Neural Time-Series Analysis Lab module

A) Generate a time series by creating and summing sine waves, as in figure 1B. Use four sine waves, so that the individual sine waves are still somewhat visible in the sum. Perform a Fourier analysis on the resulting time series and plot the power structure. Confirm that your code is correct by comparing the frequencies with nonzero power to the frequencies of the sine waves that you generated.

B) Try adding random noise to the signal before computing the Fourier transform. First, add a small amount of noise so that the sine waves are still visually recognizable. Next, add a large amount of noise so that the sine waves are no longer visually recognizable in the time domain data. Perform a Fourier analysis on the two noisy signals and plot the results. What is the effect of a small and a large amount of noise in the power spectrum? Are the sine waves with noise easier to detect in the time domain or in the frequency domain, or is it equally easy/difficult to detect a sine wave in the presence of noise?

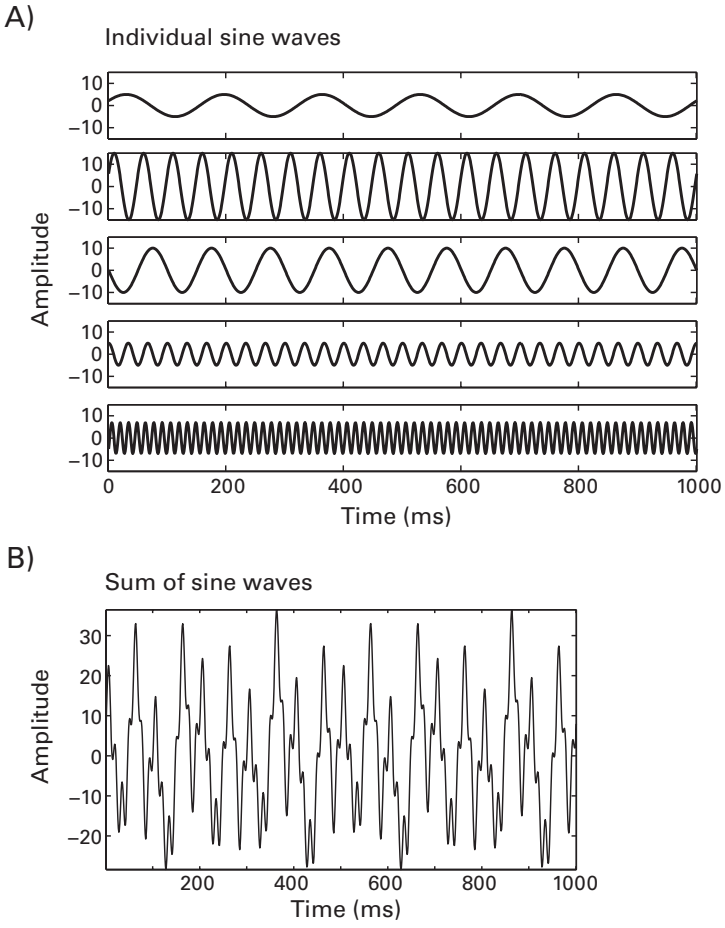

Figure 1. Several sine waves of differing amplitudes, frequencies, and phases, plotted separately (panel A) and after being added together (panel B).

C) create a nonstationary time series (similar to the waveform in Figure 2) using the sine waves from section A, perform the Fourier analysis on the entire signal and plot the results.

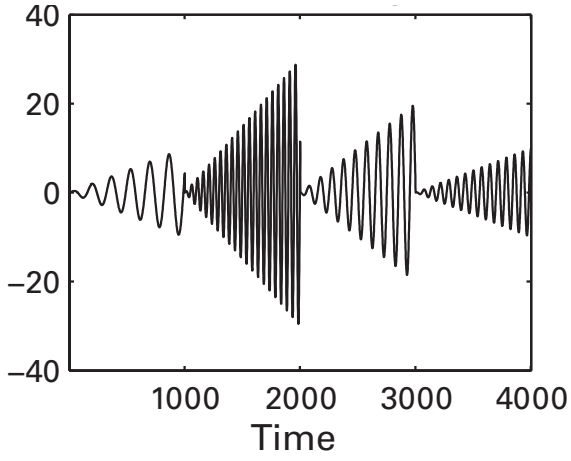

Figure 2. Time-dependent amplitude and frequency

D) Perform Short-Term Fourier Transform on the entire signal from section C and plot the results. Experiment with different window sizes and compare the results.

E) ‘dataset.mat’ contains data from real EEG recordings. This dataset is a concatenation of multiple recording segments (trials). Repeat the analysis in sections B and D using the EEG dataset. How many trials are included in this dataset?