中文摘要

賓士汽車所使用的 ABC 主動式懸吊，此懸吊系統的設計，是在彈簧上方串聯一個油壓控制的致動器，以產生一力量來抵抗路面對車身所產生的震動與維持車身高度。藉由各感知器所接收的車輛動態訊號，經過電腦計算控制，改變彈簧係數與阻尼比以適應各種路況與駕駛需求。如此可增加車輛的乘坐舒適性，於加減速與過彎時減少車身滾動角度(roll)與車頭升降角度(pitch)，並隨車速與負載自動調整車身高度 。

本文利用自由體圖與力量平衡的觀念， 取 1/4 車 ABC 主動式懸吊系統之車身與輪胎之力量平衡數學方程式以及推導系統架構之狀態變數方程式。在液壓動力組件方面，利用流量公式與力量平衡的觀念，推導三通三位伺服閥的數學模式，其數學模式包括閥口流量,，閥軸力量平衡與油壓缸動態之數學模式，可用來模擬和分析懸吊系統之油壓變化與油壓元件的動態反應和特性。再依據先前所建立的懸吊系統的數學模式，使用 MATLAB 模擬程式，配合實驗設計法(Experimental Design Method)中之反應曲面法(Response Surface Methodology) 及多目標最佳值搜尋，調節辨識懸吊系統參數，使模擬結果和實際實驗之結果趨勢吻合。

英文摘要

ABC (Active Body Control) suspension system is used in the Mercedes- Benz vehicles. The major design of ABC suspension system links a hydraulic actuator located in the zenith of coil spring to generate a force to resist the body shock generated from the road and also maintain the body height. From the vehicle dynamic state signals receiving from each sensor, the spring coefficient and damping rations can be changed to adapt every kind of road condition and drivers' need through the calculating and control of computers. This design increases the comfort of the riding the vehicle, decreases the body pitch and roll angle when accelerating, decelerating and turning around, and speed-dependent reduction in the body height also improves aerodynamics.

By using the free-body diagram method and force balance concept, this paper has derived the car body and wheel force balance equations and state equations of the system frame for the quarter-car model of ABC suspension system. By using the flow equation and force balance concept, this paper also derives the mathematic modeling of the actuating elements of the hydraulic system including the solenoid force, orifice flow equation, the force balance equations of the armature for the 3/3 servo valve and the dynamic equation of the hydraulic cylinder. These models combined can be used to simulate and analyze the pressure variation of the suspension system and the dynamic responses and characteristics of the actuating elements. The parameters of this model will be obtained by experiments on the test rig in Vehicle Control Lab with Response Surface Methodology of Experimental Design Method and Multi-objective Optimization. The advantages of Model-Based approach are timesaving. By deriving the mathematic model, running computer simulation and validating by experiments, this Model-Based Diagnostics approach would make easy adjustments with new parameters for different suspension system.