EECE 340 Project - Section 1.1 Report Summary

Prepared by: Carl Wakim and Joseph Chahine

Introduction

This document summarizes the implementation and results of Part 1.1 of the EECE 340 project, which focuses on Finite Fourier Series approximation of time-limited signals. The report explains the purpose of each MATLAB script and function, followed by detailed descriptions of the generated plots.

MATLAB Files Description

1. ffs.m:
This function computes the finite Fourier series approximation of a signal. Given a time-limited signal, a time vector, a number of harmonics n, and a period T, it returns the reconstructed approximation and the complex Fourier coefficients.

2. test_ffs.m:
This script tests the ffs function using two types of signals: a Gaussian pulse and a time-limited sine wave. It visualizes the approximation quality and plots the original and reconstructed signals.

3. (Inside test_ffs.m) Error Analysis Sections:
Additional code segments are included to plot the squared error versus the number of harmonics (n), and to evaluate the effect of varying the period T on approximation quality.

Figure Descriptions

Figure 1: Fourier Series Approximation of a Gaussian Pulse

This figure compares the original Gaussian signal x(t) = e^(-t^2) with its Fourier series approximation using 20 harmonics and T = 4. The approximation follows the original signal closely, especially near the center.

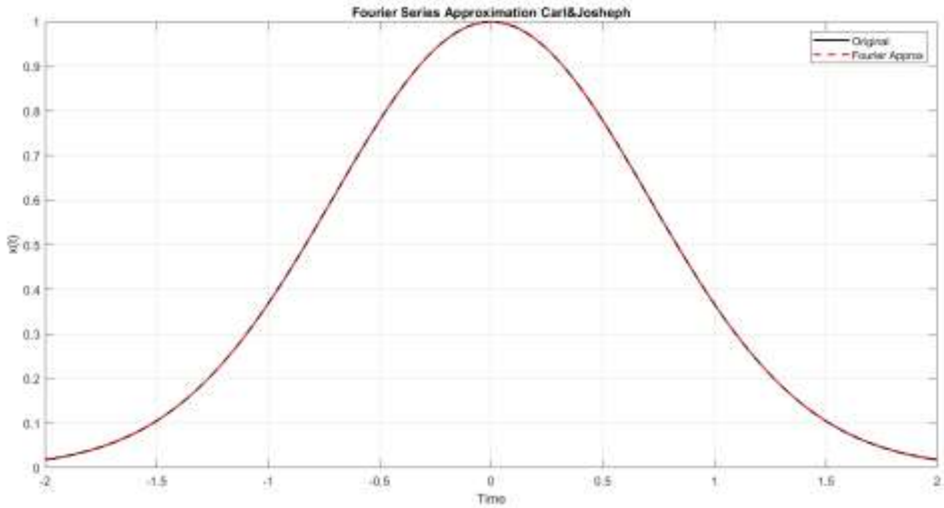

Figure 2: Fourier Series Approximation of a Time-Limited Sine Wave

Shows the approximation of x(t) = sin(2*pi*t) for |t| < 1. The red dashed curve shows the Fourier approximation using 20 harmonics and T = 4. Gibbs phenomenon is visible near the discontinuities.

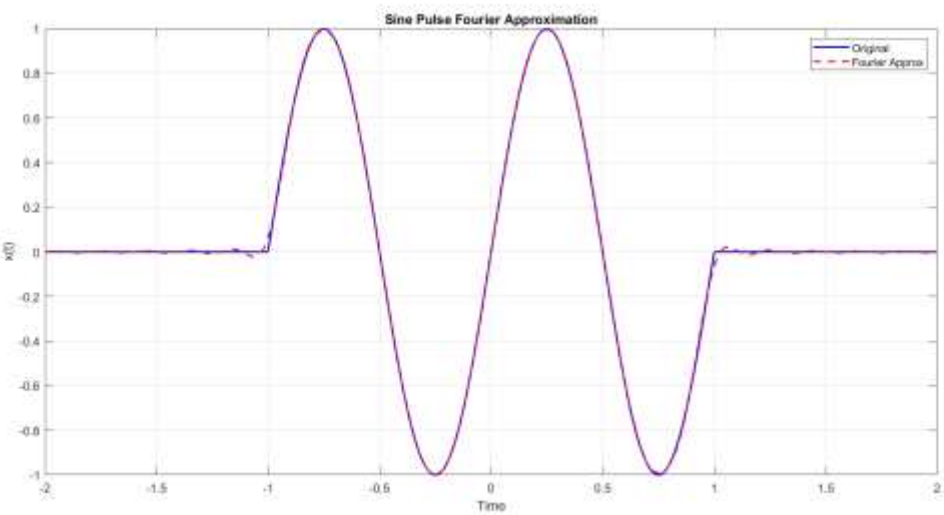

Figure 3: Squared Error vs. Number of Harmonics

Demonstrates how the squared error drops significantly as n increases. Most of the signal energy is captured with a small number of harmonics, with diminishing returns beyond a certain point.

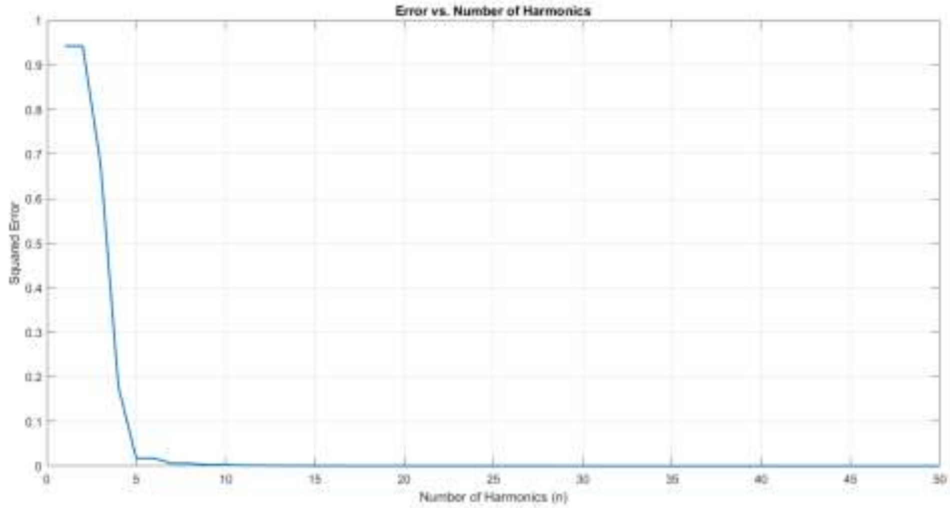

Figure 4: Squared Error vs. Harmonics for Varying Periods

Compares the approximation error using different T values (2, 4, 6). Larger T yields slightly better accuracy at low harmonic counts, but all curves converge as n increases.