Effective connectivity in a network of spiking cortical neurons

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The average cortical neuron makes and receives about 1,000 – 10,000 synaptic contacts. This anatomical information suggests that local cortical networks are connected in a fairly democratic manner, with all nodes having about the same degree. But the physical connections found in the brain do not necessarily reveal how information flows through the network. We used transfer entropy \cite{1} to assess effective connectivity in cortical slice cultures placed on a 512 electrode array system (in collaboration with Alan Litke of UC Santa Cruz). Data were binned at \textasciicircum1 ms and cultures (n = 6) were active for periods exceeding 1 hr, which allowed for accurate entropy estimation. Analysis revealed wide differences in node degrees, and pointed to the existence of cells with high effective connectivity that acted as highly central hub nodes in the network.

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