摩托車動態與穩定性之研究

武英文、林海平

E-mail: 344755@mail.dyu.edu.tw

摘 要

在此研究中，使用Lagrange 方程式推導運動方程和其限制條件，在滾動不滑動的條件下，每一個腳踏車輪都有兩個完整和非完整限制條件。使得方程式具有DAE型式。此運動模型已藉由對照基準模型和實驗結果而被驗證其成效。 為了解運動方程式中的DAE並確保腳踏車模擬系統中數學的準確性，需要討論其限制條件處理的計算方法。基本上有兩種方法，第一為座標簡化法(coordinate reduction)，第二為內嵌法(embedding method)。另外三種數值法，Baumgarte，後穩定法(post-stabilization)和SMC後穩定法，在此用來修正並提升解題效率。上述方法的成效將被應用，並完成比較其計算時間和數值精確度之結果。 當腳踏車改變方向時，騎乘者總是必須去控制腳踏車的側傾角。換言之，控制側傾角為產生轉向或路徑跟隨的首要步驟。在本研究中，使用兩步驟做路徑跟隨控制。第一步驟，在側傾角跟隨控制器中，藉由控制轉向角轉矩，訓練其跟隨參考輸入，確保側傾角在不同情形下的穩定性。 第二步驟，發展路徑跟隨控制器以產生適當的參考側傾角，並讓側傾角利用模糊控制器可以跟隨預定義路徑。此控制法則之效果已藉由數學模型所推導的模擬結果證明。此控制法則之成效可用來評估不同之條件，包含：誤差資訊、預路徑設定、固定車速、變動車速和外部干擾因素。

關鍵詞 : 摩托車動態方程、多體系統、數值穩定、拉格朗日方程

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