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应用

一种变形Lorenz系统的混沌特性研究

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摘要：

在Lorenz混沌系统的基础上，加入周期策动力信号形成一种变形的Lorenz系统。利用广义哈密顿系统理论的梅尔尼科夫方法，证明变形Lorenz系统具有Smale马蹄变换意义下的混沌。利用功率谱、Lyapunov指数谱、庞卡莱映射等分析方法，进一步证明了变形Lorenz系统具有混沌系统的运动规律。变形Loren系统主要具有混沌态和类周期态两种状态。当系统处在一个临界状态，系统参数的微小变化就可以引起系统状态的性质变化，使最大Lyapunov指数由正变负。仿真实验表明该混沌系统对微弱周期信号非常敏感，同时对噪声具有极强的免疫力，这种性质使得混沌系统具有检测小信号的潜力，可以实现强噪声背景下弱周期信号有效的自动检测。变形Lorenz系统信噪比工作门限可达到-29dB，进一步优化系统参数，还可以继续降低信噪比下限。

关键词： 哈密顿系统；梅尔尼科夫方法；混沌系统；微弱信号检测；信噪比

The research on chaos characteristic in a deformable Lorenz system

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Abstract:

Based on Lorenz chaos system, a deformable Lorenz system is constructed by adding cycle motive power signals.The validity of Melnikov’s method in the generalized Hamilton proves that deformable Lorenz system has a deformation transformation in the sense of Smale chaos. The deformable Lorenz system is further proved that it has dynamical behavior, such as power spectrum, Lyapunov exponents pectrum, Poincare mapping.The deformable Lorenz chaotic system has two kinds of states, chaos state and class period state. When the system is in the critical state a small perturbation of the system parameters may lead to the qualitative change of the system state,making the maximum Lyapunov exponent from positive to negative.The simulation experiences show that the deformable Lorenz chaotic system is sensitive to weak periodic signals and this system can effectively restrain the strong noise,at the same time, the properties of which demonstrate their potential application in weak signal detection. The deformable chaotic system can detect weak periodic signals in strong noise effectively and automatically. The deformable Lorenz system has a stable working-detection limit of-29dB.If deformable Lorenz system further optimizes parameters of system,still can continue to reduce signal-to-noise ratio Lower limit.

Keywords: Hamilton system Melnikov method chaotic system weak signal detection SNR

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