

Workshop

Nonlinear Dynamics and Synergetics: Theoretical Foundations, Analysis Methods, and Application to the Human Sciences (Brain Dynamics, Psychology, Psychotherapy)

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This workshop will introduce the basic concepts of nonlinear dynamics and self-organization. Concepts like order formation, order transition, control parameter, deterministic chaos, complexity will be illustrated by examples from physics, but also from psychology (e.g., movement, perception, decision making, social interaction). One important focus will be the perhaps most complex nonlinear system we know: the human brain.

Since complexity is realized in dynamics, the workshop will introduce some methods of nonlinear time series analysis, e.g., the embedding of time signals in a phase space, Lyapunov Exponents, Recurrence Plots, or synchronisation and coupling measures. Some of these measures are implemented in an Internet-based device for data mining in the practice of psychotherapy and psychiatry (the Synergetic Navigation System).

Applications to practice are illustrated by examples from psychotherapy, invasive and noninvasive neuromodulation, and suicide prevention.

Results from an actual process-outcome-project in psychotherapy using repeated fMRI measures with an individualized stimulation paradigm at the one hand and real-time monitoring of therapeutic change processes at the other hand indicate that nonstationary changes (order transitions) play a crucial role in psychotherapy. Consequences for the future of an integrative "systemic" psychotherapy will be outlined.

In neuromodulation, the coordinated reset stimulation developed by Peter Tass will illustrate how concepts from synergetics and neural plasticity led to innovative brain technologies in medicine.

In psychiatry, the prediction of suicidal attempts is still a big challenge and an unsolved problem. Actual work using the nonlinear dynamics approach bridges the gap from theory to practice and real-world phenomena by means of the Synergetic Navigation System. Goal is the development of an early warning system for rare and extreme events like suicidal attempts.