Reconstruction and Simulation of Neocortical Microcircuitry.

By esc_admin

Abstract:

We present a first-draft digital reconstruction of the microcircuitry of somatosensory cortex of juvenile rat. The reconstruction uses cellular and synaptic organizing principles to algorithmically reconstruct detailed anatomy and physiology from sparse experimental data. An objective anatomical method defines a neocortical volume of 0.29 ± 0.01 mm(3) containing ~31,000 neurons, and patch-clamp studies identify 55 layer-specific morphological and 207 morpho-electrical neuron subtypes. When digitally reconstructed neurons are positioned in the volume and synapse formation is restricted to biological bouton densities and numbers of synapses per connection, their overlapping arbors form ~8 million connections with ~37 million synapses. Simulations reproduce an array of in vitro and in vivo experiments without parameter tuning. Additionally, we find a spectrum of network states with a sharp transition from synchronous to asynchronous activity, modulated by physiological mechanisms. The spectrum of network states, dynamically reconfigured around this transition, supports diverse information processing strategies.

Journal:
Cell

Volume:
163

Issue:
2

Pagination:
456-92

Date Published:
2015 Oct 8

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