

ISTVÁN ULBERT



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RESEARCH AREA

Experimental and Clinical Electrophysiology

The development and application of specialized microelectrodes capable of simultaneously recording signals from different depth layers of the cerebral cortex (laminar recordings). This enables an understanding of the information flow between cortical layers.

Brain-Computer Interfaces (BCI)

The goal is to develop systems capable of decoding brain signals and translating them into commands to control external devices (e.g., robotic arms or a cursor).

Sensory Information Processing

Investigating how the human and animal brain processes stimuli from the external world.

Studying the functioning of the loop between the thalamus and the cerebral cortex, which is crucial for perception, attention, and sleep. The primary focus is on mapping the functioning of the visual and auditory systems.

Epilepsy Research

His research conducted in a clinical environment aims to understand the mechanisms of epileptic seizures. Investigating the genesis of epileptic seizures at a microscopic level using electrodes implanted in the human cerebral cortex. The goal is to more precisely determine the site of seizure onset (the focus) to improve the success rate of surgical interventions.

Electrode Development (MEMS Technology)

From an engineering perspective, he actively participates in the development of new types of MEMS (Micro-Electro-Mechanical Systems) based neural implants and electrodes, which cause less tissue damage while allowing for more precise measurements.

recording, capturing signals during epilepsy surgeries, complemented by animal models. Additionally, we employ spike sorting and time-frequency analysis algorithms to understand brain networks and epilepsy.

SELECTED PUBLICATIONS

Cash, S. S., Halgren, E., Dehghani, N., Rossetti, A. O., Thesen, T., Wang, C., Devinsky, O., Kuzniecky, R., Doyle, W., Madsen, J. R., Bromfield, E., Eross, L., Halász, P., Karmos, G., Cserscsa, R., Wittner, L., & **Ulbert, I.** (2009). The human K-complex represents an isolated cortical down-state. **Science** **324**(5930): 1084–1087.

Stefanics, G., Hangya, B., Hernádi, I., Winkler, I., Lakatos, P., & **Ulbert, I.** (2010). Phase entrainment of human delta oscillations can mediate the effects of expectation on reaction speed. **J Neurosci** **30**(41): 13578–13585.

Fiáth, R., Márton, A. L., Mátyás, F., Pinke, D., Márton, G., Tóth, K., & **Ulbert, I.** (2019). Slow insertion of silicon probes improves the quality of acute neuronal recordings. **Sci Rep** **9**(1): 111.

Rácz, M., Liber, C., Németh, E., Fiáth, R., Rokai, J., Harmati, I., **Ulbert, I.**, & Márton, G. (2020). Spike detection and sorting with deep learning. **J Neural Eng** **17**(1): 016038.

Fiáth, R., Meszéna, D., Somogyvári, Z., Boda, M., Barthó, P., Ruther, P., & **Ulbert, I.** (2021). Recording site placement on planar silicon-based probes affects signal quality in acute neuronal recordings. **Sci Rep** **11**(1): 2028.

TECHNIQUES AVAILABLE IN THE LAB

I work at the interface of bionics and neuroscience. My primary method is laminar electrophysiology: we simultaneously measure the activity of cortical layers (LFP, MUA) using self-developed MEMS-based microelectrodes. We determine the direction of information flow from the data using Current Source Density (CSD) analysis. A specialized technique of mine is human intraoperative