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Discrete Fourier Transform

For the take-home exercise, the main addition was the generatesquare function, which creates square waves with adjustable duty cycles. This function helps analyze how changing the duty cycle affects the wave's behavior in both time and frequency domains. Using scipy.signal.square, the function efficiently generates square waves, allowing for an exploration of their harmonic content and how different duty cycles impact the signal.

Digital Filter Design

In the take-home exercise for the digital filter design, several additions were made to expand functionality and improve filter exploration. A multitone function was introduced to generate multi-tone signals with adjustable frequencies, amplitudes, and phases, enabling more complex signal testing. The take-home section now includes a bandpass filter implementation using scipy.signal.firwin, designed to isolate a specific frequency range. This bandpass filter was applied to a multi-tone signal, and its effect was visualized both in the time and frequency domains. A freqzPlot function was also used to plot the frequency response of the bandpass filter, providing insights into its performance.

Digital Filtering of Data Streams Divided into Blocks

In this take-home exercise, we replaced the firwin function, lfilter function, and the block processing function. The firwin function was substituted by implementing the pseudocode provided in the lab document under the filter design section. For the lfilter function, we filtered the coefficients generated by the first filter and performed a convolution with the raw data using a nested for loop to iterate through the data and coefficients. The main block processing function is similar to the provided function but incorporates the two newly implemented functions.