WS 2019/20	Exercises Digital Image Processing I	Task No. 10

Discrete Fourier Transform

Task 10.1 *Transformation of the filter from frequeny into the spatial domain*

a) for the frequency domain filter, define the following filter transfer functions:

- Ideal low pass filter
- Butterworth-low pass filter
- Gauss-low pass filter

b) Implement one or more functions such that the matrices [1] generates transfer functions from exercise part a) !

c) Write a function that transforms the filter transfer function from exercise b) into the spatial domain!

d) Write down the function that represents the filter mask of the complex `ComplexImage` object into `GrayImage` objects and also show them on the screen.

e) Generate responses for different values of D_0, σ and n (depending on the type of filter) and show them on the screen. Compare the results for: $D_0 = 5$, $D_0 = 10$, $D_0 = 15$, $n = 2$, $n = 10$, $\sigma = 2$, $\sigma = 5$ und $\sigma = 10$.

The following methods are available in GETLib:

`void inverse_fourier_transform(const ComplexImage& input, ComplexImage& output)`
Perform the inverse Fourier transform on the complex images of the type `<input>` and provide the output as a `<output>`.

`void fourier_center(ComplexImage& image)`
Center the complex value image `<image>` after multiplication with $(-1)^{(x+y)}$.

`void real_part(const ComplexImage& input, GrayImage& output)`
Copy the real value of complex value images `<input>` into the gray value images `<output>`.

`void imag_part(const ComplexImage& input, GrayImage& output)`
Copy the imaginary part of the complex value images `<input>` into the gray value images `<output>`.

[1] The programming environment from exercise of *Digital Image Processing* contains no matrix class. Therefore, the matrix with filter transfer function is to be stored in the image of the type `ComplexImage` . Utilize `ComplexImage` instead of `GrayImage` , In principle the filter transfer function contains complex value while the transfer function of the ideal low pass filter contains only real values.