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基于ESN的航空发动机状态组合预测方法

ESN-based combination method for aero-engine condition prediction

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英文关键词: [aero-engine](#) [health prediction](#) [echo state network\(ESN\)](#) [wavelet analysis](#) [principal components analysis\(PCA\)](#)

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中文摘要:

基于回声状态网络(ESN)预测模型,结合小波分析和主元分析,提出一种组合预测方法.首先对含噪非线性时间序列进行小波降噪,并重构时间序列产生训练样本,再将训练样本通过主元分析进行降维处理,降维后的时间序列数据则输入ESN模型进行预测分析.对控制飞机动力输出的动压参数非线性时间序列数据进行了仿真对比实验,结果表明:组合预测方法的5步和单步预测速度累计提高了66.97%,预测的平均平方误差、标准均方根误差和归一化绝对误差也均有较大提高.该方法与传统基于ESN的预测模型相比,能有效地提高预测的效率和精度,是一种有效的非线性时间序列预测方法.

英文摘要:

As a nonlinear time series prediction method,echo state network (ESN) attracts more attention because of its good approximation capability for the nonlinear system.Aiming at the characteristics of nonlinear time series in the aero-engine's condition prediction analysis,such as noise and presenting chaos,a combination method based on ESN was proposed.Firstly,the noise contained in nonlinear time series was reduced by the wavelet analysis.Then the training sample data were yielded via phase space reconstruction of the time series.After reducing the dimension of the training sample data by principal component analysis,all the remaining principal data were sent into the ESN prediction model.An actual dynamic pressure time series of aircraft power was conducted.The experiments compare the proposed method with traditional ESN prediction model on prediction accuracy and time cost.The results show that the prediction accuracy rate of proposed method within 5 steps and one-step are totally raised 66.97%, and the prediction of the mean square error, normalized root mean square error and normalized absolute error are also improved simultaneously. The proposed method is an effective nonlinear time series prediction method in practice.

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