Denoising Auditory Brainstem Responses

Auditory brainstem responses (ABRs) are tiny evoked potentials generated in response to acoustic stimuli, and are recorded using surface mounted electrodes on the human scalp. They are commonly used to diagnose and identify different forms of hearing impairment, and often form the basis of neonatal screening programs. The sooner hearing impairment can be determined, the sooner an auditory prosthetic such as a hearing aid or cochlear implant can be applied.

The recorded ABR is typically very small relative to background EEG activity. The predominantly used approach to deal with this is simply averaging across repeated stimulus repetitions. Thus assuming that the ABR is deterministic, and that background EEG activity is an additive noise process. For clinical/research usage estimates of the post-average signal-noise-ratio (SNR) are used for either signal detection or quality assessment to determine when to stop presenting stimuli and averaging. These methods make the assumption that the background EEG activity is a white, gaussian, stationary random process. This project proposes to revisit the assumptions placed on SNR estimation methods and determine if more realistic approaches are warranted. I.e. that EEG is more like 1/f noise (Novikov et al., 1997) and is nonstationary (Silva, 2009; Kaplan et al., 2005).

A strong basis in engineering maths and statistics is recommended, as well as programming skills in MATLAB. This project will make use of an existing EEG database and recorded ABR template.