Neuroscience 2015

Presentation Abstract

Add to Itinerary

Print

Program#/Poster#:	38.10/B81
Presentation Title:	An event-driven model of short-term presynaptic dynamics based on detailed molecular simulations with MCell
Location:	Hall A
Presentation time:	Saturday, Oct 17, 2015, 1:00 PM - 5:00 PM
Presenter at Poster:	Sat, Oct. 17, 2015, 2:00 PM - 3:00 PM
Topic:	++B.08.a. Short-term plasticity
Authors:	***J. W. GARCIA**[1], T. M. BARTOL[1], D. J. SPENCER[1], T. J. SEJNOWSKI[2]; [1]Salk Inst. for Biol. Studies, La Jolla, CA; [2]Howard Hughes Med. Inst., La Jolla, CA
Abstract:	Chemical synapses enable information transmission between neurons throughout the brain and are generally considered fundamental to learning and memory. We propose a novel model designed to efficiently reproduce their short-term dynamics. In biological synapses, action potentials trigger an influx of calcium ions through voltage-gated channels. These ions stochastically bind with the vesicular release machinery with some delay,

causing probabilistic release of neurotransmitter that occurs asynchronously with incoming spikes. Nonlinear calcium binding and unbinding kinetics both determine the timing of neurotransmitter release and enable facilitation of release probability between spikes, while depletion of the finite vesicle pool in the presynaptic space depresses the release probability. Although many synaptic models implement probabilistic release and some form of short-term plasticity, most of them do not take asynchronous release into account. Detailed molecular models of the presynaptic machinery, on the other hand, achieve all these features but with huge cost in computational efficiency. To investigate the significance of these dynamics in the context of larger networks, we designed our presynaptic model to capture the phenomenology of the molecular models while maintaining the speed and efficiency of the simpler models. The model achieves both probabilistic, asynchronous release and facilitation by matching the release profiles from detailed molecular simulations in MCell, and the time course for depression is implemented with exchanges between vesicle pools. The model treats spikes, releases, and vesicle exchanges as point events, allowing it to skip over intervening time without computational overhead by asynchronously calculating the timing of future events. It thus has significant advantages in biological realism, efficiency, and scalability.

Disclosures:	**J.W. Garcia:** None. **T.M. Bartol:** None. **D.J. Spencer:** None. **T.J. Sejnowski:** None.
Keyword (s):	PRESYNAPTIC MODELING
	SHORT TERM PLASTICITY
	VESICLE RELEASE
Support:	NIH P41-GM103712
	Howard Hughes Medical Institute

Note: *When adding items to your Itinerary, please click "Add Checked Selections to My Itinerary" on EACH page of your search results.*

OASIS Technical Support.
Monday - Friday, 9 am - 5 pm CT
Phone: 1-217-398-1792
Email: OASIS Helpdesk

Powered by OASIS

Services by CTT Coe-Truman Technologies, Inc.