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Geometrical Approach of Bifurcations in Periodically Forced Morris lecar Neurons

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Abstract

In this paper, we investigate bifurcations observed in electrically coupled Morris Lecar neural model with periodically forced and direct current. we are interested in coupling two identical ML neurons, and used continuation method to obtain various type of bifurcations. Bifurcation theory is the mathematical study of changes in the qualitative or topological structure of a dynamical system. the Morris Lecar model has two different types of neuronal excitability (i.e. class I and class II excitability), when the parameters are set appropriately. we obtained and developed bifurcations of equilibrium points and limit cycles in this two classes of this dynamical system.

Keywords: Morris Lecar model, bifurcation, periodically forced, class I and class II excitability

1 Introduction

Various types of mathematical models have been proposed for studying dynamical properties of biological membrain. most of them are based on the Hodgkin Huxley [4] type of equations which originally described the electrically excitable characteristics of the squid giant axons. we investigate bifurcation in a model equation of Morris Lecar (ML) neuon with applying periodically forced current. it is a biological neuron model developed by cathy morris and Harol Lecar in 1981. here we select electrically coupling, so we have a conductance coupling ε, can be a parameter of bifurcation. we have a four dimensional nonautonomous system. A bifurcation occurs when a small smooth change made to the parameter values (the bifurcation parameters) of a system causes a sudden 'qualitative' or topological change in its behaviour. Bifurcations occur in both continuous systems (described by ODEs), and discrete systems (described by maps). the neuronal model exhibit properties of both type I and type II membranes excitability by setting of its system parameters. It is known that neuronal models are classified by the dynamical structure that underlies the onset of autonomous periodic firing. From a bifurcational point of view, the