Feed-Forward Propagation of Information Between Neuronal Assemblies in Defined InVitro Cortical Networks

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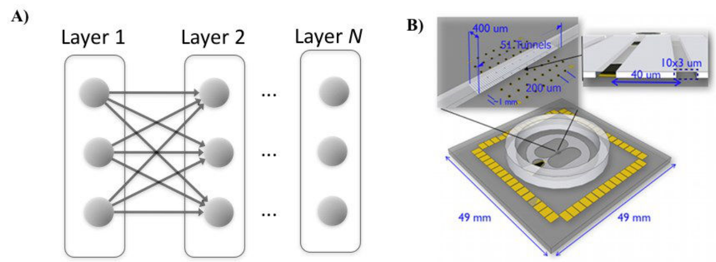
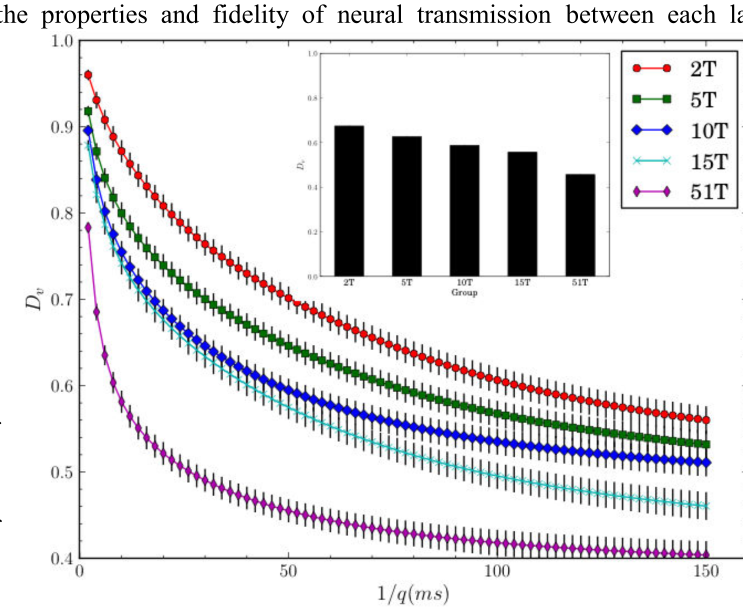
PROPAGATION of information across transiently active neuronal assembles is thought to underly many cognitive processes. The nature of the neural code embedded within the transmission of information between assemblies is however a matter of heated debate. Much of our understanding has been derived from computational models that make simplifying assumptions about the biophysical properties of neurons that may influence the nature of the code expressed within these models. To address this issue, we created an in vitro analogue of a feed-forward network (FFN) composed of two neuronal assemblies from dissociated rat cortical tissue. An array of MEMs micro-tunnels provided pathways to enable axon communication between each layer of the FFN. We then systematically manipulated the number of pathways (Tunnels) for axons to travel between each layer (2, 5, 10, 15, and 51 Tunnels) and assessed its effect on the properties and fidelity of neural transmission between each layer. Increasing the number of tunnels increased the fidelity (Victor-Purpura (dis)similarity) of neural transmission at rate based and temporal scales. Fidelity was also dependent on the distance information traveled, and appeared to be modulated in the gamma band. This tunnel technology can be easily expanded to include additional layers or employed as a model of specific in vivo neural architectures (e.g., hippocampus) providing an important tool for the exploration of information encoding, transmission, and retrieval among living neuronal assemblies.





This work was supported in part by the National Institute of Health under Grant NS05223

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