# Homework 10

**Problem 1 Problem 1 (5 points):**

Have a look at the particular realization of the $N$ point forward DFT with the omitted normalization coefficient:

$$C_n = \sum_{k=1}^{N} y_k \exp(-i2\pi(k-1)n/N)$$

Analytically prove that the forward discrete Fourier transform is periodic, i.e., $c_{n+N} = c_n$. Note: recall that $\exp(\pm i2\pi) = 1$.

Does this also prove that $c_{-n} = c_{N-n}$?

**Problem 2 Problem 2 (5 points):**

Use proof for the previous problem relationships and show that the following relationship holds for any sample set which has only real values (i.e., no complex part)

$$c_n = c^*_{N-n}$$

Where $^*$ depicts the complex conjugation.

**Problem 3 Problem 3 (10 points):**

Load the data from the file 'hw_data_for_filter.dat' provided at the class web page. It contains a table with $y$ vs $t$ data points (the first column holds the time, the second holds $y$). These data points are taken with the same sampling rate.

(a) (2 points) What is the sampling rate?

(b) (3 points) Calculate forward DFT of the data (use Matlab built-ins) and find which 2 frequency components of the spectrum (measured in Hz not rad$^{-1}$) are the largest. Note, I refer to the real frequency of the sin or cos component, i.e., only positive frequencies.

(c) (2.5 points) What is the largest frequency (in Hz) in this data set which we can scientifically discuss?

(d) (2.5 points) What is the lowest frequency (in Hz) in this data set which we can scientifically discuss?