EECE 340 Project - Section 1.2 Report Summary

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Introduction

This document summarizes the implementation and results of Part 1.2 of the EECE 340 project, which focuses on approximating the continuous-time Fourier transform (CTFT) and its inverse using manual numerical integration. No built-in MATLAB Fourier functions such as fft or ifft were used in the primary implementation, to stay consistent with continuous-time signal behavior.

The report explains the purpose of each MATLAB script and function, followed by detailed descriptions of the generated plots.

MATLAB Files Description

1. ftr.m:
This function numerically approximates the continuous-time Fourier transform (CTFT) of a time-limited signal using manual integration. Given a sampled time vector, signal values, and total duration T, it manually computes the Fourier Transform by summing the integrand $x(t) * \exp(-j2\pi ft) * \Delta t$ across all time samples for each frequency.

2. iftr.m:
This function approximates the inverse continuous-time Fourier transform, again using manual summation. Given a frequency vector and corresponding Fourier transform values, it reconstructs the original signal by summing $X(f) * \exp(j2\pi ft) * \Delta f$ across all frequency samples for each time point.

3. test_famous_duals.m:
This script tests the accuracy of the ftr.m and iftr.m functions by verifying classical time-frequency duals:
- A rectangular pulse and its corresponding sinc function in frequency,
- A sinc pulse and its corresponding rectangular function in frequency,
- A constant signal and its corresponding Dirac delta-like peak in frequency.
The figures generated validate the correctness of the manual CTFT and its inverse.

Figure Descriptions

Figure 1: Rectangular Pulse and its Fourier Transform

This figure shows a rectangular pulse in the time domain and its Fourier transform, which approximates a sinc function in the frequency domain. The shape and scaling of the sinc function match theoretical expectations.

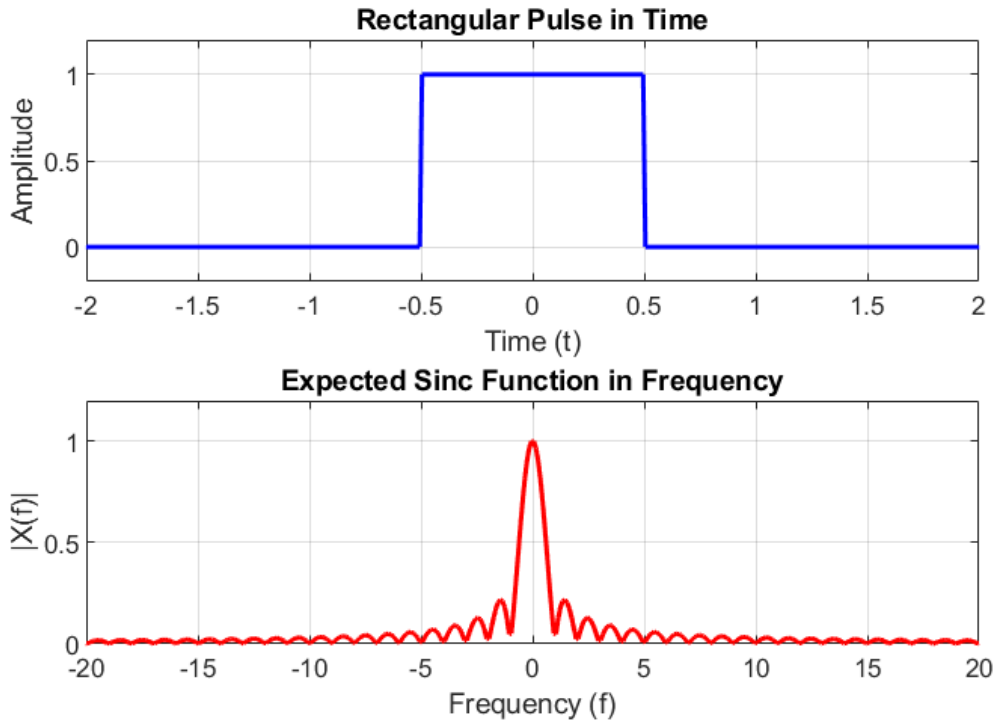

Figure 2: Sinc Pulse and its Fourier Transform

This figure shows a sinc pulse in the time domain and its Fourier transform, which approximates a rectangular function in frequency. The rectangular spectrum is sharply defined around f = 0, as expected from the theory.

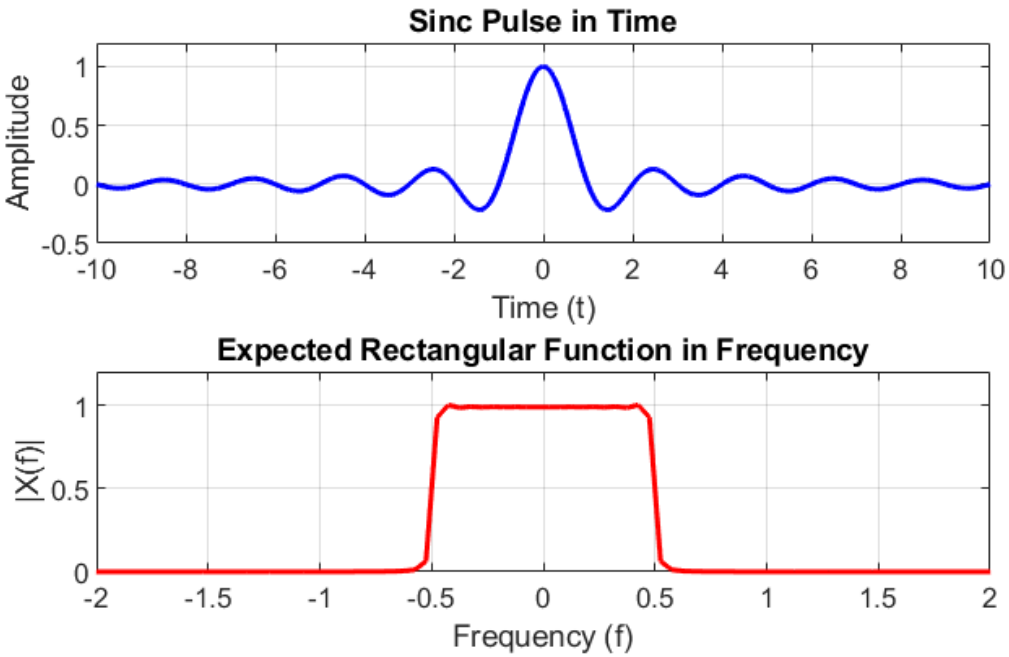

Figure 3: Constant Signal and its Fourier Transform

This figure shows a constant signal in the time domain and its Fourier transform, producing a sharp peak at frequency zero, approximating the behavior of a Dirac delta function.