Technische Universität Berlin

Computer Vision &
Remote Sensing

Prof. Olaf Hellwich

Examination

Digital Image Processing

Summer term 2011

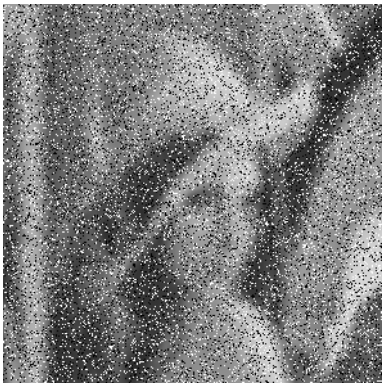
Name: ..... **Student ID:** .....

Duration: 1 hour **Auxiliary material:** None

Berlin, July 12, 2011

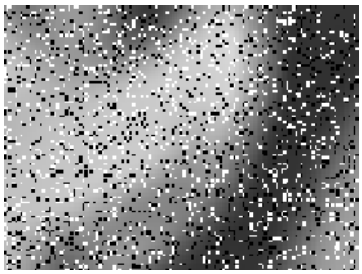
1 Image restoration 10P

Figure 1a) shows an image acquired by a defect camera, while figure 1b) shows an image of the same scene, but acquired with a functional camera. Figures 1c) and d) show a small image area more detailed.



a)

b)



c)

d)

Figure 1

a) Name the visible image degradations. (2P)

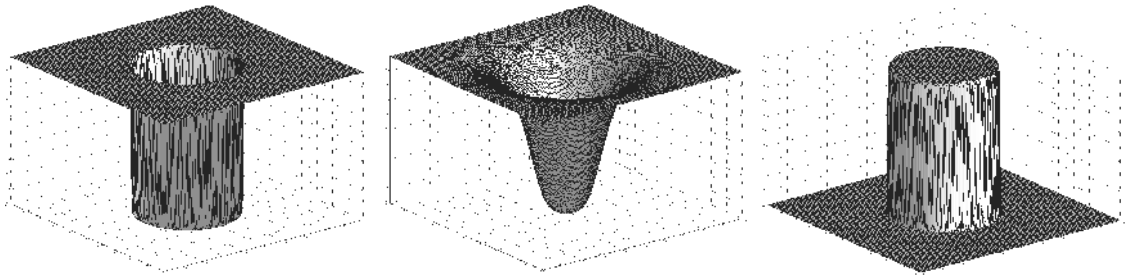
b) State and explain the signal-model used by the Wiener filter. (2P)
Why would the Wiener filter not lead to satisfactory results, when applied to the image in figure 1a)? (1P)

c) Explain a reasonable pre-processing step to suppress at least one of the image degradations. (3P)

d) An often made assumption is, that noise in images follows a Gaussian distribution. Give reasons why this assumption is advantageous as well as reasonable. (2P)

2 Convolution 11P

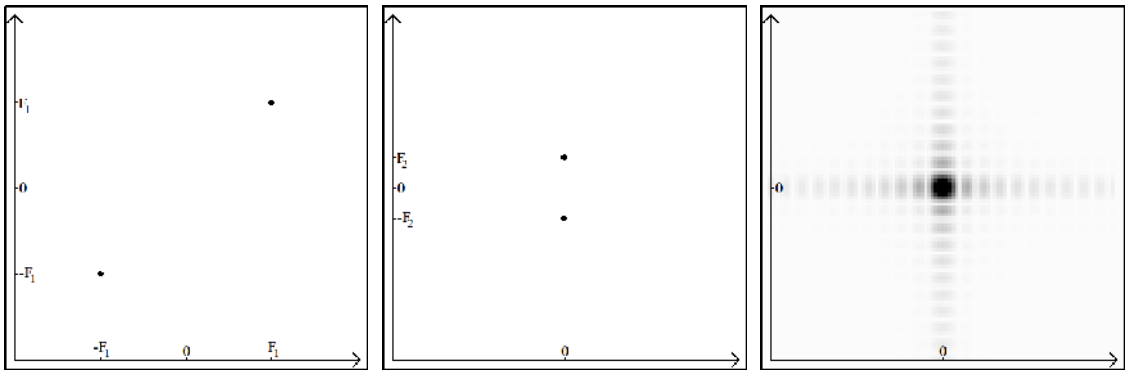
a) As stated by the convolution theorem, a convolution in spatial domain is equivalent to a multiplication in the frequency domain. Nevertheless, when should the first be preferred over the latter? (2P)



a) b) c)

Figure 2

b) Figures 2a) - c) show amplitudes of three different filter spectra. Which of those filters should be used to enhance edges within an image? (1P)
Briefly explain your decision for each of the three filters. (3P)



a) b) c)

Figure 3

c) Figures 3a) - c) show the amplitude spectra of three different images. The axes of the different plots are identically scaled, the origin is at the center, black corresponds to high values, white corresponds to zero. Sketch the corresponding images. (5P)

3 Interest Points 12P

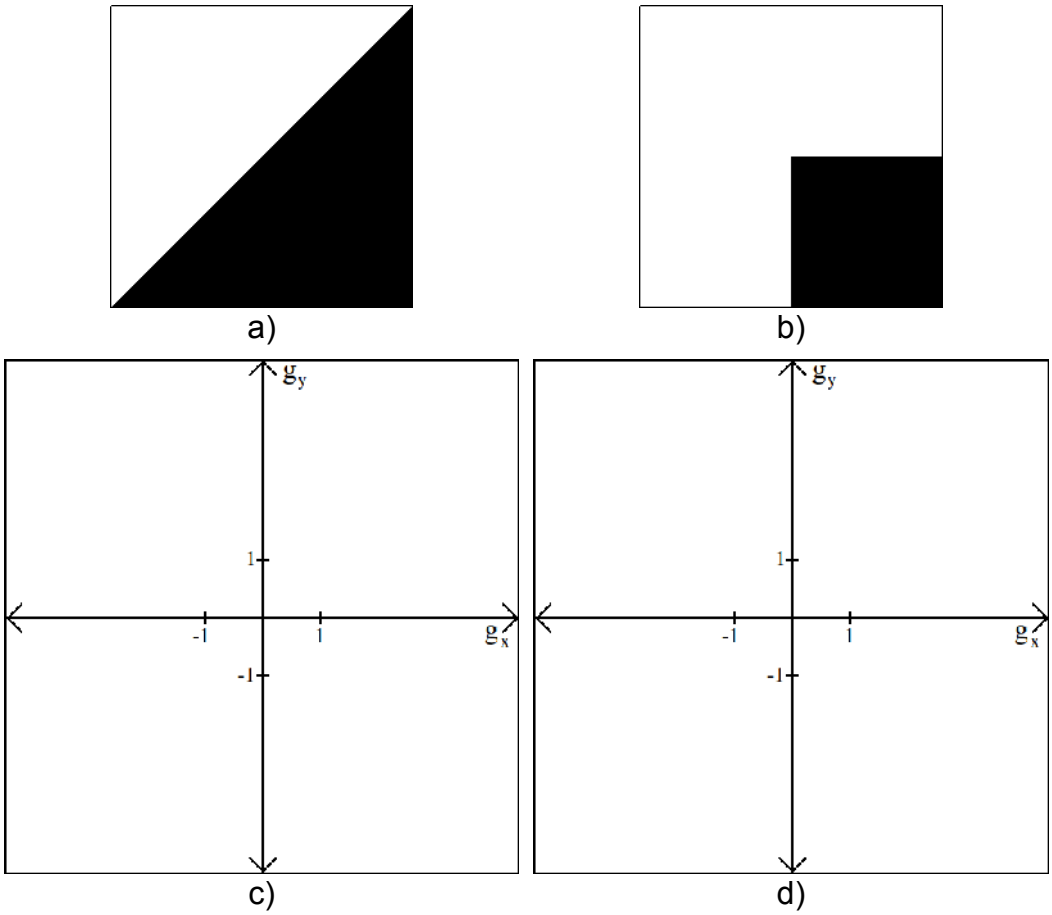


Figure 4

a) Define mathematically or otherwise two filter kernels to calculate directional gradients in x- and in y-direction, respectively. (2P)

b) Sketch the distributions of gradient vectors if the filters defined in 3a) are applied to the images shown in figures 4a) - b). (4P)
Use the coordinate systems given in figures 4c) - d), where g_x denotes the gradient in x-, and g_y denotes the gradient in y-direction, respectively.

b) Explain how to apply the Harris/Plessey interest point operator to a grey-scale image. (6P)

A total of **33 points** can be attained.
Good Luck!