Directional and Scalable (DISC) Electrode Array

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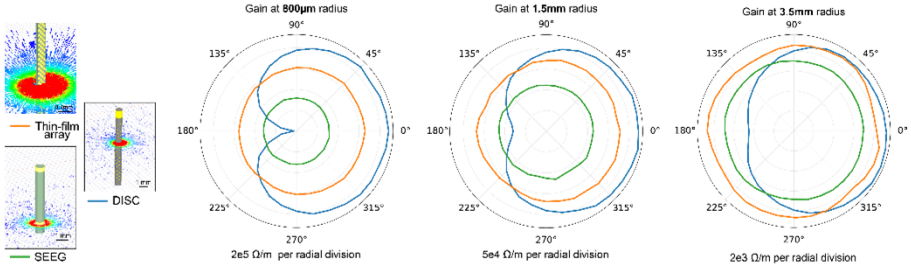
A novel device for the accurate recording of electrical signals in multiple regions of the brain with improved sensitivity, directionality, and scalability

A **di**rectional and **sc**alable (DISC) electrode array has been developed and tested to provide improved performance while overcoming limitations seen in conventional neural sensors. The array design proposed here is an improvement on the state-of-the-art electroencephalogram (sEEG) by enabling the recording of spatially distinct local field potentials (LFP). This is achieved by radially positioning of electrodes around the array using advanced manufacturing techniques. The device demonstrates superior performance in terms of signal-to-noise (SNR), directional sensitivity, and decoding accuracy compared to a ring electrode, and additionally provides clinicians with equivalent fidelity as the macroscale ring electrode by averaging a concentric set of electrodes. As another demonstration of its powerful and diverse montaging capability, linear arrays of electrodes on DISC have also demonstrated spatially distinct current source density analysis.

Components. The tool developed in this invention is capable of high quality, multidirectional current source density (CSD) with mesoscale source separation and ring-equivalent recordings. The more generalizable design developed and prototyped here establishes the ability of microelectrodes fabricated on large substrates. DISC shows improved spatial diversity without the necessity of a large craniotomy as required in other devices such as ECoG arrays or microelectrode arrays such as the "Utah array". Directionality and vertical span further improve decoding capability generating a greater diversity of signals that can be source separated and source localized.

Benefits/Technology Advantages. One major advantage offered by this tool is its interchangeability with stereo-EEG depth arrays to achieve state-of-the-art placement accuracy, efficacy, and safety for detection of focal seizure type ailments. It can be used as a substitute for other devices such as linear microelectrodes while also offering greater scalability and directionality advantages. A sensitivity map for DISC compared to a sEEG and a state-of-the-art microelectrode are provided here.

Potential Applications. Application areas such as epilepsy diagnosis and advanced decoding of brain signals, e.g., brain computer interfaces, could benefit significantly from this invention. It can provide better understanding of LFPs in complex networks by providing unique montaging abilities between one or more devices. The resulting network maps will identify disease biomarkers and high fidelity decoding of brain activity.



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Portfolio available for licensing.

Stage of Development

Prototype

Associated Publications

"Sensing Local Field Potentials with a Directional and Scalable Depth Array: the DISC electrode array"

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