Electrical Impedance Tomography on High-density Microelectrode Arrays

Background

Electrical Impedance tomography is a noninvasive, label-free imaging method in which the electrical impedance of a cell or tissue is measured between many metal electrodes and used to form a tomographic image. Impedance imaging can be used to infer the cell morphology, position and growth. The recently developed high-density micro-electrode array system, featuring around 60k integrated electrodes (Figure 1), allow for performing impedance measurements down to single-cell resolution.

Desirable Skills

- Basic programming skills (MATLAB, C/C#)
- Familiar with electrical & electronic measuring instruments, LabVIEW

Task description

The aim of this project is to perform electrical impedance tomography of biological cells and tissues placed on the array by stimulating interesting electrodes and sensing the current from the surrounding electrodes (Figure 2). The student has to work with the existing setup to perform the required experiments. Cell layers (e.g., iPSC-derived cardiomyocytes) or tissues (e.g., retina or an acute slice of mouse brain) will be put on the array, and an electrical impedance tomography image of region of interest will be obtained by 1) applying a sinusoidal voltage to stimulating electrode, 2) measuring the current from the sensing electrodes and 3) extracting the impedance image using tomographic reconstruction techniques, which have to be developed by the student (e.g. in MATLAB).

You learn

- Electrical impedance tomography
- Cell culturing and experimental techniques

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