

Assignment 2

Submission Deadline: 12.05.21 11:00 am

Topics:

- Image filtering with Gradient of Gaussian (GoG)
- Interest point operator (Förstner)

You are free to use the provided image (*ampelmaennchen.png*) or own photos.

Always use **grayscale images** and scale your input images to be represented in **double-precision floating-point** format with values in the **range [0.0 ... 1.0]**.

Tasks:

A) Gradient of Gaussian (GoG) filtering

- a. Compute continuous GoG-filter kernels for convolution in x - and y -direction.

Example: for standard deviation $\sigma = 0.5$ the two 2D kernels are

$$G_x = \begin{bmatrix} 0.0000 & 0.0001 & 0.0000 & -0.0001 & -0.0000 \\ 0.0002 & 0.0466 & 0.0000 & -0.0466 & -0.0002 \\ 0.0017 & 0.3446 & 0.0000 & -0.3446 & -0.0017 \\ 0.0002 & 0.0466 & 0.0000 & -0.0466 & -0.0002 \\ 0.0000 & 0.0001 & 0.0000 & -0.0001 & -0.0000 \end{bmatrix}, G_y = G_x^T$$

- b. Apply these filters to your input image I to derive two **gradient images**: I_x and I_y (one in x - and one in y -direction). Write a function for the convolution of the image with the kernel and ignore the boundaries of the image for simplicity, i.e. no padding needed (conv2).
- c. Compute and visualize the **gradient magnitude** image G

$$G = \sqrt{I_x^2 + I_y^2}$$

B) Förstner interest operator:

Use the gradient images to identify Förstner interest points in your input image

- a. Compute the autocorrelation matrix M for each pixel using a moving window of 5×5 pixels (use I_x , I_y and ignore the boundaries of the images).
- b. Compute the **cornerness** w and **roundness** q from M for each pixel and store the values in two matrices W and Q . Plot W and Q (imshow, colormap(jet)).
- c. Derive a binary mask of potential interest points by simultaneously applying the thresholds $t_w = 0.004$ and $t_q = 0.5$ on W and Q , respectively.
- d. Plot an overlay of the initial input image with the detected points (plot).