BMC Neuroscience

BioMed Central

Poster presentation

Phase-locking in electrically coupled spiking neurons: the influence of intrinsic properties of neurons

Timothy J Lewis*

Address: Department of Mathematics, University of California, Davis, CA 95616, USA

Email: Timothy J Lewis* - tjlewis@ucdavis.edu

* Corresponding author

from Sixteenth Annual Computational Neuroscience Meeting: CNS*2007
Toronto, Canada. 7–12 July 2007

Published: 6 July 2007

BMC Neuroscience 2007, **8**(Suppl 2):P59 doi:10.1186/1471-2202-8-S2-P59

Electrical coupling between groups of inhibitory interneurons appears to be ubiquitous in the cortex. Because inhibitory interneurons are thought to play a fundamental role in generating cortical oscillations, phase-locking dynamics of electrical coupled interneurons has received considerable interest. A recent experimental study showed that electrically coupled neocortical interneurons have the ability to robustly synchronize over a broad range of frequencies and an inability to phase-lock in anti-phase [1]. How electrical coupling interacts with the intrinsic properties of neurons to generate stable phase-locked states remains unclear. Using the theory of weakly coupled oscillators and phase-response curves (PRC) from both real and model interneurons, I identify some of the intrinsic properties of neurons that determine the stability of phase-locked states and describe the underlying dynamical mechanisms. In the real and model interneurons that are examined, wide spikes and shallow action potential afterhyperpolarizations promote synchronous behavior; however, this property depends critically on the shape of the PRC. I discuss the combinations of PRC shapes and membrane potential time-courses required for stable synchrony and for stable anti-phase activity. I then use these results as a framework to examine how specific ionic conductances alter stability of phase-locked states.

References

1. Mancilla JG, Lewis TJ, Pinto DJ, Rinzel J, Connors BW: **Firing dynamics of coupled pairs of inhibitory interneurons in neocortex.** *J Neurosci* 2007, **27:**2058-2073.