

# COM-SGN.110 Introduction to Image and Video Processing

## EXERCISE 8

19.11.2020-20.11.2020

The tasks should be completed and presented to TA during the lab session. **Do not forget to upload your solutions to Moodle!** Questions about exercises should be addressed to the TA personally, through Moodle messages or via email, which can be found on the Moodle page of the course.

### 1. Image Blurring

(Hint: If division by values close to zero causes problems, add a small constant value to the denominator.)

- a. Implement a motion blurring filter as follows:

$$H(u, v) = \frac{T}{\pi(ua + vb)} \sin[\pi(ua + vb)] \exp(-j\pi(ua + vb)),$$

where  $T$  is the exposure time of the camera and  $a$  and  $b$  are the total distances covered by the motion of the imaged objects relative to the camera, in time  $T$ , in the  $x$  and  $y$  directions respectively. We will blur the image in the  $135^\circ$  direction (considering the unit circle) by using  $T=1$  and the total distances covered by the motion set to 0.1.

(Hint: Use `meshgrid` to obtain the 2D grid coordinates as follows:

```
[u, v] = meshgrid(-row/2:row/2-1, -col/2:col/2-1);)
```

- b. Apply  $H(u, v)$  to the image *DIP.jpg* to generate a motion blurred image. (Note: filtering in DFT domain, *Ex6\_DFT.pdf* is attached for reference)
- c. Apply inverse filtering to restore the image.
- d. Display the original image, motion blurred image (1b) and the restored image (1c) in a row subplot. Also calculate and display the Mean Squared Error values of the motion blurred and the restored image with respect to the original. (`help immse`)

### 2. Image Restoration via Wiener Filtering

- a. Add noise to the blurred image (1b) with zero mean and a variance of 50. (`help randn`)
- b. Apply simple inverse filtering to the degraded image (2a).
- c. Apply the Wiener filter:

$$\hat{F}(u, v) = \frac{1}{H(u, v)} \left[ \frac{|H(u, v)|^2}{|H(u, v)|^2 + \frac{S_n(u, v)}{S_f(u, v)}} \right] G(u, v)$$

- d. Display the degraded image (2a), result of inverse filtering(2b) and the result of Wiener filtering (2c) in a row sub-plot.
- e. Explain why simple inverse filtering generally cannot recover problems such as in Task 2a.
- f. What would the restoration using the Wiener Filter look like if, as in most cases, you do not know  $S_n$  and  $S_f$ . Show results using three different values of  $k$  ( $= S_n/S_f$ ). Compare to 2c.