Exercises on MMDB
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Exercise 4

Topic: Image Processing Part 2

Aufgabe 1: Point Operations

In this exercise, we assume that we are using an 8-Bits grayscale image. The HK point operation is defined as follows:

$$P_{output} = \alpha.P_{input} + \beta$$

P_{input} and P_{output}: Pixel values of the input and output image respectively.

1. How do the parameters α and β influence the result of the operation?
2. Explain which HK operation could be applied to implement the image inversion function.
3. Which problems could appear, if HK is used with unadapted α and β parameters? Propose a method to deal with these effects.
4. Let G be a grayscale image with minimum pixel value a and maximum pixel value b. Which HK Operation could be applied to G in order to maximize its contrast ratio?

Aufgabe 2: Linear filter

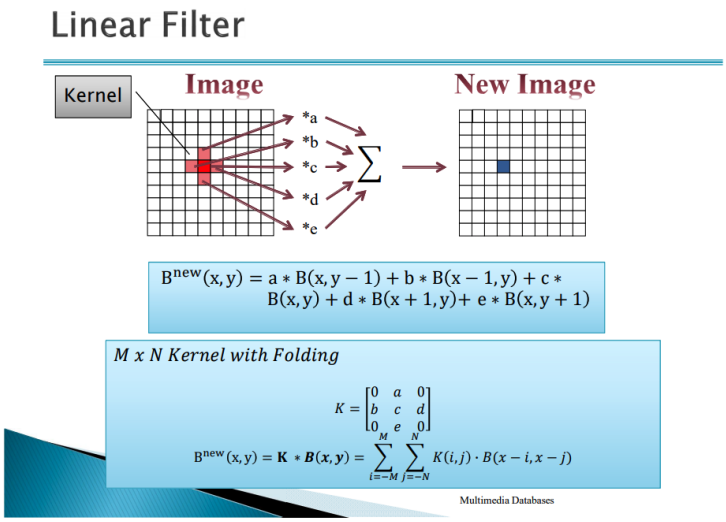

Abbildung 1: Convolution

Figure 1 describes the region processing operation called *(*convolution). The application of the operation on all pixels of an image defines a linear filter.

1. Which problems can occur to edge pixels when using this filter? Propose possible approaches to deal with these problems.

2. A smoothing filter can be implemented using a linear (convolution) filter and a well-chosen kernel. For this purpose calculate a 5x5 kernel for the 'moving average' variant of the smoothing filter, in which a pixel is replaced by the average values of its neighbours.

3. Weighted smoothing: in this case pixels which are closer to the target pixel get higher coefficients. The coefficients can be calculated using 2D-functions, see for example:

   - the pyramid-area-function:

     $$f(x, y) = -\alpha.max(|x|, |y|) + k$$

     x and y designate the distance to the target pixel on the x and y axes, α is a parameter of the function and k a constant which you add for creating positive values.

   - the conical area function:

     $$f(x, y) = -\alpha.\sqrt{x^2 + y^2} + k$$

   Calculate the coefficients of a 5x5 kernel for these 2 cases with $\alpha = 2$. Select an adequate k so that the smallest coefficient is equivalent to zero, and round the values to get integers.

4. Why are laplacian filters used? Give an example.