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Effects of Interconnected Suspension Systems on the In-plane Dynamics of Sport Motorcycles

C. Moreno-Ramírez[*], M. Tomás-Rodríguez[#], S. A. Evangelou[†]

[*] Department of Industrial Engineering and Automobile
Universidad Antonio de Nebrija
C/ Pirineos 55, 28040 Madrid, Spain
e-mail: CMorenoRa@nebrija.es

[#] Department of Mechanical Engineering and Aeronautics
City University of London
Northampton Square, EC1V 0HB London, United Kingdom
e-mail: Maria.Tomas-Rodriguez.1@city.ac.uk

[†] Electrical and Electronic Engineering Department
Imperial College London,
Exhibition Road, SW7 2AZ London, United Kingdom
e-mail: S.Evangelou@imperial.ac.uk

ABSTRACT

The effects of interconnected front and rear suspension systems on the in-plane dynamics of sport motorcycle is investigated. The interconnected suspension mathematical description is presented and included in a high-fidelity motorcycle model. The suspension behaviour under road step bump inputs is studied for different values of stiffness and damping interconnection coefficients. Optimal values of interconnection coefficients are proposed for the current motorcycle model. Finally, the oscillating dynamics of the motorcycle at straight running conditions is studied through its normal modes.

Keywords: motorcycle dynamics, suspension systems, interconnected suspensions, stability analysis.

1 INTRODUCTION

Interconnected suspensions have been widely used within the car industry. Nowadays most of the marketed cars are equipped with antiroll bars that connect mechanically the two wheels of the front and rear ends separately. Although the connection between the front and the rear ends is not as usual as the anti-roll bars, some notable example has been marketed, being the 1948 Citroën 2CV the first mass production car fitting this system. No many companies have published research on this topic, although some literature can be found. This is the case of Creuat [1] that published its research on semi-active/passive connected suspension system [6] from which the Hydropneumatic Suspension Systems LTT-Creuat has being developed [2]. However, in the two wheels field, these systems are not extended. Although some proposal can be found such is the case of the bicycle concept demonstrator developed by [7].

The interconnection of the front and rear suspension primarily affects the dynamics of the motorcycle on its symmetry plane. In the present research the effects of the interconnected suspensions on the in-plane motorcycle's dynamics are investigated. Firstly, the mathematical description of