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WS 15/16
Exercise Sheet 3
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Exercises in Tracking & Detection

Exercise 1 Multi-scale Harris and Harris-Laplace corner detectors

In the lecture you have learned about the multiscale Harris and Harris-laplace corner detectors based on the basic Harris detector.

Basic Harris Detector: The response R is computed by:

$$R(\mathbf{x}, \sigma_{I_n}, \sigma_{D_n}) = det(M(\mathbf{x}, \sigma_{I_n}, \sigma_{D_n})) - \alpha \cdot trace(M(\mathbf{x}, \sigma_{I_n}, \sigma_{D_n}))^2 \tag{1}$$

$$M(\mathbf{x}, \sigma_{I_n}, \sigma_{D_n}) = \sigma_{D_n}^2 g(\sigma_{I_n}) * \begin{bmatrix} L_x^2(\mathbf{x}, \sigma_{D_n}) & L_x L_y(\mathbf{x}, \sigma_{D_n}) \\ L_x L_y(\mathbf{x}, \sigma_{D_n}) & L_y^2(\mathbf{x}, \sigma_{D_n}) \end{bmatrix} \tag{2}$$

Where $L_x(\mathbf{x}, \sigma_{D_n})$ and $L_y(\mathbf{x}, \sigma_{D_n})$ are the first derivatives in x-direction and y-direction respectively on an image smoothed with σ_{D_n}. For this sheet you can use the MATLAB convolve for gaussian smoothing/derivative functions.

a) Implement the multiscale Harris detector with different input parameters determining the scale level n, the initial scale value s_0, the scale step k, the constant factor α and a threshold value t for the Harris response R.

b) Implement the Harris-Laplace detectors as described in the Mikolajczyk et al. 2001 paper "Indexing based on scale invariant interest points", by using the multi-scale Harris detector implemented in a). Use the Laplacian scale selection as presented in Eq. 2. Don't forget to incorporate the scale normalization as described in section 2 of the paper ($F(x, s_n)$ with $s_n = k^n s_0$; $s = s_n$ in Eq. 2).

c) Apply the multi-scale Harris and Harris-Laplace detector on the provided images in the web-page. Adjust the parameters in order to get a similar response to the output images given.

d) Apply the multi-scale Harris and Harris-Laplace detector on the images uploaded with three scale levels n=0, n=7, n=17.