Introduction: This experiment utilizes Matlab, both symbolic and numeric, to visualize three pulses and their Fourier transforms. Some time domain parameters of the pulses are determined and compared to the visualizations; frequency domain parameters of the Fourier transforms are determined and compared to the visualizations. The energy in the difference between the time domain pulses and between their Fourier transforms are computed and compared with the visualizations.

The signals are then amplitude scaled to have identical energies; the signals and their Fourier transforms are visualized and the time domain pulse parameters are again computed. The energy in the differences between the pulses and between their Fourier transforms are again computed and compared with the visualizations.

Finally, the signals are then amplitude and time scaled so they are equal energy, and have equal time durations; the resulting signals and their Fourier transforms are visualized and the pulse parameters are again computed and compared with the visualizations. Finally the energy in all the differences between the signals and between their Fourier transforms is computed and compared with the visualizations.

We will work with following three signals that are described in the frequency domain.

\[
A(f) = \text{sinc}(f) = \frac{\sin(\pi f)}{\pi f}, \quad B(f) = A(f)^2, \quad C(f) = A(f)B(f)
\]

1) Use symbolic Matlab to determine and simplify the three pulse waveforms. On one set of axes, plot the three Fourier transforms; on another set of axes plot the three pulses. Discuss your resultant visualizations and discuss all differences between the pulses; discuss all differences between the three Fourier transforms. Find the centers and widths of the time signals and the Fourier transforms; compare your results with the visualizations. Repeat results for numeric Matlab (Matlab). Compute the energy of the pulses in time domain and frequency domain. Compute the energy of the difference between each pair of pulses.

2) Use Matlab to amplitude scale each of the three pulses to create three unit energy pulses. Plot the pulses and their Fourier transforms. Compute the energy of the difference between each pair of pulses.

3) Use Matlab to time scale and amplitude scale each of the three pulses to create three unit energy pulses that are all equal width. Plot the pulses and and their Fourier transforms. Compute the energy of the difference between each pair of pulses.

4) Compute the smoothness in time and frequency of the original pulses. Determine the width of the original pulses, amplitude scaled, and time and amplitude scaled pulses in time and frequency domain.