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DATE OF JOINING: 14-06-2016

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LABOURATORY: Neuroengineering Lab

AREA OF RESEARCH: Non-linear integration in Neurons, application in Visual Cortex, structure-function relationship, morphology.

TITLE/TOPIC: Modelling of Non-linearity in Neuronal Dendritic Structures and non-linear integration.

SUMMARY: Neurons are the most exciting and yet the most exquisite biological unit capable of performing complex parallel computations. Computational properties of neuron is one of the major aspects not well defined either in terms of neuronal signal processing, or cognition, learning, memory etc. Literature from physiology and connectomes theory seems to support the concept of the parallel complex computational behaviour, which is due to continuous modification of efficacy between neurons. Similar implication in current world neural network, inspired from connectomes theory of biological neurons, results in development of efficient artificial intelligent systems. But the scope of biological neuronal learning and computation is not only limited to efficacy between neurons and adjustment of the current connectome (synaptic) weights, rather it is also a combination of modification of the entire neuronal morphology along with growth of new connectome site (dendritic spine) along the dendritic arbour and localized change in the chemical behaviour of the membrane. Earlier, these morphological as well as physio-chemicals behaviour were not well known with its detailed understanding and the behaviour of dendrites are assumed to be passive. This passive nature of dendrites describes them as linear spatio-temporal integrator of the incoming signals which leads to the linear nature of dendrites signal processing ability. Due to availability of advanced imaging techniques, dyeing techniques as well as sophisticated sensing technologies, a number of facts related to the nonlinear nature of neurons comes into light. Recent literature reported some very interesting facts such as the existence of localized active channels in dendrites, capable of initiating dendritic spikes, growth of complex dendritic arbour during early developmental period, different roles of neurotransmitter antagonists and protagonists etc.

EXPERIMENTAL SETUP: NA