

國科會計畫

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發展車輛起動馬達故障輔助診斷系統
Development of an Automotive Starter Motor Fault Diagnosis System

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中文摘要

本研究主要是計畫發展一套以車輛啟動馬達電流訊號為基礎之啟動馬達故障診斷系統。此一系統主要是打算利用主成份分析(principal component analysis, PCA) 與獨立成份分析 (independent components analysis, ICA)技術與三種不同架構的分類器所建構成的智慧型診斷系統。其原理主要是利用車輛啟動馬達輸出電流訊號中某些特徵，來預先得知啟動馬達內部元件狀況。傳統上，故障診斷方法依賴於技術人員的經驗，但有些不準確判斷故障可能是由於技術人員的經驗作出的主觀決定。此系統發展的主要目的在於利用定位性的察覺與智慧型的檢測方式，來預先得知啟動馬達的故障狀態，以有效監控車輛引擎的運轉機械運轉之狀態，並利於維修工程師之維護保養，以減少不必要的維護時間，並且避免更大損壞情況的發生。在本研究中，將利用主成份分析與獨立成份分析為特徵擷取的方法，藉此減少多餘的特徵向量，在輸出信號分類方面將使用幾種不同之分類技巧，如分類歸屬樹(classification and regression trees, CART)、決策樹 C4.5 (decision tree C4.5)及徑向基神經網絡(radial basis function networks, RBFN)來進行資料分類以減少直覺性評估的錯誤。本研究計畫以三年時間來深入進行相關性的研究與實現，包括車輛啟動馬達測試平台的建立、故障模擬與訊號特性之探討、主成份分析與獨立成份分析理論之實現、智慧型分類技巧的實際運用。最後期望將此系統應用於實際行駛中車輛之啟動馬達故障監控與輔助診斷。

關鍵字：電流訊號；故障診斷系統；車輛啟動馬達；決策樹；類神經網路

Abstract

The project proposes an automotive starter motor fault diagnosis system using component analysis and fault conditions classification based on a decision tree and neural network. Traditionally, the fault diagnosis method depends on the technician's experience, but some faults might be judged inaccurately due to the experience of the technician making subjective decisions. The purpose of the start system in a vehicle is to rotate the crankshaft smoothly to start the engine. In the present study, a starter motor fault diagnosis system is proposed and developed for the classification of different fault conditions. The proposed system consists of feature extraction using principal component analysis (PCA) and Independent components analysis (ICA) to reduce the complexity of the feature vectors, together with classification using the decision tree and neural network techniques. In the output signal classification, three of the regression trees (CART), Decision tree C4.5 and radial basis function networks (RBFN) are used to classify and compare the synthetic fault types in an experimental automotive starter motor platform.

Key words : Starter motor; Decision tree; Neural network; Independent component analysis; Fault diagnosis; Feature extraction