
*Monday, November 11th, 2013
10h00, Room SV 1717a*

Computational Neuroscience Seminar

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**Unlearning pathological neuronal synchrony by
coordinated reset neuromodulation**

Several brain diseases, such as Parkinson's disease (PD) or subjective tinnitus, are characterized by pathological neuronal synchronization. With methods from non-linear dynamics and statistical physics Coordinated Reset (CR) stimulation was developed to specifically counteract pathological synchrony by desynchronization. Mediated by spike timing-dependent plasticity (STDP), neuronal activity and synaptic connectivity are strongly connected. Even simple neuronal and oscillatory networks with STDP display a pronounced multistability, comprising strongly synchronized and synaptically connected as well as desynchronized and weakly synaptically connected states. In networks with STDP, CR-induced desynchronization causes a decrease of the rate of coincidences and, in turn, a decrease of the synaptic weights, ultimately shifting networks from pathological states to desynchronized states. As shown computationally, the CR-induced unlearning of pathological synchrony can be achieved by means of direct electrical stimulation or by indirect, synaptically-mediated excitatory or inhibitory stimulation. Accordingly, electrical deep brain CR stimulation of the subthalamic nucleus causes pronounced long-lasting after-effects in both Parkinsonian monkeys and PD patients. By the same token, acoustic CR stimulation causes a significant reduction of tinnitus symptoms along with a pronounced reduction of pathological neuronal synchrony, pathological effective connectivity as well as pathological cross-frequency coupling within a network of tinnitus-related brain areas. A major goal of my theory-based approach is to further the theoretical understanding of therapeutic rewiring processes and optimize and/or develop invasive as well as non-invasive (e.g. vibrotactile) neuromodulation techniques accordingly.