四行程機車汽油引擎之動態性能模擬分析

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摘 要

本研究主旨在建立四行程機車汽油引擎機車動力系統控制、性能輸出之模擬軟體與引擎燃燒及進氣壓力、轉速、點火角度等之整合研究。配合量測，研究引擎之加減速時，動態特性與有相關影響之操作變數間之工程相關性，以建立性能與引擎控制參數和設計參數之間的關係。 本論文亦實際量測研究測試一部四行程機車汽油引擎之動態特性，由各種不同之穩態操作點，量取之引擎性能，如制動扭力、比耗油率、排放廢氣量等，與操作變數如轉速及油門開度之關係。 再由各種引擎加減速暫態負荷變化之模擬方式，與現有文獻及引擎動態模擬程式所使用之經驗工程相關性公式加以比較。 實驗設計量測之測試引擎動態數據，以作為將來設計製造引擎管理系統控制策略設定之參考。 本研究針對機車點火正時控制系統模擬，其測試條件設定在無負荷及固定負荷下，綜合扭力及轉速、馬力響應圖，可發現可變點火提前角度較能符合引擎工作狀態。以此測試之結果，所建構之點火正時控制器能依引擎轉速與負荷之變化而調整更能接近實際引擎性能。 經由機車引擎噴油安全失效模式之模擬結果可發現當感知器失效時，會對引擎性能造成相對程度的影響，像節氣門位置感知器、進氣歧管壓力感知器及轉速感知器對引擎性能影響更是明顯，在模擬中當進氣歧管壓力與轉速等感知器失效時，扭力會急速下降，而轉速也會呈現緩慢下降情形。由此系統模擬結果，可作為評估噴油安全失效控制參數之設定。 機車引擎動力系統動態模式，由輸入之量測實驗數據包括油門開度與引擎負荷扭力隨時間之變化，估計引擎空氣流量或空氣燃油混合比、容積效率，配合引擎管理系統控制策略設定之燃燒點火正時及噴油間隔與噴油正時參數調整以預估輸出之引擎轉速與進氣歧管壓力等隨時間之變化，與實驗量測值加以比對修正相關模型參數。本研究節省許多測試驗證的時間及費用，修正模擬動力系統動態模式以協助工程師評估機車引擎性能及改善設計、縮短研發試誤時辰。

關鍵詞 : 機車引擎動態性能分析 ; 引擎控制與性能輸出整合模擬

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