Technische Universität München
Fakultät für Informatik
Dr. Slobodan Ilic

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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 two different 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):

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

with $\delta(I(\xi), I(x)) = \|I(\xi) - I(x)\|$ and σ_r the desired amount of combining pixel values. 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.