Abstract View

REFINED MONTE CARLO MODELS OF NMDA RECEPTOR SIGNALING

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Optical measurements of synaptically activated calcium transients in single dendritic spines revealed that only a low number of NMDA receptors (NMDARs) open at the peak of synaptic transmission (Nimchinsky EA et al, J Neurosci. 2004). Moreover, variability in the calcium transient amplitudes was much lower than expected from such a small number of open NMDARs. Here we investigate various models that might reconcile the observed large dynamic range of NMDAR mediated synaptic transmission and small variability in calcium responses with previous observations of a lack of saturation of NMDARs. We use MCell, the Monte-Carlo cell simulator, to model the consequences of local clustering of NMDARs. A model of calcium-dependent NMDAR inactivation is implemented which results in variance dampening effects with increased inactivation at high ranges of calcium input. Other hypothetical phenomena such as receptor cooperativity and spillover are also investigated. The effects on the calculated variance are analyzed and compared.

Citation:D.X. Keller, A. Sobczyk, T.M. Bartol, K. Svoboda, T.J. Sejnowski. REFINED MONTE CARLO MODELS OF NMDA RECEPTOR SIGNALING Program No. 404.14. 2004 Abstract Viewer/Itinerary Planner. Washington, DC: Society for Neuroscience, 2004. Online.