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基于正则化多核判别分析的航空发动机滚动轴承早期故障融合诊断方法

Approach for incipient fusion fault diagnosis of rolling bearing of aero-engine based on regularized multiple kernel discriminant analysis

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中文摘要：
　　针对基于机匣测点信号的航空发动机滚动轴承早期故障诊断问题，提出了一种基于正则化多核判别分析的融合诊断方法.该方法首先提取多种类型的滚动轴承故障特征；然后采用相同的一组核参数为不同类型的特征分别构造一组核矩阵，并将所有核矩阵组合在一起；最后通过求解一个半无限线性规划得到该组核矩阵关于正则化核判别分析的目标函数的最优线性组合系数，进一步采用该系数计算所有核矩阵的线性组合，从而实现多种类型特征信息的融合.实验结果表明：该方法诊断正确率与采用单一类型特征诊断的最高正确率相比提高了9.25%，同时可以避免核矩阵需要人工选择的问题，从而进一步提高了故障诊断的自动化水平.

英文摘要：
　　To solve the problem of incipient fault diagnosis of rolling bearing of aero-engine based on the testing signal from engine case, a fusion fault diagnosis approach based on regularized multiple kernel discriminant analysis was proposed. In this method, firstly, several different types of features for the fault diagnosis of rolling bearing are extracted. Secondly, for each of these types of features, a group of kernel matrices are computed by the same set of kernel parameters respectively, then all of the kernel matrices are combined together. Finally, the optimal linear combination coefficients of the kernel matrices for the objective function of regularized kernel discriminant analysis are obtained by solving a semi-infinite linear program, then the linear combination of the kernel matrices was obtained by the combination coefficients to fuse the information of different types of features. The experimental results demonstrate that the proposed fusion fault diagnosis method can improve the accuracy of fault diagnosis about 9.25% significantly when compared with the diagnosis method using a single type of features,and can also improve the level of automation of fault diagnosis by avoiding the problem that kernel matrix must be selected manually.