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PDF文档

高维混沌降维的投影追踪主分量分析法

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一些生理信号,例如脑电是源自于高维混沌系统,因此低维混沌理论和方法不适用于分析这类高维混沌。采用投影追踪主分量分析法(Principal Component Analysis based on Projection Pursuit,PP PCA)对高维Lorenz模型系统进行了降维的研究。在用上述方法成功地对线性和非线性噪声周期模型分别进行PP PCA分析的基础上,对Lorenz高维混沌系统进行了PPPCA降维的研究。结果表明,正确选用非线性的投影追踪主分量分析法,可以通过简化原系统达到降维的目的,并能保留研究所关心的原系统的主要动态特性。同时也阐明了方法的稳定性和将该方法应用于高维脑电降维的可行性。

SIMPLIFICATION OF HIGH- DIMENSIONAL CHAOS BY PRINCIPAL COMPONENT ANALYSIS BASED ON PROJECTION PURSUIT

Since some physiological signals, such as EEG are generated from high dimensional chaotic system,low-dimensional chaos theories and algorithms are not suitable for them. To make feasible application of such theories and algorithms to high-dimensional system, a nonlinear technique called Principal Component Analysis based on Projection Pursuit (PP PCA) is introduced, which decomposes any signal into an orthogonal linear expansion of waveforms. These waveforms are selected to best match the signal structure.

First,an application of PP PCA to linearly and nonlinearly mixed noisy periodical signals is described. Next, multiple Lorenz attractor is formed. PP PCA is performed to simplify this high-dimensional system. Estimation of correlation dimension(D2) shows its effectiveness in reducing dimension, to make a simpler system. The important original information is also retained discussed. This simulation proves that it is possible to further apply PP PCA to high-dimensional chaos in EEG.

关键词

高维混沌(High dimensional chaos); 投影追踪主分量分析(Principal Component Analysis based on Projection Pursuit); 相关维数(Correlation dimension)