Title: Computational Models and Interface Technologies for Hippocampal Memory Prostheses

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Abstract: Hippocampal memory prostheses are implantable devices that aim to restore or enhance memory functions through closed-loop electrical stimulations to the hippocampus or its surrounding brain regions. Two essential components of such prostheses are (1) computational models mimicking encoding and re-encoding processes of the hippocampus, and (2) interface technologies for recording from and stimulate the hippocampal circuits. In my talk, I will describe the multi-input, multi-output (MIMO) model and memory decoding model of the hippocampus and how these models are used to drive electrical stimulation to restore/enhance spatial and visual memory function in animals and human patients during behavioral tasks. I will talk about how these computational models are extended to model long-term plasticity and synaptic learning rules in the hippocampal circuits, which is critical for building adaptive prostheses. In the end, I will present our recent advances on the development of chronical large-scale flexible hippocampal probes and neural code-based asynchronous microstimulators for building clinically viable memory prostheses.

Short Biography

Dr. Dong Song is Research Associate Professor of Biomedical Engineering, and Co-Director of the Center for Neural Engineering at the University of Southern California (USC). His research interests include nonlinear dynamical modeling of the nervous system, hippocampal memory prosthesis, neural interface technologies, and development of novel modeling strategies incorporating both statistical and mechanistic modeling methods. He invented the multiple-input, multiple-output (MIMO) nonlinear dynamical model of spike transformation that serves as the computational basis of hippocampal memory prostheses. Dr. Song received his B.S. degree in Biophysics from the University of Science and Technology of China in 1994, and his Ph.D. degree in Biomedical Engineering from the University of Southern California in 2004. He became a Research Assistant Professor in 2006, and a Research Associate Professor in 2013, at the Department of Biomedical Engineering, USC. He received the James H. Zumberge Individual Award at USC in 2008, the Outstanding Paper Award of IEEE Transactions on Neural Systems and Rehabilitation Engineering in 2013, and the Society for Brain Mapping and Therapeutics Young Investigator Award in 2018. Dr. Song has published over 180 peer-reviewed journal articles, book chapters, and reviewed conference papers. He is a member of American Statistical Association, Biomedical Engineering Society, IEEE, Society for Neuroscience, Society for Brain Mapping and Therapeutics, Organization for Computational Neurosciences, and National Academy of Inventors. Dr. Song's research is supported by DARPA, NSF, and NIH.