
*Thursday, December 18th, 2014
13h30, Room AAC 132*

Computational Neuroscience Seminar

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**Implications of neuronal diversity on
information transmission in networks and
population coding**

Gain scaling is an adaptive computation whereby a neural system's mapping between inputs and outputs adjusts to dynamically span the varying range of incoming stimuli. We have demonstrated that gain scaling emerges during early development as an intrinsic property of single neurons in mouse cortex, coinciding with the disappearance of spontaneous waves of network activity. Using biophysical models with different gain scaling properties, I examine the ability of cortical networks to propagate waves of activity. My work demonstrates that such changes can strongly affect how multi-layered feedforward networks represent and transmit information on multiple timescales. Young neurons lacking gain scaling fire synchronously and transmit large amplitude events – thus, are better suited for wave propagation. As these neurons become gain scalers, they become efficient encoders of fast input fluctuations over few layers, but lose the ability to transmit large-scale waves. This work underscores the significance of single neuron properties in governing how neurons represent and propagate information.

Diverse response properties may also emerge as an efficient coding strategy to maximize information transfer by a population of neurons. Indeed, many sensory systems split the neural signal into multiple parallel pathways. As a specific example, I investigate the benefit for pathways splitting into ON and OFF, which code for stimulus increments and decrements, respectively. My work suggests that the evolution of ON-OFF diversification in sensory systems may be driven by the benefits of lowering average metabolic cost, especially in a world in which the relevant stimuli are sparse.