Bauhaus-Universität Weimar

Exercise 4

Topics:

- Filtering in frequency-domain
- Object- /Shape recognition using Fourier descriptors

A) Image filtering

a. Read the input image *taskA.png* and convert it to a grayscale image from data type double with values between 0.0 and 1.0
b. Add Gaussian noise to the image (function *imnoise*, parameters e.g. M=0, V=0.01) and plot the result
c. Filter the noisy image with a self-made (!) 2d Gaussian filter (e.g. $\sigma = 0.5$ → V=0.25) in the frequency-domain and plot the result (*fft2, circshift, ifft2*)
d. Plot the logarithmic centered image spectra of the original image, the noisy image, the Gaussian filter and the filtered image (*imagesc, log, abs* and *fftshift*)

B) Shape recognition

a. Read the image *trainingB.png* and convert it to a grayscale image from data type double with values between 0.0 and 1.0
b. Derive a binary mask (data type *logical*) of the image where 1 represents the object of interest and 0 is background (functions *graythresh* and *im2bw*)
c. Build a Fourier-descriptor D_f based on the binary image of b.
    i. Extraction of boundaries of the binary mask: *bwboundaries*
    ii. Use $n = 24$ elements for the descriptor
    iii. Make it invariant against translation, orientation and scale
d. Apply steps a.-c. on images *test1B.jpg* and *test2B.jpg* in order to identify all potential object boundaries in the images. Note that here more than one boundaries will be identified by *bwboundaries*.
e. Identify the searched object by comparison of the first trained Fourier-descriptor (result of task c) with all identified descriptors of the two test images (result of task d). Use the Euclidean distance of the Fourier-descriptors for identification. E.g., if

$$norm\left(D_{f,train} - D_{f,test}\right) < 0.06$$

➔ $D_{f,test}$ represents the searched object

f. Plot the identified boundaries on your mask (result of task b.) in order to validate the results

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