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流体力学与飞行力学

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### 基于ImOS-ELM的航空发动机传感器故障自适应诊断技术

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### Sensor Fault Adaptive Diagnosis of Aero-engines Based on ImOS-ELM

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摘要

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#### 摘要

针对在线贯序极端学习机(OS-ELM)算法矩阵容易陷入奇异和病态、在算法开始阶段不具有预测能力的问题,结合选择策略提出一种改进的OS-ELM(ImOS-ELM)算法。该算法通过引入正则化因子,消除了矩阵奇异和病态的问题,提高了预测精度,并使得算法能够在初始阶段就具有预测能力。同时以泛化能力为判断依据,通过选择策略对输出权值进行选择性地更新,该算法在很大程度上缩短了训练时间。为了验证算法的有效性,用时间序列数据进行了仿真测试验证。最后,将ImOS-ELM算法应用于航空发动机传感器故障的诊断与隔离。仿真结果表明,该算法能够对航空发动机双传感器偏置故障和单传感器漂移故障进行有效地诊断与隔离,并具有较高的预测精度和实时性。

关键词: 极端学习机 正则化 选择策略 航空发动机 传感器 故障诊断与隔离

#### Abstract:

On-line sequential extreme learning machine (OS-ELM) algorithm is likely to fall into matrix singularity and ill-posedness, and it has no predictive ability at the beginning stage of training. Hence, in this paper, an improved scheme with selection strategy, named improved OS-ELM (ImOS-ELM) algorithm, is proposed. This algorithm overcomes matrix singularity and ill-posedness by regularization, which can improve the predicting accuracy and achieve predictive ability from the start stage of training. Meantime, the output layer weight vector is updated selectively based on generalization capability, and it reduces considerably the mean training time of the algorithm. In order to verify the effectiveness of the proposed algorithm, simulation tests are carried out using time series data, which show that the proposed algorithm achieves higher accuracy and faster speed. Finally, ImOS-ELM algorithm is applied to the sensor fault detection and isolation of an aero-engine. The simulation results show that the sensor faults diagnosis method using the proposed algorithm is able to detect and isolate faults of double-sensor failures and single-sensor drift, which also proves the validity and feasibility of the proposed algorithm.

Keywords: extreme learning machine regularization selection strategy aero-engine sensor fault detection and isolation

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