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WS 15/16
Exercise Sheet 2
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Exercises in Tracking & Detection

Exercise 1 Median Filtering

As you have learned in the lecture, the median filter removes image noise by sorting the image values of a local region and assigning the median of the sorted values to the center of the filter.

a) Implement a Matlab function that applies the median filter to an image. The size of the considered region has to be parameterizable.

b) Implement a Matlab function that is able to add different types of noise to an image. Implement the following two types of noise:

- Gaussian noise
- salt-and-pepper noise

c) Apply the Gaussian filter, implemented in the last exercise, and the median filter to images corrupted by Gaussian noise and salt-and-pepper noise, respectively. Which one works better for which type of noise?

Exercise 2 Bilateral Filtering

In the lecture you have learned about non-linear range filtering (see Eq. 1):

$$s(\xi, v) = e^{-\frac{1}{2}\left(\frac{\delta(I(\xi), I(x))}{\sigma_r}\right)^2} \tag{1}$$

with $\delta\left(I(\xi), I(x)\right) = \|I(\xi) - I(x)\|$ and σ_r the desired amount of combining pixel values. The bilateral filter is an edge-preserving smoothing filter which combines domain filtering and range filtering. Please refer to the slides of the lecture and answer following questions.

a) Implement a bilateral filter with a filter mask of size $3\sigma \times 3\sigma$ pixels.

b) Apply this filter on the Lena image with $\sigma = 1.0$, $\sigma = 5.0$ and $\sigma = 10.0$. What can you see?

c) Compare the bilateral range filter to normal Gaussian smoothing with $\sigma = 1.0$, $\sigma = 5.0$ and $\sigma = 10.0$. What is the difference?

d) Can you implement the bilateral filter with simple convolution masks? Why or why not?

e) State the difference between domain filter and range filter.