BMC Neuroscience

Poster presentation

Open Access

Physics of psychophysics: optimal dynamic range of critical excitable networks

Mauro Copelli*[1] and Osame Kinouchi[2]

Address: [1]Laboratório de Física Teórica e Computacional, Departamento de Física, Universidade Federal de Pernambuco, 50670-901, Recife, PE, Brazil and [2]Departamento de Física e Matemática, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, 14040-901, Ribeirão Preto, SP, Brazil

Email: Mauro Copelli* - mcopelli@df.ufpe.br

* Corresponding author

from Sixteenth Annual Computational Neuroscience Meeting: CNS*2007
Toronto, Canada. 7–12 July 2007

Published: 6 July 2007

BMC Neuroscience 2007, **8**(Suppl 2):P174 doi:10.1186/1471-2202-8-S2-P174

A recurrent idea in the study of complex systems is that optimal information processing is to be found near phase transitions [1-3]. However, this heuristic hypothesis has few (if any) concrete realizations where a standard and biologically relevant quantity is optimized at criticality. Here we give a clear example of such phenomenon: a network of excitable elements has its sensitivity and dynamic range maximized at the critical point of a nonequilibrium phase transition. Our results are compatible with the essential role of gap junctions in olfactory glomeruli and retinal ganglion cell output. Synchronization and global oscillations also emerge from the network dynamics. We propose that the main functional role of electrical coupling is to provide an enhancement of dynamic range, therefore allowing the coding of information spanning several orders of magnitude. The mechanism provides a microscopic neural basis for psychophysical laws.

References

1. Langton CG: **Computation at the edge of chaos: phase transitions and emergent computation.** *Physica D* 1990, **42:**12-37.
2. Bak P: *How nature works: the science of self-organized criticality Oxford University Press, New York*; 1997.
3. Chialvo D: **Critical brain networks.** *Physica A* 2004, **340:**756-765.