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Title : **The Visual Brain : Computing through Multiscale Complexity**

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Abstract :

The early visual system is responsible for most of our conscious perception of the visual world. Despite more than 50 years of progresses in Neuroscience, we remain largely ignorant of the computational principles underlying its functions. The main reason for this is the absence of a solid theoretical framework linking multiple biological observations realized at different scales of integration, from the biophysical activation of conductances to the emergence of unified psychological laws (Gestalt), guiding our everyday perception.

Primary visual cortex (V1) in the mammalian brain computes on-the-fly perceptual primitives (form, motion, visual flow) from the feedforward bombardment of retinal events channeled through the thalamus. At the same time, it integrates lateral diffusion within V1 itself and the distributed feedback of higher cortical areas involved in more elaborate cognitive functions. The reverberating activity evoked by the interplay between these three streams has been hypothesized to form the trace of the low-level computational operations written on the "high resolution buffer" of primary cortical areas.

The focus of this talk is to show, from the reading of synaptic echoes recorded in a single V1 neuron, to what extent emerging macroscopic features in low-level perception (Gestalt and motion illusory percepts) can be predicted in primary sensory areas from microscopic levels of neural integration. Various concepts borrowed to non-linear system theory, ultrasonic echography and dynamic systems are presented to account for the functional complexity of a strange matter, the living brain.

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