nanoSeminar Series 2022

Institute for Materials Science

Dr. Hayder Amin

German Center for Neurodegenerative Diseases (DZNE) and DCIM at TUD

Probing Olfactory Spatiotemporal Coding in Large-scale Neural Recordings

Thursday, June 4th 2022
13:00 – 14:00

Normal: Seminar Room 115, Hallwachsstr. 3 (HAL)
Pandemic version: https://tinyurl.com/nanoSeminar-GA

Large-scale multi-site biosensors are essential to probe the olfactory bulb (OB) circuitry for understanding the spatiotemporal dynamics of simultaneous discharge patterns. Current ex-vivo biosensing techniques are limited to recording a small set of neurons and cannot provide an adequate resolution, which hinders revealing the fast dynamic underlying the information coding mechanisms in the OB circuit. We have recently demonstrated a novel biohybrid OB-CMOS biosensing platform to decipher the cross-scale dynamics of the OB electrogenesis and quantify the distinct neuronal coding properties. The approach with 4096-microelectrodes offers a non-invasive, label-free, bioelectrical imaging to decode simultaneous firing patterns from thousands of connected neuronal ensembles in acute OB slices. The platform can measure spontaneous and drug-induced extracellular field potential activity with substantially improved spatiotemporal resolution over conventional OB-based biosensors. Also, we employ our OB-CMOS recordings to perform multidimensional analysis to instantiate specific neurophysiological metrics underlying the olfactory spatiotemporal coding that emerged from the OB interconnected layers. Our results delineate the computational implications of large-scale activity patterns in functional olfactory processing. The systematic interplay of the experimental CMOS-base platform architecture and the high-content characterization of the olfactory circuit with various computational analyses endow significant functional interrogations of the OB information processing, high-spatiotemporal connectivity mapping, and global circuit dynamics. Thus, our study can inspire the design of advanced biomimetic olfactory-based biosensors and neuromorphic approaches for diagnostic biomarkers and drug discovery applications.

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Hayder Amin received the MSc degree in biomedical engineering from Martin-Luther University, Halle, Germany, in 2011, and the Ph.D. degree in microtechnology for neuroelectronic and neuroscience with a focus on the development of CMOS-based multielectrode arrays from the Italian Institute of Technology, Genoa, Italy, in 2015.

He is currently leading the research group BIONICS at the DZNE Dresden. His research team focuses on developing and applying innovative neuroelectronic solutions and computational toolboxes to measure and analyze large-scale recordings of neuronal ensembles to understand the multiscale computational dynamics and network functions of neural information underlying the complexity of the adult brain.

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