

应用

阵列双稳随机共振在微弱信号检测中的应用研究

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摘要:

阵列双稳随机共振(stochastic resonance, SR)系统可利用噪声在单个双稳SR系统基础上进一步增强微弱信号检测的能力, 为强噪声背景下微弱信号的检测开创了新方法。本文应用阵列双稳SR原理进行微弱信号检测的研究, 采用理论和数值仿真相结合, 通过稳态自协方差函数, 分析了阵列双稳SR系统输出信噪比(signal-to-noise ratio, SNR)增益。在此基础上, 分别讨论了阵列噪声、外部噪声及阵列单元数对检测性能的影响。并与单个双稳SR检测弱信号进行性能比较, 分析和仿真结果都表明, 在相同条件下, 采用阵列双稳SR比采用单个双稳SR检测微弱信号性能有较大改善。这些研究结果对于阵列双稳SR的进一步发展及应用具有重要意义。

关键词: 微弱信号检测; 随机共振; 阵列双稳随机共振; 信噪比增益

Study on Application of Array Bistable Stochastic Resonance in Weak Signal Detection

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Abstract:

Noise can be used in array bistable stochastic resonance (SR) systems to furtherly enhance the ability of weak signal detection over isolated one. This leads to new methods of weak signal detection from heavy background noise. In this paper, we investigate a method of weak signals detection Noise can be used in array bistable stochastic resonance (SR) systems to furtherly enhance the ability of weak signal detection over isolated bistable one. This leads to a new method of weak signal detection from heavy background noise. In this paper, we investigate a method of weak signal detection using array bistable SR theory. By introducing stationary auto-covariance, we study the signal-to-noise ratio (SNR) gain by using both theoretical and numerical arguments. Based on this study, we analyze the effects of array noise, external noise and array sizes on detection performance. Finally we compare the corresponding detection method with the one using isolated bistable SR. Both theoretical analysis and numerical simulation show that the detection performance is much improved by using an array bistable SR than an isolated bistable one under the same conditions. Thus this study is significant for the development of array bistable SR theory and applications.

Keywords: weak signal detection stochastic resonance(SR) array bistable stochastic resonance signal-to-noise ratio(SNR) gain

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