Research

Laboratory of Neurotechnology

The Laboratory of Neurotechnology carries out work in two broad areas: (1) Cognitive Single-Cell Neurophysiology and (2) Development of Neuroprosthesis and Brain-Machine Interface.

1) Cognitive Single-Cell Neurophysiology:

Selective activation of individual neurons is a cornerstone of our modern understanding of how brain activity relates to cognitive processes, such as perception, attention, memory and decision making. However, understanding neuronal activity in the context of other brain cells (i.e. networks of neurons) is essential to achieve a deeper understanding of brain function. In our lab we record the activity of dozens of neurons simultaneously while animals perform complex behavioral tasks. The goal is to understand information processing in networks of neurons distributed in multiple brain regions.
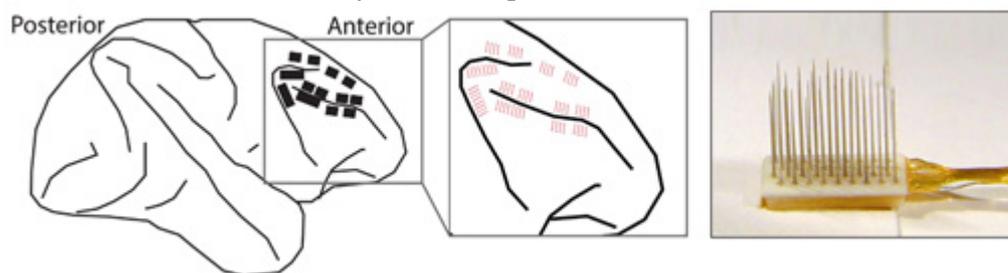

Figure: Electrode array locations in prefrontal cortex

2) Development of Neuroprosthesis and Brain-Machine Interface:

Damage to the central or peripheral nervous system can have devastating consequences. Due to the limited capacity of neurons to regenerate, alternative solutions are required. Neurodevices that use nervous information (by measuring activity) and/or induce activations (by stimulation) have been applied to multiple conditions, such as deep brain stimulation for the treatment of epilepsy or cochlear implants for the treatment of hearing impairments. This is an area of rapid progress, and there are many more applications and new technologies in the horizon waiting to reach the clinic. In our lab we employ neurophysiological techniques to test and apply novel neurotechnologies in collaboration with engineers. The goal is to develop novel treatments to aid patients with neurological disorders or lesions.
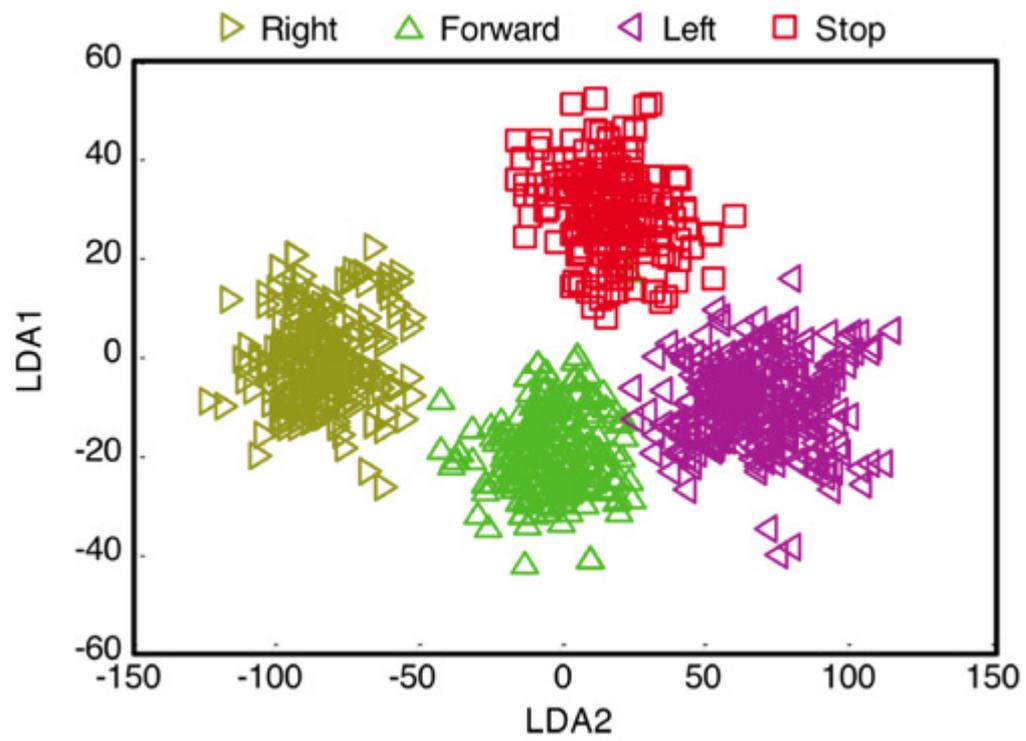
Figure: First and second principal components of population activity during a motor task with four movement categories.