TITLE

Towards human-like sense of touch by means of neuromorphic approach

ABSTRACT

Conventional electronic (e-) skin, as a large-area electronic device for sensing tactile events, comprises a sensor array, which analog signal is readout by serially sampling individual sensors in the array. The generated frame-based data are usually utilized by machine learning based on artificial neural network (ANN) for artificial sense of touch, e.g., object classification, by touching and grasping. The conventional e-skin has poor energy efficiency that prevents it from up-scalability, and is ill-suited for taking advantage of dynamic tactile information required for rapid tactile feedback. In this talk, design and development of new e-skins for energy-efficient, dynamic tactile feedback are to be presented. By means of the neuromorphic approach based on neuroscientific theory, building blocks for artificial tactile sensory systems are designed. By means of in mixed hardware and software implementation, event-driven neuromorphic tactile systems that efficiently code dynamic tactile information for rapid object classification, and exhibit an enhancement in the spatial resolution in response to touching and grasping events are demonstrated.

SPEAKERS

Dr. Zhibin Zhang is docent in electronics and group leader of Flexible Electronics and Neuromorphic Engineering (FENE) at Uppsala University, the Department of Electrical Engineering, since 2011. He obtained his bachelor and master degree in physics at Lanzhou University in 1993 and 1997, respectively, and received his PhD degree in Shanghai Institute of Applied Physics, Chinese Academy of Sciences in 2001. He worked as a postdoctor from 2002 for two years and then as researcher for 6 years at Royal Institute of Technology, Sweden. He has published around 110 peer-review journal articles with h-index 26 (google scholar). His research spans from nanomaterials (carbon nanotubes, graphene), printed electronic components, energy devices, electronic skin, neuromorphic circuit and neuromimetic systems.

Dr. James Goodman is a postdoctoral research scientist in the Neurobiology Lab at the German Primate Center (Deutsches Primatenzentrum). James earned joint Bachelor's and Master's degrees in biomedical engineering from Drexel University in 2013, where his studies concentrated on neuroengineering and where he conducted research with Dr. Karen Moxon into the use of spinal cord stimulation to restore movement in a rodent model of spinal cord injury. James then earned his Ph.D. in 2018 from the University of Chicago, where he worked with Dr. Sliman Bensmaia applying machine learning to in-vivo primate electrophysiology data to elucidate the specialized computations and neural dynamics supporting proprioception of the hand. He then joined the Neurobiology Lab in 2019, where he continues to blend machine learning and in-vivo electrophysiology to study the influence of sensory information on the cortical circuits which control movement in primates. In particular, his research focuses on how cortical responses to tactile feedback and the observation of others performing actions might be leveraged to improve the performance of brain-computer interface technologies.