Assignment 4

Submission Deadline: 12.06.24, 11:00 pm

Topics:

- Filtering in frequency domain
- Shape recognition using Fourier descriptors

A) Image filtering in frequency domain

a. Read the input image `taskA.png` and convert it to a grayscale image (double values between 0.0 and 1.0).
b. Add Gaussian noise to the image (`imnoise`, parameters e.g. M=0, V=0.01) and plot the result.
c. Filter the noisy image with a **self-computed** 2D Gaussian filter in the frequency-domain (`fft2, ifft2`). Which σ is suitable to remove the noise? Plot the result.
d. Plot the logarithmic centered image spectra of the noisy image, the (padded) Gaussian filter and the filtered image (`imagesc`, `log`, `abs` and `fftshift`)

B) Shape recognition using Fourier descriptors

a. Read the image `trainB.png` and convert it to a grayscale image (double 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 represents background (`graythresh` and `im2bw`).
c. Build a Fourier-descriptor D_f based on the binary mask of b.
    i. Extraction of boundaries of the binary mask (`bwboundaries`).
    ii. Use $n = 24$ elements for the descriptor.
    iii. Make the descriptor invariant to translation, orientation and scale.
d. Apply steps a.-c. on the images `test1B.jpg`, `test2B.jpg` and `test3B.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 object of interest by comparig the trained Fourier-descriptor (result of step c) with all identified descriptors of the test images from step d. Use the Euclidean distance of the Fourier-descriptors for identification, i.e.

$$\mathrm{norm}\left(D_{f,train} - D_{f,test}\right) < 0.09$$

f. Plot the identified boundaries on your mask (result of task b.) in order to validate the results (`imshow`, `hold on` and `plot`)

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