

## **STDP imprinting and retrieval of oscillatory patterns in a hippocampal neural model**

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I show a model of learning and retrieval in oscillatory neural networks modeling cortical areas such as hippocampus and olfactory cortex. Recent experiments have shown that synaptic plasticity depends on spike timing (STDP), especially on synapses from excitatory pyramidal cells, in hippocampus and in sensory and cerebellar cortex. I show how such plasticity can be used to form memories and input representations when the neural dynamics are oscillatory, as is common in the brain (particularly in the hippocampus and olfactory cortex). Learning is assumed to occur in a phase of neural plasticity, in which the network is clamped to external teaching signals. In our model combined phase and amplitude coding requires matching both the amplitude and phase patterns of the inputs with the learned signals under recall, making the matching specific. In addition to this pattern tuning, the system exhibits tuning with respect to the frequency: the network response is weakened for input frequencies different from that used during learning. By suitable manipulation of the nonlinearity of the neurons or of the oscillation frequencies during learning, the model can be made, in a retrieval phase, either to categorize new inputs or to map them, in a continuous fashion, onto the space spanned by the imprinted patterns. The first of these possibilities can be identified with the function of olfactory cortex and the second with the observed response characteristics of place cells in hippocampus. Both kinds of networks are investigated both analytically and by computer simulations. Finally the effects of noise are investigated.

Reference: Silvia Scarpetta, Li Zhaoping and John Hertz, *Neural Computation* 14, pag.2371, 2002