

EE 215
Semester Project
Bridging Continuous Time (CT) signals with Discrete Time (DT) Via Fourier Transform Methods

Preface: DT signals are generally created by sampling CT signals. The choice of the sampling frequency F_s plays an important role in the accurate representation of the corresponding CT signal. The Nyquist's criterion says that the sampling frequency should be at least twice the highest frequency in the sample signal. FFT algorithm, available in MATLAB, is the algorithm of choice to accurately obtain the spectral content of the sample signal. FFT is an efficient way to perform the DFT algorithm, which is just a modified version of the DTFS algorithm.

Goal: The main goals of the project are:

- To understand how the different DT Fourier Transform methods are related to each other.
- Bridge the gap between observing the spectral content of a CT signal, using FFT, DTFS, DTFT, & DFT, algorithms.

Operations: For the signals assigned to you, perform the following operations for different values of F_s and time range (window function width) and observe the effect:

- Obtain the DT version of the CT signal assigned to you. Note: in MATLAB, all signals are DT versions of the corresponding CT signals.
- Obtain the DTFT of the DT signal. Extract 1 period of the DTFT (-0.5 to 0.5) and multiply the frequency axis with F_s .
- Another method to obtain the DTFT:
 - Obtain the theoretical expected DTFT
 - Obtain the DTFT of the window function that resembles the time range and F_s chosen earlier. Also, the window function should match the time range for the CT signal. Make sure that the array sizes and frequency range are the same!
 - Convolve, 1 period, the DTFT of the window function with the theoretical DTFT, to get another version of the DTFT. Again multiply the frequency axis with F_s .
- Obtain the DFT of the signal. Make sure the frequency range and window sizes are kept consistent.

- Obtain the FFT of the DT signal (basically the CT signal) and compare it with the three Fourier transforms obtained above. What do you observe?
- Obtain results that show the effect of varying F_s and time range on the spectral content of the signal under observation.
- Note: For DTFT & DFT, you must create your own code using the mathematical definitions of the transform. You cannot use the in-built functions available in MATLAB
- Note: For FFT, you may use the in-built functions available in MATLAB.

Signals:

Name	$\cos(2\pi ft)$ f (Hz)	$\text{rect}(t/a)$ a
Name 1	250	200
Name 2	500	90
Name 3	750	80

Project Deliverables:

- Project report: A detailed project report along with code used (include code in your report), results obtained and conclusions drawn. The report (only 1 word document, .doc/.docx) is due via e-mail, to rdua@mst.edu, by...

Project Grading:

- Project report: 70%
- Project creativity: 30%