Zenith

INTERNATIONAL PHD PROGRAM IN NEUROSCIENCE

In collaboration with SmartNets

WEDNESDAY, 5 JANUARY 2022
AT 5:00 PM (CET)

ZENITH SEMINARS

TATJANA TCHUMATCHENKO

UNIVERSITY OF MAINZ MEDICAL CENTER
UNIVERSITY OF BONN MEDICAL CENTER
GERMANY

TARGETING DIVERSE OPERATIONAL REGIMES IN RECURRENT SPIKING NETWORKS

Neural computations emerge from recurrent neural circuits that comprise hundreds to a few thousand neurons. Continuous progress in connectomics, electrophysiology, and calcium imaging require tractable spiking network models that can consistently incorporate new information about the network structure and reproduce the recorded neural activity features. However, it is challenging to predict which spiking network connectivity configurations and neural properties can generate fundamental operational states and nonlinear cortical computations. Theoretical descriptions for the computational state of cortical spiking circuits are diverse including the balanced state where excitatory and inhibitory inputs balance almost perfectly or the inhibition stabilized state (ISN) where the excitatory part of the circuit is unstable. It remains an open question whether these states can co-exist with experimentally reported non-linear computations and whether they can be recovered in biologically realistic implementations of spiking networks. Here, we show how to identify spiking network connectivity patterns underlying diverse nonlinear computations such as XOR, bistability, inhibitory stabilization, supersaturation, and persistent activity. We established a mapping between the stabilized supralinear network (SSN) and spiking activity which allowed us to pinpoint the location in parameter space where these activity regimes occur. Notably, we found that biologically-sized spiking networks can have irregular asynchronous activity that does not require strong excitation-inhibition balance or large feedforward input and we showed that the dynamic firing rate trajectories in spiking networks can be precisely targeted without error-driven training algorithms.

Dr. Tatjana Tchumatchenko is the head of the Theory of Neural Dynamics group at the MPI for Brain Research in Frankfurt, where she is also a faculty member for the IMPRS Graduate School for Neural Circuits. She is a physicist by training but went on to pursue a PhD in Computational Neuroscience in Göttingen University, where she graduated with a 'Summa Cum Laude' in 2011. She was a joint postdoctoral fellow at Max Planck Institute for Dynamics and Self-

Organization, the Bernstein Center Göttingen, and the Interdisciplinary Collaborative Research Center (SFB 889) in 2011. She completed a postdoctoral fellowship at the Center for Theoretical Neuroscience, Columbia University in New York City from before becoming a Group Leader at the MPI for Brain Research in 2013. She has received a number of grants and awards of excellence such as Behrens-Weise-Foundation Award, CRC1080 Network Grant, Heinz Maier-Leibnitz-Prize of the German Research Foundation and Dollwet Foundation Award. She is currently a PI in the Loewe Schwerpunkt Program and holds a three-year grant for DFG Computational Connectomics priority program. In 2017 and 2018 she was elected Steering Committee member for the Bernstein Computational Neuroscience Network 2018-2020 and was chosen as one of the 25 young innovators of Germany by Focus magazine in 2018.

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