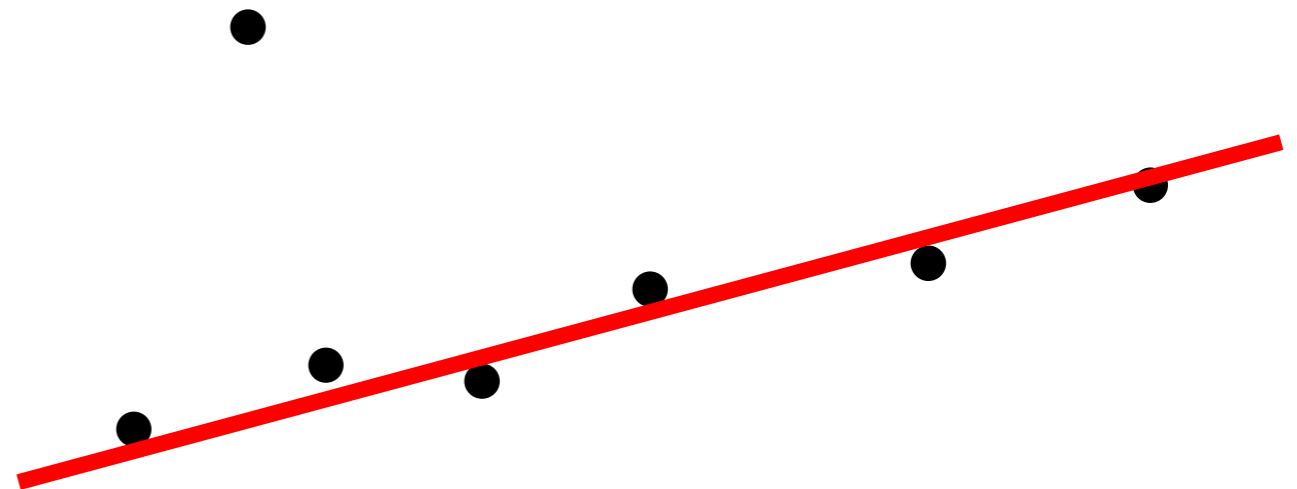


RANSAC

- Least squares solution is dramatically effected by outliers:



What we want to have:

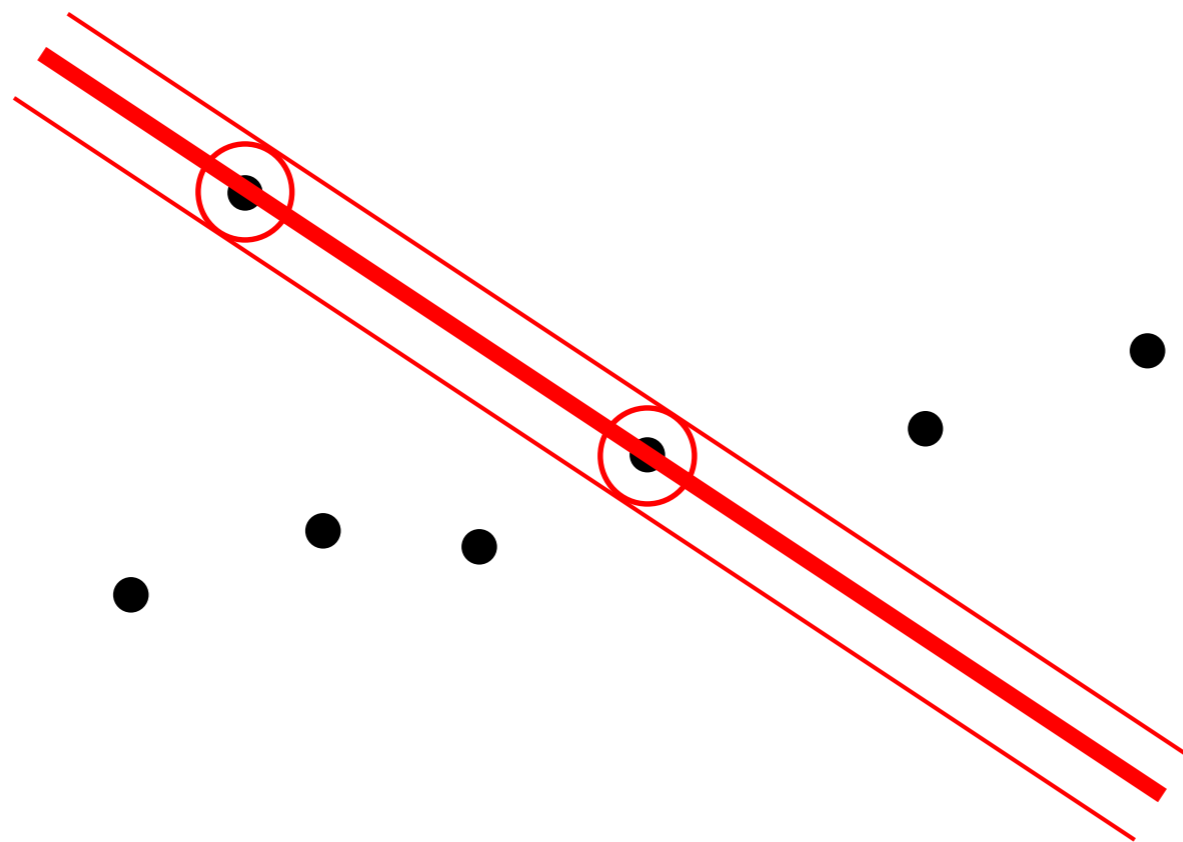


RANSAC

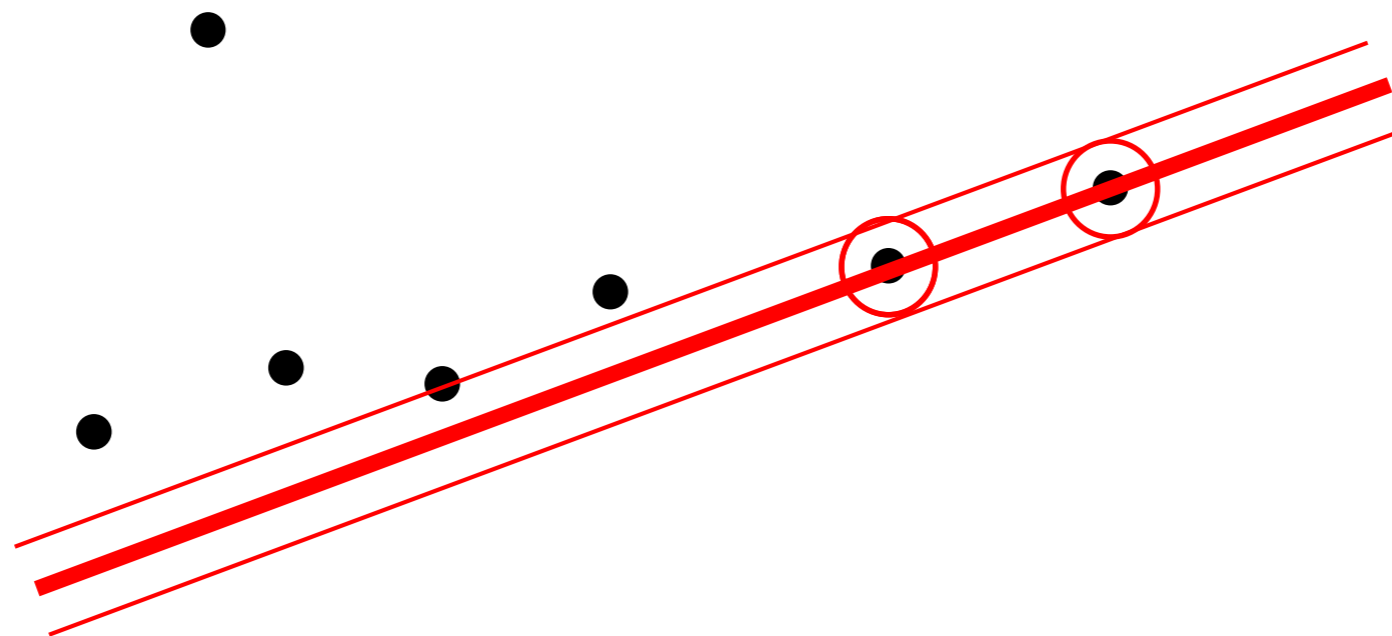
■ Algorithm

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.

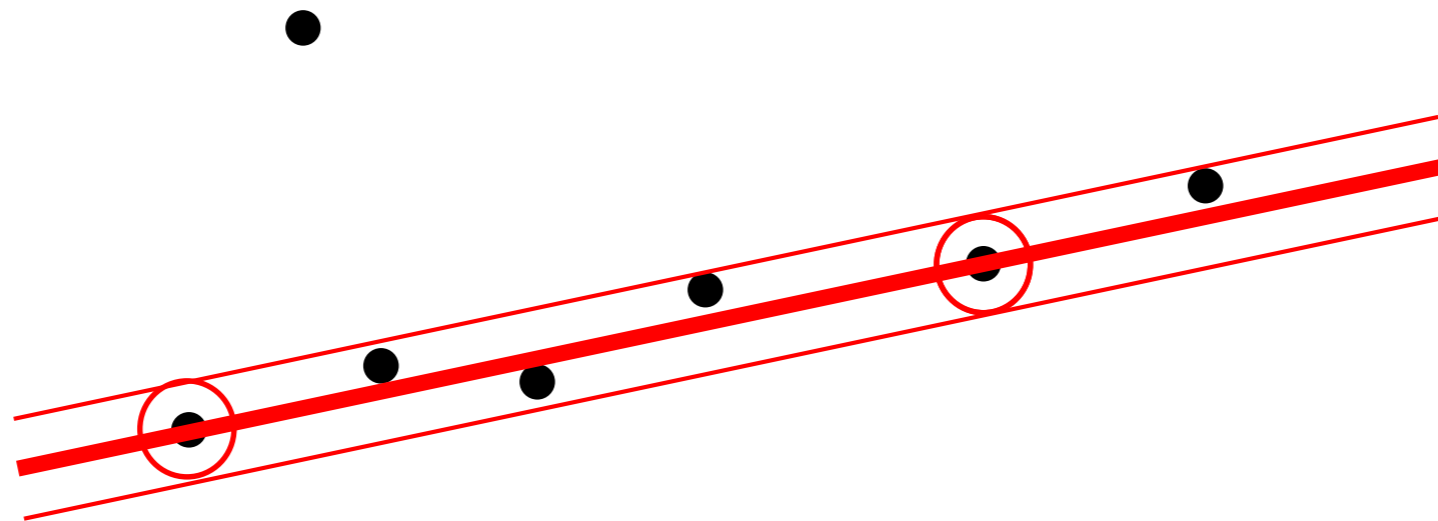
RANSAC



RANSAC



RANSAC



Error measure

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

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

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: $\text{error_sum} += \text{error}$
 - if outlier: $\text{error_sum} += \text{error_threshold}$
- The essential matrix with the smallest error wins

Hand-in

- Assignment 4 should be submitted latest by
 - 1300hrs, 24th Oct 2013
 - Bastien.Jacquet@inf.ethz.ch