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Editorial

Brains are dynamical systems, acting on different time scales with typically different functional capabilities. In the regime of msec to sec there is the need for a direct processing of a wide variety of spatiotemporal data. On a larger scale of seconds to months, the modification of the processing characteristics of systems by adaptation and learning plays a key role. Associated with this general area of research, the "*Dynamic Brain Forum*" comprises a series of workshops, initiated and sponsored by the Tamagawa University Brain Science Research Centre in Tokyo, Japan. After its initiation in 1996, an international group of scientists met annually at various places in Japan, Europe, the USA, and China, the group's composition varying each year (i.e. both brain and forum are dynamic). Adopting a systems oriented approach, the key intention of these meetings has been to advance our understanding of the dynamics of higher brain functions. This implies mapping empirical data onto adequate theoretical concepts which, in turn, are related to particular brain functions. To reach a suitable understanding of the functioning of a highly complex biological system like the brain, experimental and theoretical approaches have to be effectively combined. Of particular interest in this context are new approaches from the theory of dynamical systems, and their possible application and critical test in modern brain research. Thus, it has been an actively pursued goal of the *Dynamic Brain Forum* workshops to bring together theorists who honour experimental facts and experimentalists with an open ear for theoretical suggestions.

Each of the various *Dynamic Brain Forum* workshops was devoted to a specific topic from the research area of brain dynamics. The 6th Dynamic Brain Forum[1] in Breisach, Germany, in September 2001 focussed on the subject of "Cortical Dynamics: Physiology, Theory, and Applications". The contributions in this issue offer a representative sample of the presentations and discussions that took place in the workshop. They are arranged here according to their focus of interest, ranging from issues of data analysis methodology, via the evaluation of physiological experiments on neural dynamics, to the dynamical properties of various model neural systems.

The first three studies concentrate on methodological issues by discussing possibilities and limitations of novel data analysis techniques, designed to capture different aspects of neural dynamics in single- and multiple single-neuron spike train recordings. Thus, Nawrot et al. describe a new method to assess the trial-by-trial variability in the latency of spike responses to repeated stimulus presentations or recurrent executions of a particular motor behavior. Also the paper by Grün et al. is concerned with variability – they present a systematic analysis of the robustness of statistical measures of coincident spiking among multiple neurons against trial-by-trial variations of spike rates. Gütig et al. close this triplet of methodical contributions by presenting a novel technique to detect the presence of higher-order interactions among groups of neurons, which is illustrated in the test case of distinguishing second- and third-order interactions in a three-neuron system.

The following two papers describe different aspects of neural dynamics as observed in electrophysiological recordings from the brains of awake behaving animals. Grammont and Riehle present new results from their studies on the dynamical properties of spike synchronization and firing rates in the motor cortex of the monkey, and their relation to movement parameters such as direction of hand motion and reaction time. Ohl and colleagues distinguish different temporal features of stimulus-related activity in the auditory cortex of the gerbil, and investigate their relation to behavioral performance during category learning.

Finally, a block of four contributions presents insights into mechanisms and function of neural dynamics as obtained from a variety of network models. First, Jian-Feng Hu et al. discuss the performance of different models of

[1] The 6th Dynamic Brain Forum took place in Breisach, Germany from September 11–14, 2001. Understandably, our gathering was overshadowed by the concurrent terror attack on the World Trade Center in New York. We dedicate this issue to the memory of the victims of this infamous act.

activity dependent synaptic plasticity, and the associated nonlinear interactions between different signaling pathways in the representation of color in the retinal network. Synaptic plasticity returns in the study by Kitano et al., who investigate its role in the dynamic self-organization of persistent activity in the frontal cortex and its possible function for the neural implementation of mental time. Also Mehring and colleagues focus on possible mechanisms of self-organizing network dynamics by characterizing the intricate interplay between synchronous spiking and on-going network dynamics in anatomically inspired large-scale models of cortical network activity. Finally, Erlhagen presents a more abstract view in his study of the performance of a dynamic field model for the representation of moving stimuli in a visual scene and their motion-induced extrapolation as observed in visual perception.

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Ad Aertsen (Freiburg)
Gert Hauske (München)
Minoru Tsukada (Tokyo)