Bauhaus-Universität Weimar

Exercise 2

- Gradient of Gaussian filtering (GoG)
- Förstner interest point operator

You are free to use the provided image (ampelmaennchen.png) or own photos. Please compute **grayscale image** as first step, if there are more than one channels.

A) Gradient of Gaussian filtering (GoG)

a. Compute two GoG-filter masks for GoG-filtering in x- and y-direction (see slides of lectures and assignment session). Example: for $\sigma = 0.5$ the masks 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 the two filters on the input image to derive a filtered image in x- and y-direction (I_x and I_y) using *self-written* code. Ignore the edges of the image (no padding needed).

c. Compute the gradient magnitude image G (just a by-product and not used in further steps)

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

using the filter outputs I_x and I_y. Plot and export the resulting image.

B) Förstner operator:

a. Compute the autocorrelation Matrix M for each pixel using a moving window of 5x5 pixels (ignore the edges of the image).

b. Instead of storing the matrix M for each pixel, compute the cornerness w and roundness q for each pixel from that matrix. The results are two matrices W and Q. Make a plot of these two images.

c. Derive a mask of potential interest points by simultaneously applying the thresholds $t_w = 1.0$ and $t_q = 0.5$ on W and Q, respectively. The result is a mask M_C with pixel values = 1, if $w > t_w \; and \; q > t_q$, and 0 otherwise.

d. Multiply W or Q with the interest point mask $\bar{Q} = Q \cdot M_C$ and use the function "houghpeaks" to derive pixel coordinates of the interest points from $\bar{Q}$.

e. Plot an overlay of the initial input image and the detected points.

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