Experiment No 1
Exponential Fourier Series

Laboratory Tasks
To calculate and plot exponential Fourier series coefficients

Background

In mathematics, a Fourier series decomposes periodic functions or periodic signals into the sum of a (possibly infinite) set of simple oscillating functions, namely sines and cosines (or complex exponentials). The study of Fourier series is a branch of Fourier analysis. Using Euler's Equation, and a little trickery, we can convert the standard Rectangular Fourier Series into an exponential form. Even though complex numbers are a little more complicated to comprehend, we use this form for a number of reasons:

1. Need to perform only a single integration
2. A single exponential can be manipulated more easily than a sum of sinusoids
3. It provides a logical transition into a further discussion of the Fourier Transform

Description

In this lab, you will perform the following tasks:

1. Evaluate the Fourier series coefficients using

$$D_n = \frac{1}{4}\, e^{-jn\frac{\pi}{4}}\, sinc\left(\frac{n}{4}\right)$$

   Plot the magnitude $|D_n|$ (in volts) and phase $\angle D_n$ (in degrees) of the first twenty-one coefficients $n = [-10, -9, \ldots\ldots\ldots 10]$ versus frequency (in rad/sec). What is the time period of its corresponding time domain signal $D(t)$.

2. From the above first twenty-one terms of the exponential Fourier series of D_n, plot an approximation to its corresponding time domain signal $D(t)$ given by

$$D(t) \approx \sum_{n=-10}^{n=10} D_n\, e^{jn\omega_o t}$$

   Use $t = [0: 0.01: 8]$ seconds or any other appropriate period.

Laboratory Rubrics

Detailed rubrics for Software experiments are reiterated here so that a student knows and remembers that how he is being evaluated.

Performance	Exceeds expectation (3)/(1)	Meets expectation (1.5)/(0.5)	Does not meet expectation (0)/(0)	Marks
				S1
K: Knowledge of required functions for code design. Marks: 1	Knows all appropriate functions required for this experiment	Partially Knows all appropriate functions required for this experiment	Does not know appropriate functions required for this experiment	
D: Design of Code Marks: 3	Does Code design without guidance	Needs guidance for code design	Unable to design code even with guidance	
S: Show proper results. Marks: 1	Correct results are displayed	Results are with minor errors	Results are with major errors	