

# 实验性神经起步点自发放电的分叉和整数倍节律

古华光<sup>1</sup>、任维<sup>1</sup>、陆启韶<sup>2</sup>、杨明浩<sup>1</sup>

1 航天医学工程研究所

2 北京航空航天大学理学院

在实验性神经起步点发现了放电峰峰间期序列随细胞外 $[Ca^{2+}]$ 变化产生的加周期分叉和整数倍节律,并用确定性Chy模型和随机Chy模型进行数值模拟。从模拟实验结果的角度看,加周期分叉过程遵从Chav模型决定的确定性机制,随机因素对其有影响但影响较小;而在相应的参数区间,整数倍节律则是在随机因素驱动下产生,是随机共振现象,是由确定性机制和随机因素共同作用的结果。这表明:实验性神经起步点放电节律的分叉和随机共振现象的出现是必然的,受确定性机制和随机因素共同影响。但在不同参数区间,随机因素对神经放电节律的作用不同。

## THE BIFURCATION AND INTEGER MULTIPLE SPIKING IN THE EXPERIMENTAL NEURONAL PACEMAKERS

The period-adding bifurcation and the integer multiple spiking were observed in the experiments on the neuronal pacemakers when the extracellular concentrations of  $Ca^{2+}$  was changed. And the numerical stimulation was done through both the deterministic model and the stochastic model. The results show that the period-adding bifurcation obeys the deterministic mechanism decribed by Chay model and lightly affected by stochastic factors. In the corresponding parameter region, the integer multiple spiking generates only when the stochastic resonance. The generation of the integer multiple spiking is the interaction between the deterministic mechanism and the stochastic factors. The results revealed that the generation of the bifurcation and stochastic resonance is natural. It obeys the deterministic mechanism and is influenced by the stochastic factors, which play different roles in different parameter region.

### 关键词

神经元(Neuron pacemaker); 自发放电(Spontaneous discharge); 分叉(Bifurcation); 随机自共振(Autonomous stochastic resonance); 节律(Rhythm); 动作电位间期(Interspike interval)