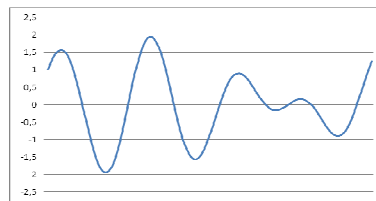


Assignment 6

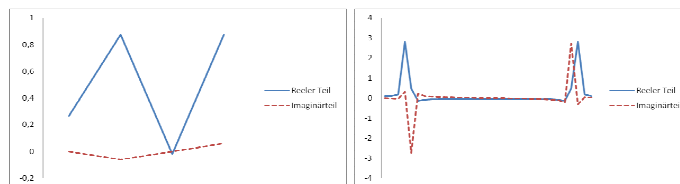
Deadline: Tuesday, 20.12.2011

Assignment 6.1 (10 Points)

- a) [3 Points] Consider the following signal of length 1 second:



If we are sampling the signal with different frequencies: 32 Hz and 4 Hz. How many observations do we have? Which of the following Fourier spectra corresponds to which sampling frequency?



- b) [2 Points] For which case is the sampling frequency sufficient? Considering both spectra, is it possible to determine whether we have aliasing or not?
- c) [5 Points] How shall we set the sampling frequency in general? Which of the following sampling frequencies would be appropriate for the above signal? Explain your selection.

2 Hz, 50 Hz bzw. 64 Hz

Is it in general possible to determine good sampling frequencies if we have (have not) the Fourier transform of the continuous signal?

Assignment 6.2 (10 Points)

- a) [5 Points] Implement the Fourier transform for a one-dimensional, discrete signal according to: (1) its cached, naive version and (2) its faster version of the FFT.
- b) [3 Points] Compare both versions with respect to their runtime. What is their theoretical runtime complexity? What is their empirical runtime in seconds of a signal of length i) 8192 ii) 8193 and iii) 8194?
- c) [2 Points] Why is it that discrete signals with different signal lengths also have different runtime gains?