Technische Universität Berlin

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Digital Image Processing

Exercise 04

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1 Theory

1. **What is the ringing effect in the context of image filtering? How is it caused and how can it be avoided?**

   The ringing effect is caused by filtering an image with an ideal low-pass filter (which has side-lobes in the time-domain). The resulting image shows ripples. To avoid these behavoir, the butterworth low-pass filter is used, which has no side-lobes in the time-domain.

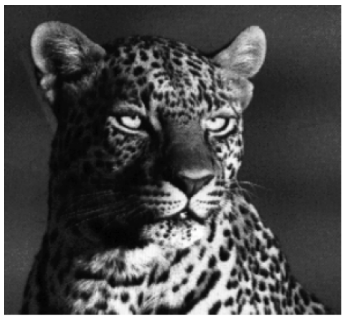
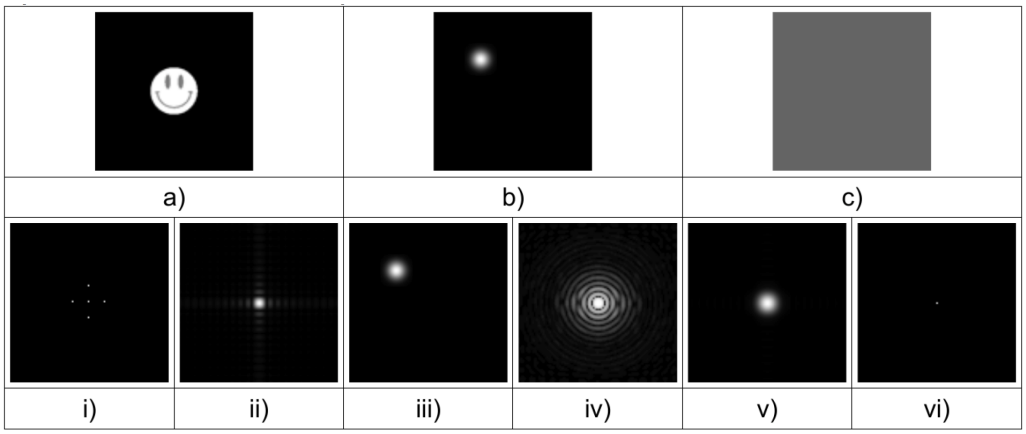


Figure 1: Original image

Figure 2: Filtered image

2. **Figures a)-c) show three different images, while Figures i)-vi) depict the amplitude of six different Fourier spectra. State which of the given spectra corresponds to which of the images. Note: A spectrum can be assigned multiple time and not all spectra have to be used.**



   (a) This image can be approximated by an ideal low-pass filter. The spectrum of this filter is described by a spectrum with side-lobes (iv).

   (b) A gaussian in the time-domain is described by a gaussian in the frequency domain centered in the middle of the frequency image (v).

   (c) A homogenous image has no frequencies, i.e. the spectrum shows only the offset at position (0,0) (vi).

Image Sources

- *Figure 1*: Digitial Image Processing - Lecture Sheet 04 - Page 61
- *Figure 2*: Digitial Image Processing - Lecture Sheet 04 - Page 61