Session 407 - Cortical Planning and Execution: Animal Neurophysiology

Add to Itinerary

407.12 / LL13 - Transcranial laser scanning photostimulation and video motion tracking for optogenetic cortical motor mapping of mouse corticospinal neurons

November 13, 2017, 1:00 PM - 5:00 PM | Halls A-C

Presenter at Poster
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Abstract
Motor mapping, based on stimulating different cortical locations and measuring the evoked movement, has long been used to define and study motor cortical areas. Traditional electrophysiological mapping methods have several limitations, including lack of cell type specificity and poor spatial resolution. Light-based mapping (LBM; Ayling et al., 2009) has emerged as a method to overcome both these limitations, and several groups have recently developed various implementations of this technique for investigating limb and whisker movements in mice. We will present progress towards developing a variant of LBM based on combining transcranial laser scanning photostimulation (tcLSPS) with video motion tracking (VMT) using inexpensive cameras, with the aim of using tcLSPS-VMT to map the cortically evoked movements generated by selective photostimulation of channelrhodopsin-2 (ChR2) expressing corticospinal neurons. To selectively label corticospinal neurons with ChR2, we injected the cervical spinal cord with rAAV2-retro-Syn-ChR2-GFP (gift of Alla Karpova, Janelia), a recently developed retrogradely transported AAV (Tervo et al., 2016). Subsequently, ketamine-anesthetized mice were head-fixed and laser stimulus grids of varying size and resolution were oriented either over the labeled corticospinal neurons in motor cortex or to cover as much of cortex as accessible. Cortical sites in the grid were sequentially stimulated by tcLSPS by steering the beam of a blue laser with a pair of scanning galvanometers (Thorlabs), using a pair of acousto-optical modulators for power control. Videos of the evoked movements were simultaneously captured with a pair of USB3 CMOS video cameras (Chameleon3, FLIR) running at 100 or 250 fps. Laser parameters and video capture were controlled using LabView. A simple, offline, ROI-based, 2D cross-correlation-based motion tracking algorithm written in MATLAB was used to measure movements of each paw from the recorded videos. The results demonstrate the utility and efficacy of tcLSPS-VMT for detecting and characterizing cortically evoked limb movements, and furthermore demonstrate that such movements can be evoked by selectively activating corticospinal neurons.