

# 基于随机森林的核电厂系统故障诊断方法

## 摘要

实施快速、准确的故障诊断对于保障核安全十分重要，针对现有随机森林方法在核电厂故障诊断中未充分利用“类型-程度”关联信息的不足，建立了四种分类和回归融合随机森林的核电厂系统故障类型和程度协同诊断模型，结合故障仿真模拟数据测试对比了四种诊断模型的性能。测试结果表明，建立的四种分类和回归融合随机森林方法均可以实现核电厂系统故障类型及故障程度的协同诊断，相较而言，分层回归模型表现出较好的鲁棒性，诊断准确性显著优于其他方法。

## 关键词

核电厂；故障诊断；随机森林；分类和回归融合；分层回归；条件回归；多任务学习

## Abstract

Implementing rapid and accurate fault diagnosis is crucial for ensuring nuclear safety. To address the limitation of existing random forest methods that fail to fully utilize the “type-severity” correlation information in fault diagnosis of nuclear power plants, four collaborative diagnosis models integrating classification and regression with random forests are established for identifying both fault types and severities in nuclear power plant systems. The performance of these four models is compared and evaluated using fault simulation data. The test results show that all four proposed classification-regression integrated random forest methods can achieve collaborative diagnosis of fault types and severities. Among them, the hierarchical regression model demonstrates better robustness, with diagnostic accuracy significantly superior to the other methods.

## Keywords

Nuclear power plant; Fault diagnosis; Classification-regression fusion; Random forest; Hierarchical regression; Conditional regression; Multi-task learning

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