

# SPATIO-TEMPORAL NEURAL CODING AND WLC PRINCIPLE: FROM EXPERIMENTS TO UNDERSTANDING

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Information processing in neural networks by computation with attractors (steady states, limit cycles, strange attractors, continuous attractors) has been extensively discussed in application to many neural systems: central pattern generators, sensory systems (e.g. visual, olfactory), hippocampus, etc. Computation with attractors in a traditional way faces a fundamental contradiction between robustness and sensitivity. In this lecture we discuss a new direction in information neurodynamics based on experiments performed in the locust olfactory system, the orientation sensory system of the marine mollusk *Clione*, the sequential activity of the HVC of songbirds and the hippocampal place cell networks. This new concept uses the transformation of the incoming spatial or identity information into spatio-temporal output based on the intrinsic switching dynamics of a neural network with nonsymmetric inhibitory connections. This is called the Winner-Less Competition Principle (WLC). The key feature of such networks that computes with separatrices or heteroclinic conour is the robustness against noise and the simultaneous sensitivity of the sequence of switching to the incoming information. We present rigorous results about the stability of the sequential switching in the framework of the generalized Lotka-Volterra model. Because the discussed neural networks are able to change their intrinsic dynamics to answer the new incoming information, such networks may solve many different functional tasks. Computation with separatrices can be an optimal principle for the design of new paradigms of artificial neural networks.