

Time Perception in an Adaptive Excitable System

Ying-Jen Yang^{1,2}, Chun-Chung Chen¹, Pik-Yin Lai^{1,3}, Chi Keung Chan^{1,3,*}

¹Institute of Physics, Academia Sinica, Taiwan

²Department of Physics, National Taiwan University, Taiwan

³Department of Physics and Center for Complex Systems, National Central University, Taiwan

***Email of Presenting Author: ckchan@gate.sinica.edu.tw**

Time anticipation is the ability of a system to produce transient oscillations with a period similar to that of a periodic stimulation after the stimulation is removed. However, the observations of anticipative dynamics in biological systems raise the question of the existence of a clock. Here we demonstrate that an excitable system, such as FitzHugh-Nagumo model with an adaptive excitability, will exhibit anticipative dynamics; suggesting that no such clocks are needed. In our adaptive model, the excitability of system is controlled by the external stimulations and will drive the system to move from an excitable resting state (with no external stimulation) to an oscillatory state (with external stimulations) which is synchronized with the external periodic stimuli. After the stimulations are removed, transient oscillations similar to the synchronized state will be sustained before the excitability of the system returns back to its resting value. Furthermore, since our adaptive mechanism requires that the excitability of the system increases with the frequency of the external stimulation, such an adaptive mechanism can be viewed as the facilitation of synapses in a neural system.