

Percolation and propagation in living neural networks: why cultured neurons are limited

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The repertoire of activity patterns in neural networks cultured in vitro is surprisingly limited, taking into account the extraordinary computations that the same neurons can carry out in the brain. We review our recent work involving several simple experimental situations in which the underlying connectivity of the network, previously inaccessible, is revealed in detail. We show that the random, unguided manner in which connections are created in vitro limits the network.

We will present results from experimental systems include 1D patterned neural networks and a percolating 2D one. Their experimental and conceptual simplicity enables the precise comparison to theoretical models and an excellent agreement is obtained for: 1) The measured velocities of the propagating activity front, 2) Localization and interaction of "Burst Initiation Zones", 3) The decay of information transport as a function of distance and 4) The threshold and growth of the giant component in percolation.

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