MULTI-STABILITY OF IN-PHASE AND ANTI-PHASE ACTIVITY PATTERNS IN NEURAL NETWORKS WITH INHIBITORY AND ELECTRICAL SYNAPSES

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Abstract
As shown in modeling and experimental studies, network comprised of spiking cells interconnected by inhibitory and electrical synapses may express different activity patterns without any change of the network topology or parameters. In this study we confirm robustness of this phenomenon by demonstrating multi-stability of hybrid networks consisting of biological neurons of different types. Moreover we show here, using relaxation oscillator model cells, that multi-stability of in-phase (IP) and anti-phase (AP) patterns may be expressed in a network fully connected by instantaneous synaptic inhibition and electrical coupling independently of the network size. In such a network a stimulus of a given profile, consisting of depolarizing and hyperpolarizing signals sent to different subpopulations of cells, can evoke direct switching between IP and AP patterns. We also show that similar phenomenon occurs in more realistic network models with sparse connectivity. Our results suggest that transient signals if arriving in a proper time window may instantaneously reconfigure a given spatio-temporal activity pattern expressed by the network into another stable pattern without any change of the network properties.

Keywords: hybrid network, oscillatory microcircuits, patterns' switching