

Model: Ketamine Disrupts Theta Modulation of Gamma in a Computer Model of Hippocampus

Authors		
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Brief Description *		This is a model of CA3 region of hippocampus. It has 3 cell populations: pyramidal, Basket cells (fast spiking interneurons) and OLM-cells. It explores the effect of ketamine (NMDA receptor antagonist) on network dynamics, as measured by the effect on theta and gamma frequency bands of local field potentials.
Narrative *		The model consists of a networks of 1200 multicompartment neurons [pyramidal, basket, and oriens-lacunosum molecular (OLM) cells]. The network generated theta and gamma oscillations from intrinsic network dynamics: basket cells primarily generated gamma and amplified theta, while OLM cells strongly contributed to theta. Extrinsic medial septal inputs paced theta and amplified both theta and gamma oscillations. Exploration of NMDA receptor reduction across all location combinations demonstrated that the experimentally observed ketamine effect occurred only with isolated reduction of NMDA receptors on OLMs. In the ketamine simulations, lower OLM activity reduced theta power and disinhibited pyramidal cells, resulting in increased basket cell activation and gamma power.
Tags		computational, ketamine, NMDA, oscillations

Architecture

Diagrams	
<p>Pyramidal: 800 cells 5 compartments</p> <p>Basket: 200 cells 1 compartment</p> <p>OLM cells: 200 cells 1 compartment</p> <p>MS</p> <p>GABA ● AMPA ○ NMDA □</p>	<p>This shows how the 3 cell populations in the model connect together. It also shows the synaptic inputs into each cell population.</p>

Outputs		
Name	Data Type	Description
Local field potentials	hoc vector	simulated local field potentials calculated as the sum of differences in membrane potential between the most distal apical and the basal dendritic compartment overall pyramidal cells.

Spike times	hoc vector	records of the time of spikes for each cell in each of the populations.
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