Report Blatt 1

Alexander Attinger

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1 Excercise 1

2 Exercise 2

2.1 Smoothing

In this exercise we are presented with two images of the same scene. Artificial noise has been added to both images, in image one, it looks like it was white noise, whereas in image 2 it looks more like a salt-and-pepper kind of noise. Smoothing or blurring is a frequently used technique to reduce noise in an image. There are different kind of filters. We were asked to use and compare three: Gaussian Blur, Median Blur and normal Blur.

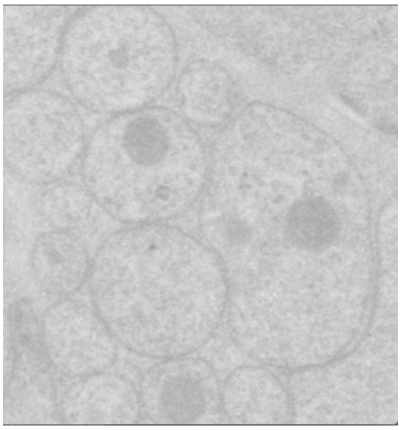
Blur The blur filter or normalized box filter is the most simple linear filter. Each output pixel is just the mean of all $n * n$ pixel surrounding it.

Gaussian Blur Another frequently used linear filter. The value of each output pixel is now determined by the weighted mean of its neighbours. The weights are determined by a bivariate gaussian distribution.

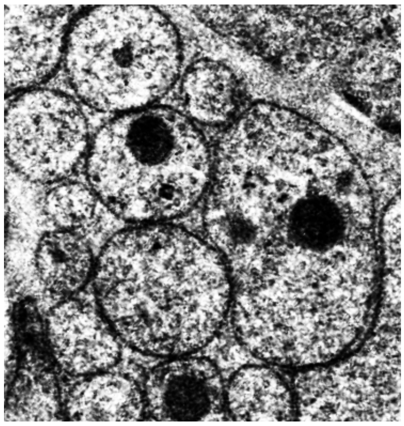
Median Blur The median blur is a non linear filter, since the computation of the median is a non-linear operation. The value of an output pixel is determined by the median of its surrounding neigbours.

2.2 Applying the filters

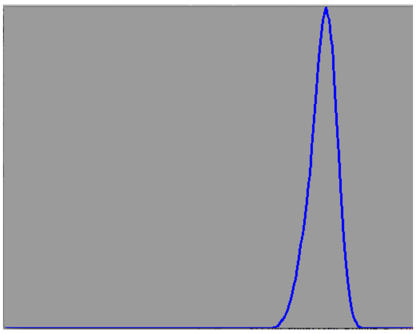
The results of applying the normalized box filter can be seen in 4. I used the function *blur* of the OpenCV API to apply blur filters of different kernel size. Only the images for the 3x3 and the 9x9 kernels are shown. Similarly, the application of the gaussian filter can be seen in **??**, and the results of the median filters is shown in **??**.



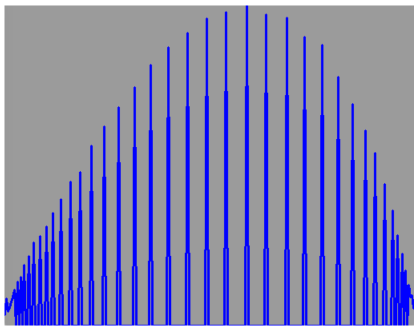
(a) "Original Image"



(b) "After hist. equalization"



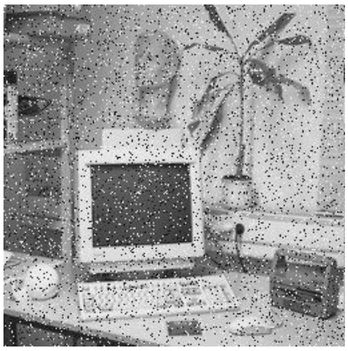
(c) "Histogram of original



(d) "Equalized Histogram"

Figure 1: Histogram Equalization. Image of neurons before and after histogram equalization. The contrast is markedly improved.

(a) "Original Image 1"



(b) "Image 2"

(c) "Blur filter Im 1 5x5"

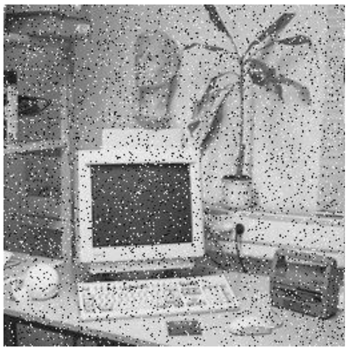
(d) "Blur filter Im 2 5x5"

(e) "Blur filter Im 1 9x9"

(f) "Blur filter Im 2 9x9"

Figure 2: Comparison of different filter kernel size for blur filter.

(a) "Original Image 1"



(b) "Image 2"

(c) "Gaussian Blur filter Im 1 5x5"

(d) "Gaussian Blur filter Im 2 5x5"

(e) "Gaussian Blur filter Im 1 9x9"

(f) "Gaussian Blur filter Im 2 9x9"

Figure 3: Comparison of different filter kernel size for Gaussian blur filter. The 3x3 kernel works very good in reducing the artificial noise of image 1. However, the filter does not work well for image 2 with a different kind of noise

(a) "Original Image 1"

(b) "Image 2"

(c) "Median filter Im 1 3x3"

(d) "Median filter Im 2 3x3"

(e) "Median filter Im 1 9x9"

(f) "Median filter Im 2 9x9"

Figure 4: Comparison of different filter kernel size for median filter. The median filter with kernel size 3x3 works very well to reduce the noise in image 2, where the gaussian and the blur filter failed.

(a) "Original Image" (b) "Laplace Transformation" (c) "Difference"

Figure 5: Laplace Transformation. The office image before and after subtraction of the laplacian transformation of the image. The laplacian transformation of the intensity calculates the second derivative and can be used to detect edges.

2.3 The Laplacian

Edge detection is a very important and frequently encountered problem in image processing. Detecting edges in visual scenes seems to be a very trivial task for us. But what actually "makes" an edge? If we look at the pixel intensity of an image, edges are characterized by a very fast change of intensity over space. If we look at the one dimensional case and model pixel intensity by $I(x)$, finding edges corresponds to finding maximas in $\dot{I(x)}$ There are several ways of detecting edges in images,