基于小波包和 SGD-XGBoost 的模拟电路故障诊断方法

莫太平，靳　鹤，石　鹃，詹　乐

(桂林电子科技大学 电子工程与自动化学院，广西 桂林 541004)

摘　要：为了提高模拟电路故障诊断中预测模型的诊断精度，提出一种基于小波包和 SGD-XGBoost 的模拟故障诊断新方法.该方法用具有深度分解能力的小波包变换获取故障特征，并利用比渐进梯度决策树(Gradient Boost Decision Tree，GBDT)更具明显优势的 XGBoost(eXtreme Gradient Boosting)算法进行故障诊断.在此基础上，选用简单且寻优能力强的随机梯度下降（Stochastic Gradient Descent algorithm，SGD）算法对 XGBoost 的学习率进行寻优，并构建出 SGD-XGBoost 模型.最后利用优化后的 SGD-XGBoost 模型进行电路故障识别分类.结果表明，XGBoost 算法优于在该领域应用较广泛的支持向量机和 BP 神经网络，且优化后的 SGD-XGBoost 诊断方法有效的提高了 XGBoost 算法的诊断精度，在故障占比为 10%时，诊断正确率为 93.75%.

关键词：随机梯度下降法；小波包变换；故障诊断

The Fault Diagnosis of Analog Circuit Based on Wavelet Packet and SGD-XGBoost

MO Tai-ping，JIN He，SHI Kun，ZHAN le

(School of Electronic Engineering and Automation, Guilin University of Electronic Technology, Guilin 541004，China)

Abstract：In order to improve the diagnostic accuracy of prediction model in analog circuit fault diagnosis, a new method of analog fault diagnosis is put forward, which bases on wavelet packet and SGD-XGBoost. This method uses wavelet packet transform with has a deep decomposition ability to obtain fault features, and uses XGBoost (eXtreme Gradient Boosting) algorithm with more obvious advantages than Gradient Boost Decision Tree (GBDT) for fault diagnosis. On this basis, Stochastic Gradient Descent algorithm (Stochastic Gradient Descent algorithm, SGD) with a simple and optimization ability is used for the learning rate of XGBoost, and constructing the SGD-XGBoost model. Finally, the optimized SGD-XGBoost model is used to classify circuit fault diagnosis. The results show that the XGBoost algorithm is superior to SVM and BP neural network, which are widely used in this field, and the optimized SGD-XGBoost diagnosis method effectively improves the diagnostic accuracy of the XGBoost algorithm. When the fault proportion is 10%, the diagnostic accuracy is 93.75%.

Key words：SGD-XGBoost；SGD；wavelet packet；fault diagnosis

作者简介：

莫太平　男，（1974-），博士，副教授，硕士生导师.研究方向为智能控制与模式识别.

靳　鹤（通讯作者）　男，（1992-），硕士研究生.研究方向为信号处理与集成和电路故障诊断.E-mail：15677338005@163.com.