fNIRS Retinopy

Matlab Case Study for Signals and Systems (Draft)

Functional Near-Infrared Spectroscopy is an imaging method capable of measuring levels of hemoglobin in various parts of the brain to detect areas of increased blood flow. Similar to other methods of brain imaging, fNIRS can be used to detect correlations between external stimuli and increased brain activity.

In this case study, you will use a variety of data manipulation techniques to examine the results of an experimental trial using fNIRS retinopy to map the brain’s response to a rotating image. You will then use least-squares regression to estimate the phase of the image at a particular moment based on a snapshot of the brain at that same moment.

# Experimental Setup

In this experiment, a subject views a checkerboard wedge that slowly rotates on the screen, completing one rotation every 36 seconds. Meanwhile, infrared sensors measure brain oxygenation to see which spatial regions of the brain are active as the wedge moves.

By recording the

# Case Study

Open the *fNIRSCaseStudy.m* script in MATLAB and read through it, then run it. Examine the plots produced.

* The Data Traces plot overlays the signal from every sensor pair on a log scale. What do you notice about signals with a smaller amplitude? What about signals with a larger amplitude? Do you see any signals with a low frequency oscillation in them? Where do those signals appear on the data trace?
* The LFO plot shows the average amplitude of the signal from each sensor pair. The x-axis represents the distance each signal penetrates before reaching the receiver. The most useful sensor data will be from sensors that have passed through much of the brain, but not so much that they have been attenuated so much that the signal is mostly noise. What range of distance do you think will be most useful for this purpose? Record your observations in your writeup.
* The Log-Ratio Signals shows each signal pair over time, with intensity mapped to color. You should see some periodic behavior on this plot. What frequency is it? What other behavior do you observe?
* Consider the experimental setup. How might we use a highpass or lowpass filter to clean up this data? Examine the highpass() and lowpass() functions included in the case study and use them to generate a new version of the Log-Ratio Signals plot that better displays the desired periodic signal.