Computer Vision

Exercise Session 3

Assignment 3

- 4 Tasks

  - Harris corner detection

  - Image patch extraction

  - Feature matching

  - Comparison with SIFT.

Harris Corner Detector

- Compute intensity gradients in x- and y-direction

- Blur images to get rid of noise

- Compute Harris response

- Threshold the response image

- Apply non-maximum suppression

Image Intensity Gradients

- 1st derivative of image intensities in 2D

- Rate of change of gray scale value at one pixel

- Simplest way, compute:

$$I_x = \frac{p_{x+1,y} - p_{x-1,y}}{2}$$

$$I_y = \frac{p_{x,y+1} - p_{x,y-1}}{2}$$

…or use gradient() in MATLAB

Blurring an Image

- Check the following functions:
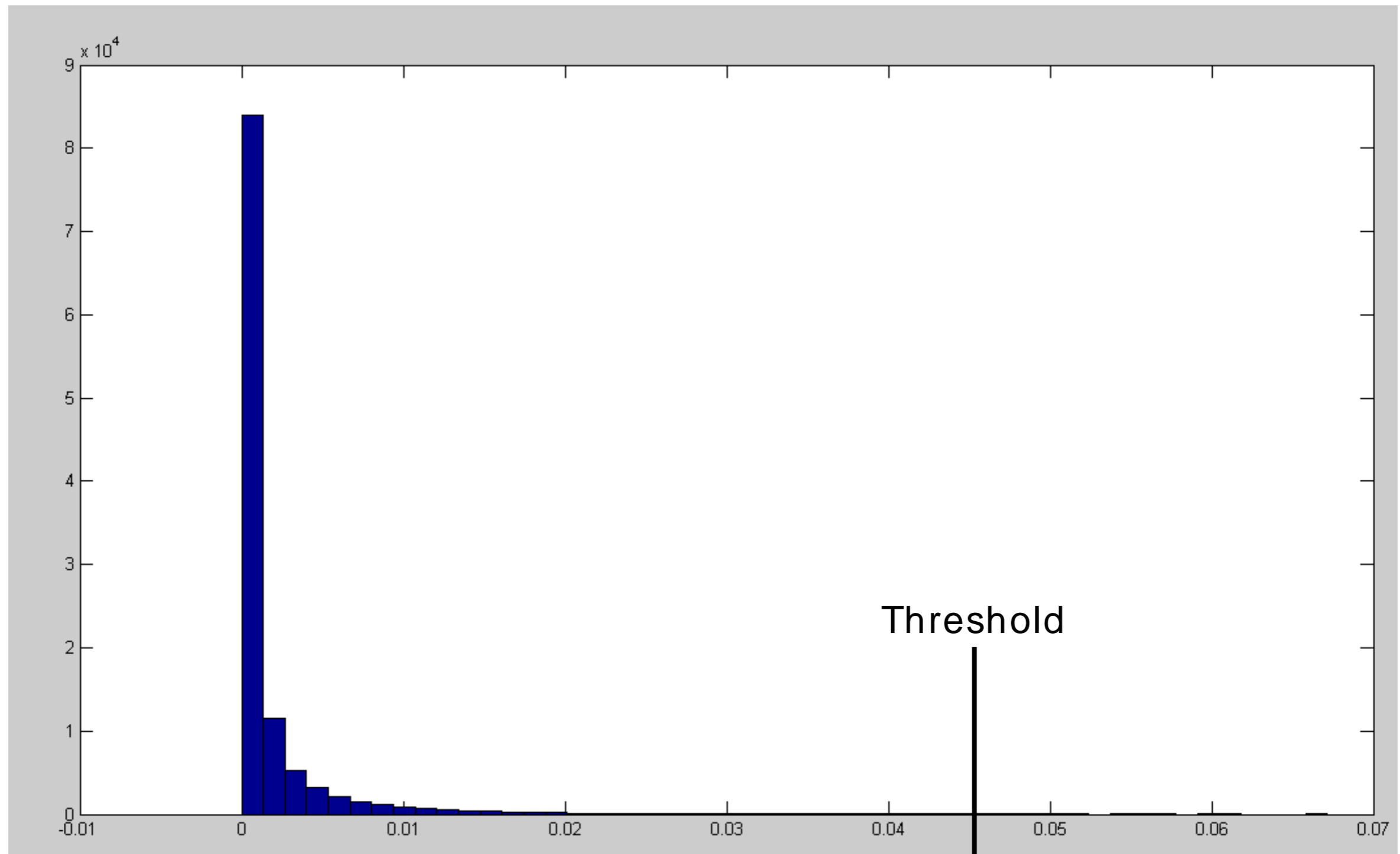 - fspecial('gaussian')
  - imfilter()

Harris Response

- First the Harris Matrix is calculated from the gradients

$$H = \begin{bmatrix} I_x^2 & I_x I_y \\ I_x I_y & I_y^2 \end{bmatrix}.$$
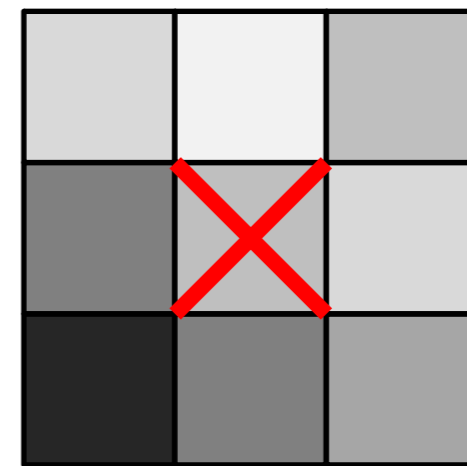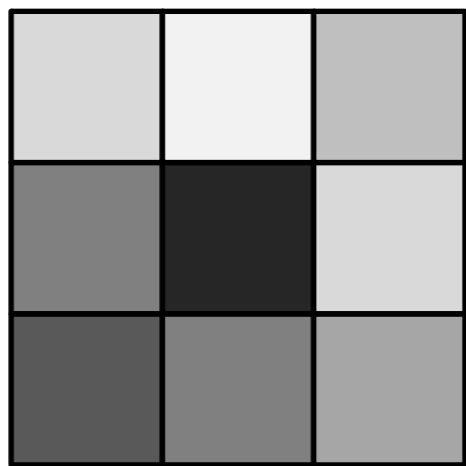
- Using this matrix, the response is given by:

$$K = \frac{det(H)}{trace(H)}$$

Harris Response Histogram

Non-maximum Suppression

- For every pixel above the threshold, check the surrounding pixels inside a window for the maximum response intensity

- If the center pixel response is smaller than a pixel inside the window, remove the center pixel from the corner candidates

Center pixel has maximum response inside window   Center pixel not maximum, suppress

Patch Descriptor

- For each keypoint, extract an image patch of 9x9 pixels and store it as descriptor vector
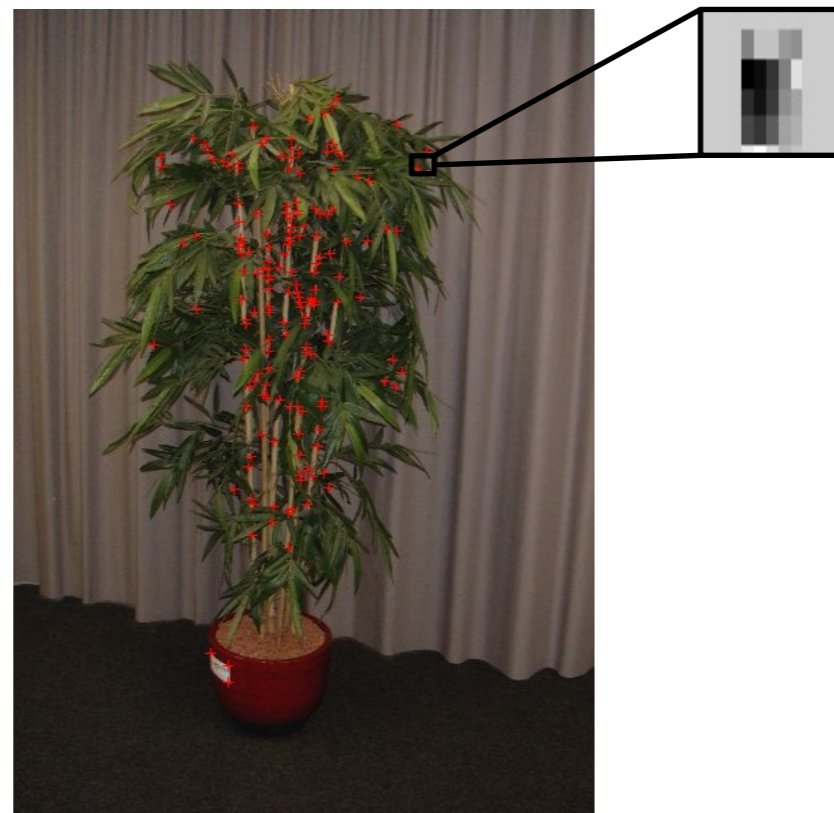
Matching Descriptors

- For each keypoint in one image find the corresponding keypoint in the other image

- Compute the sum of squared differences (SSD) between the two descriptor vectors d_A and d_B

$$ssd = \sum_i (d_{A,i} - d_{B,i})^2$$

- Small differences denote a high similarity

SIFT

- Download and install VLFeat, SIFT feature extractor from Andrea Vedaldi (http://www.vlfeat.org)

- Go through the tutorial and learn how to extract, match and visualize SIFT features

- Compare the result of your implementation with the one obtained using SIFT features

Hand-In

- Write up a short report explaining the main steps of your implementation

- Include images showing the final results

- Include both source code and report in a ex3_your_name.zip file and send it to fede@inf.ethz.ch