Linking Mind to Brain through Resonant and Complementary Computing: Unifying Vision, Cognition, and Action

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Advanced brains are self-organizing systems that can autonomously measure and adapt to a changing world in real time. How does brain organization enable such autonomous adaptation to occur? How does brain organization reflect the design of the physical systems with which it interacts? Brains unify measurements from multiple physical processes of light, sound, pressure, and temperate into unified conscious experiences. They are, in this sense, universal measurement systems operating just above the level of quantum noise. How do advanced brains generate conscious experiences in which multiple measurements are fused as they interact with a changing world? How does a brain generate a sense of self that can support an individual narrative in a world filled with change and unexpected events? Recent neural models suggest answers to these questions as they unify, explain, and predict data about behavior, anatomy, neurophysiology, biophysics, and biochemistry, and thereby begin to solve the mind/body problem. These models embody new computational paradigms, such as Complementary Computing, which clarifies the nature of brain specialization; and Laminar Computing, which clarifies why the mammalian neocortex uses laminar circuits to represent all aspects of higher intelligence. This talk will outline a method that has been used to make these theoretical discoveries, the new computational paradigms which this method has disclosed, and illustrative neural models of interacting perception, cognition, and action that illustrate how brains accomplish autonomous adaptation. Particular emphasis will be given to how nonlinear feedback processes generate resonant states that embody predictive and attentive computation. Challenging interdisciplinary data will be explained, testable predictions given, and applications to large-scale neuromorphic technology summarized.

Illustrative References: see **http://cns.bu.edu/~steve**