Title: Software for Multifaceted Analysis of Microelectrode Array Data

Authors:
Valtteri Vuolanto[1], Andrey Vinogradov[1], Oskari Kulta[1], Susanna Narkilahti[1]
1) Tampere University, Faculty of Medicine and Health Technology, Neuro Group

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Abstract
Multielectrode arrays (MEAs) are widely used for the functional characterization of electrically active cells. Many different MEA platforms and experimental setups are used as well as being developed. Furthermore, there is growing interest in developing physiologically relevant in vitro models. Human induced pluripotent stem cell (hiPSC) based experiments have been a large advancement towards human relevant research. As such, hiPSC derived cortical and peripheral neurons as well as other cell types are now frequently used to study pathologies of the nervous system, and its interaction with other physiological systems with coculture models. Robust data analysis pipelines that aid the investigation of these models are needed. For these reasons, we have been developing a MATLAB-based MEA data analysis pipeline which considers different experimental setups and data types, while producing the crucial statistics of neuronal function. This is accomplished by combining previously validated algorithms for neuronal spike and burst detection into a cohesive computer program. The application also has further high-level analysis capabilities detecting network bursts and detecting network connectivity with a spike- or a burst-based algorithm as needed. In this research, the analyses help elucidate the function of cortical and peripheral neurons and their interplay in a compartmentalized coculture even with other cell types like cardiomyocytes. The developed easy-to-use application is validated with a large dataset of MEA data from hiPSC -derived cortical and peripheral neurons. In this way, we can also discover crucial information on the possible differences of the activity of the neuron types.