Bocconi

25 MARCH 2025
12:00 PM
Room 3-B3-SR01
Via Röntgen 1, Milan, 3° floor

Computational insights into neural functions from cell culture networks

Speaker

Thierry Nieus
Adjunct Professor
University of Milan

Abstract

Although in the latests years technological improvements have allowed to study the dynamics of neural circuits in in-vivo conditions from hundreds of recordings sites, understanding the processing performed by the brain still represents a challenging topic. Reductionist approaches using 2D and 3D neuronal cell cultures, still represent an interesting approach to investigate many of the open questions about brain functions (e.g. development, topology vs emergent activities etc...).

In this talk, I will present results about a series of works in which at first we investigated the determinants of spontaneous network bursts in cell culture networks using high density multi electrode array recordings, computational models and graph theory analysis. Then, we characterized the responsiveness of the same networks to electrical stimulation and extended the Shannon's mutual information about the stimulus-response, by including the state of the network. The latter allowed us to relate a significant part of the trial to trial variability of the responses to the network state prior to stimulation. The study demonstrated that state dependent processing, previously documented only in single cells, takes also place at

Finally, we assessed the 'richness' of neural responses in cell cultures using the perturbational complexity index (PCI), a metric commonly employed in human brain studies to quantify the complexity of brain responses in TMS/EEG recordings. This study, which explored the neural underpinnings of PCI, suggests that network connectivity organization plays a key role in generating complex responses to exogenous stimuli.

Università Bocconi
DEPARTMENT OF COMPUTING SCIENCES