SUPPRESS SPIRAL OF ACTIVE MEDIA USING LOGISTIC CHAOTIC SIGNAL

Jun Ma[1] and Yan-Long Li[2]

[1]School of science
Lanzhou University of technology, Lanzhou, P. R. China

[2]Institute of theoretical of physics
Lanzhou University of technology, Lanzhou, P. R. China

Abstract. In this paper, the chaotic signal generating from the Logistic Map, is imposed on the active or excitable media, which is described by the modified Fitzhugh-Nagumo equation (MFHE). In our numerical studies, appropriate intensities of the chaotic Logistic signal are used to stabilize the stable rotating spiral wave, meandering spiral wave and spiral turbulence generating from the MFHN with appropriate parameter regions. The distribution of frequency for the mean activator of all the sites is calculated, and the snapshots are also used to analyze the evolution of spiral wave and turbulence. It is found that stronger intensity can easily remove the spiral wave and turbulence and the whole media can become homogeneous within few time units. Furthermore, the spiral wave can breakup and encounter instability when the intensity of external noise exceeds a certain threshold.

Keywords. Fitzhugh-Nagumo equation, spiral wave, turbulence, Logistic Map.

AMS (MOS) subject classification: This is optional. But please supply them whenever possible.

1 Introduction

Spiral is a special regular pattern and is observed in experiments and numerical simulation in recent years. It becomes a more interest topic [1-6] in pattern formation when ventricular fibrillation (VF)[7] is regarded as the major reason behind sudden cardiac death especially in industrial countries. VF is turbulent cardiac activity in which rapid and irregular disturbances in the spatiotemporal electrical activation of the heart makes it incapable of any concerted pumping action. Because VF leads to death in few minutes, many studies of VF have been carried out in various mammalian hearts and mathematical models [3-4,8-12]. Fitzhugh-Nagumo (FHN) equation has been regard as an ideal model for VF, which can be in spatiotemporal chaos or shows spiral waves under appropriate parameters. Generally, defibrillation is tried by two methods, electrical defibrillation and injected medication, which yield results that are subject to chance. Electrical defibrillation entails the application of electrical jolts to the fibrillating heart to make it start beating