中文摘要

汽車自動變速箱之液壓控制系統構造精密且複雜，發生故障時往往會呈現模糊性及相關聯性，過去相關文獻指出關於汽車自動變速箱的故障診斷，大部分的研究只著重於在電子控制系統故障診斷，僅少部分著重在液壓控制系統之研究。

本文推導出三菱 F4A41 汽車自動變速箱液壓控制系統之各液壓元件的數學模式，包括有電磁閥、壓力控制閥及離合器/制動器/緩衝器，根據所推導的數學模式，使用 MATLAB/Simulink 軟體撰寫其模擬程式。再者比較模擬與實驗的結果，並對液壓元件數學模式中不確定的參數值進行參數辨識。依此研究發展出以數學模式爲基礎(Model-Based)與專家知識(Expert Knowledge)結合的汽車自動變速箱液壓控制系統故障診斷法則。針對汽車自動變速箱液壓控制系統中的液壓元件離合器/制動器及緩衝器常見的故障來做研究。經模擬測試後，可以成功用於自動變速箱液壓控制系統液壓元件的單一故障診斷上。

英文摘要

In the past, the developed diagnostic technologies for automatic transmissions of cars are most emphasized on the electronic systems. The faults occurred in the hydraulic control system of automatic transmissions are almost diagnosed according to the mechanic's experience and knowledge. Because the hydraulic control systems of automatic transmissions are sophisticated and complicated, when faults in the hydraulic control systems happen, the symptoms are mostly fuzzy and interrelated and hard to diagnose. It usually takes automotive mechanics several hours to several days to pinpoint the fault and fix it. It is a challenge to develop a methodology to diagnose the faults occurred in the hydraulic control systems of automatic transmissions.
Here we propose a model-based diagnostic technology. Based on a mathematical model of the hydraulic control system of an automatic transmission, the specific characteristics in the generated clutch pressure during gear shifting have correlation with specific component in the hydraulic control system. The correlation between the specific characteristics and the components will be described in detail in the paper. The clutch pressure during gear shifting was simulated in a software program written in MATLAB/Simulink software package. The clutch pressure was also measured from an automatic transmission mounted on a test rig in our laboratory. With both the simulated and measured results, the uncertain parameters in the mathematical model of the hydraulic control system were identified, using the optimization method provided by the MATLAB/Simulink software package. Then the correctness of the mathematical model is validated and verified. At last, a diagnostic methodology based on the expert knowledge was developed which evaluates the specific characteristics in the clutch pressure generated by the model-based software program. Some examples with the faults occurred in clutch subsystem and pressure control valve of the hydraulic control system will be illustrated in this paper. The diagnostic methodology based on the mathematical model and expert knowledge is proved to be a promising tool to diagnose the faults in the hydraulic control system of automatic transmissions off-line and on-line in the future?