Topological changes and synchronization phenomena in a phase oscillator model motivated by jet-lag and social jet-lag problems

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Abstract

We analyzed the topological changes and the synchronization phenomena in a phase oscillators model, which reproduce qualitatively the experimental results about the behavior of mice under jet-lag conditions (recover from one abrupt change in the light input) for different levels of coupling between the neurons [1]. We considered a light input of one time zone for ld days and of another time zone for (7 - ld) days in order to emulate something analogous to the artificial light stimulus of people who suffer from social jet-lag. We found in the parameter space regions with bifurcations, bistability, period doubling and chaos, but in the majority of the space parameter the solutions are periodic. Also, due the high non-linearity of the model, in some specific regions of the parameter space there is a counter intuitive phenomenon: the individual spends more time in the week under a light stimulus A than B, and yet is better synchronized with the light stimulus B.

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Keywords: Social jetlag, chaos, synchronization, nonlinear dynamics

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