UNIVERSITÀ
DEGLI STUDI
DI PADOVA

NEU-PAGES - Evoked NEUronal PAtterns Generated by Electrical and Sensory stimulation in mice somatosensory cortex

Rodents sample their environment and navigate in the dark by using sensory cues, coming mainly from their whiskers. It is well known that, through a dedicated neuronal pathway and a peculiar organization, sensory inputs are precisely encoded in specific areas of the somatosensory cortex as evoked responses having a well-defined and easily recognizable shape in different cortical layers. What happens if we replace the sensory stimulation with an electrical stimulation, generating local neuronal responses in the cortex, not coming from the thalamus or sensory receptors? In this study, we investigate the capabilities of electrical neuromodulation by means of an implantable needle probe and define the optimal parameters of electrical stimuli capable of generating a controlled evoked signal, thus finely tuning a local cortical network. Neuronal patterns generated by sensory and electrical stimulations will be acquired using two-photon calcium and voltage sensitive dye imaging from lightly anesthetized and awake head-restrained mice. Surgical protocols for chronic window imaging implants and probe insertion under the two-photon microscope will be inspired by the ones previously designed and optimized during the MSCA funded project GRACE. Using two-photon imaging, not only the time course and the waveform of the evoked response can be analyzed, but also the two-dimensional pattern of the evoked signal can be obtained from different cortical layers, along with its dynamic spatial modes and flows overtime. Using carefully designed machine learning algorithms, the characterization, comparison, and classification of these evoked neuronal patterns – both sensory and electrically generated - will be carried out. The peculiar differences between sensory and electrically evoked responses found with machine learning approaches will be used to thoroughly investigate the potential of regulating neuronal activity through neuromodulation. Exploring the capabilities of patterned electrical stimulation of neuronal microcircuits for controlling a local neuronal network will contribute to potentiate the design of advanced treatments based on neuromodulation in the case of epilepsy, post-ictal conditions, or Parkinson's disease through innovative neural interfaces.