Assignment 7

Deadline: Tuesday, 10.01.2011

Assignment 7.1 (26 Points)

Perform a Fast Fourier Transformation on a **grey-scale** image of the university campus (http://www.it.uni-hildesheim.de/apps/de/webcam.htm) using the method imgFFT which is shipped with the R package *biOps*. Then,

a) [2 Points] write a method that creates a plot of a power spectrum of your image without using methods shipped with the biOps package. Compare the result of your power spectrum with the one resulting from imgFFTSpectrum. **Hint:** *Use the base methods Im and Re to get the imaginary and real parts of complex numbers.*

b) [2 Points] Why is it equivalently fine to centre power spectra such that the frequency origin (0,0) is in the centre of the power spectrum as it is typically done, (e.g. in the imgFFT method) instead of keeping the origin (0,0) in the lower left corner ?

c) [2 Points] write a method that creates a plot of the phases without using methods shipped with the biOps package. Compare the result of your power spectrum with the one resulting from imgFFTPhase. **Hint:** *Use the base method Arg to get the argument/phase of complex numbers.*

d) [12 Points] create a filter, that passes only high frequency values, i.e. those frequencies which are larger than 20, 40, 80, on the power spectrum. Then, perform an inverse Fourier transform using imgFFTInv and plot the resulting images. Do the same high pass filter for the phases but use frequency thresholds 4, 10, and 20. Plot the resulting images. Compare all six images and explain the differences.

e) [2 Points] create a filter, that passes only frequencies on the x-axis that are larger than 20, 40, 80. Then, perform an inverse Fourier transform using imgFFTInv and plot the resulting images.

f) [2 Points] create a filter, that passes only frequencies on the y-axis that are larger than 20, 40, 80. Then, perform an inverse Fourier transform using imgFFTInv and plot the resulting images.

g) [2 Points] compare the images resulting from e) and f) and explain the differences.

h) [2 Points] What are the two key ideas used by the FFT algorithm? Explain them in your own words.