Computational-Neuroscientific Correspondence of Oscillating-TN SOM Neural Networks

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Abstract

Oscillating-TN (Topological Neighborhood) Self-Organising-Map (SOM) artificial neural networks can facilitate the study of neurodevelopmental cognitive phenomena. Their cognitive modelling significance rests primarily on the premise of biological realism. Despite the difference in neuronal activity description between spike-train brain signaling and the rate-based computer SOM models, there is a valid analogy in cortical columnar activation synchrony. A cortical macro-column can be modeled as a computer-trained SOM with emerging or structural minicolumns represented by SOM-TN groups of neurons. Neural excitation and lateral inhibition result in structural cortical changes modeled by SOM Hebbian TN-activation. Oscillating-TN SOMs can model brain plasticity and regulate sensory desensitization. Neural synchrony can be modeled at various levels: macroscopically, there is an analogy between an oscillating local field potential and a SOM oscillating-TN width computational session. There are also arguments to support the hypothesis that SOM stability or entrenchment during computational map formation associates with neural oscillatory sensory prediction.