LABORATORY OF COMPUTATIONAL NEUROSCIENCE (LCN)

Prof. Wulfram Gerstner
EPFL – IC & SV– LCN
SG –AAB119 (Bâtiment SG-AAB)
Station 15
CH - 1015 LAUSANNE, Switzerland

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Thursday, September 27th, 2012
13h30, Room SG 0213

Computational Neuroscience Seminar

Prof. Fred WOLF,

Department of Nonlinear Dynamics, Max Planck Institute for Dynamics and Self-Organization

Universality in the Evolution of Neocortical Circuits

Over the past 65 million years, the evolution of mammals led - in several lineages - to a dramatic increase in brain size. During this process, some neocortical areas, including the primary sensory ones, expanded by many orders of magnitude. The primary visual cortex, for instance, measured about a square millimeter in late cretaceous stem eutherians but in homo sapiens comprises more than 2000 mm2. If we could rewind time and restart the evolution of large and large brained mammals, would the network architecture of neocortical circuits take the same shape or would the random tinkering process of biological evolution generate different or even fundamentally distinct designs? In this talk, I will argue that, based on the consolidated mammalian phylogenies available now, this seemingly speculative question can be rigorously approached using a combination of quantitative brain imaging, computational, and dynamical systems techniques. Our studies on visual cortical circuit layout in a broad range of eutherian species indicate that neuronal plasticity and developmental network self-organization have restricted the evolution of neuronal circuitry underlying orientation columns to a few discrete design alternatives. Our theoretical analyzes predict that different evolutionary lineages adopt virtually identical circuit designs when using only qualitatively similar mechanisms of developmental plasticity.

Selected References:

Kaschube, Schnabel, Lowel, Coppola, White, & Wolf (2010). Universality in the Evolution of Orientation Columns in the Visual Cortex. Science, 330(6007), 1113.
Keil & Wolf, (2011). Coverage, continuity, and visual cortical architecture. Neural Systems & Circuits, 1(1), 17.
Keil, Kaschube, Schnabel, Kisvarday, Lowel, Coppola, White, Wolf. (2012). Comment on 'Universality in the Evolution of Orientation Columns in the Visual Cortex'. Science, 336(6080), 413.