Laboratory Work #01
DIGITAL SIGNAL PROCESSING (DSP)

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1. Writing a MATLAB program to compute 128-point DFT of the following sequence, you must firstly use DFT definition (directly computing DFT) to compute and use MATLAB function to test the result. Plot the two results in one figure.

$$g[n] = \sin(\pi n / 4), 0 \le n \le 31$$

2. Write a MATLAB program to compute and plot the frequency response of a LTI discrete-time system with a transfer function given by

$$X(e^{j\omega}) = \frac{0.15(1 - e^{-j2\omega})}{1 - 0.5e^{-j\omega} + 0.7e^{-j2\omega}} \quad ,$$

for $0 \le \omega \le \pi$.

3. Writing a MATLAB program to compute the linear convolution of two length-N sequences. Using this program to determine the following pair of sequences:

$$g[n] = \cos(0.2\pi n), \; h[n] = 3^n \quad 0 \le n \le 10 \quad ,$$

and plot the result sequence.

4. Try to give a program to evaluate the following DTFT in the range: $0 \le \omega \le \pi$

$$X(e^{j\omega}) = \frac{1.35 + 4.95e^{-j\omega} + 8.55e^{-j2\omega} + 4.95e^{-j3\omega} + 1.8e^{-j4\omega}}{0.9 - 1.8e^{-j\omega} + 1.65e^{-j2\omega} - 0.75e^{-j3\omega} + 0.15e^{-j4\omega}}$$

Then run the program and compute the real and imaginary parts of the DTFT, and the magnitude and phase spectra. Is the DTFT a periodic function of ω? If it is, what is the period? Can you explain the jump in the phase spectrum? The jump can be removed using the MATLAB command "*unwrap*". Evaluate the phase spectrum with the jump removed.

5. Given a signal

$$x(t) = \sin(0.1\pi t) + 2\cos(0.3\pi t) + 3\sin(0.5\pi t) \quad ,$$

when using a sampling frequency fs = 20 kHz, plot the magnitude and phase spectrum of the sampled sequence (given length 64)