

# Numerical Investigation of Continuous Damping of The Semi-Active Suspension System for Passenger Car

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**Abstract.** The suspension of the car is considered an important element in the vehicle. The primary function of the suspension system is to isolate the vehicle structure from shocks and vibration due to irregularities of the road surface. There are two main objectives need to be satisfied which are: ride comfort and road handling. Ride comfort is inversely proportional to the absolute acceleration of the vehicle body, while the road handling is linked to the relative displacement between the vehicle body and the tires. This paper presented an attempted to enhance the performance of the shock absorber by developing a model of continuously variable damping (CVD). To evaluate the effect of the developed semi-active shock absorber on the dynamic behaviour of the vehicle, the model was analyzed and compared with the passive and On/Off sky-hook control strategy in the quarter car using two different types of road (random excitation, bumpy) as input to the quarter car model. Force hysteresis loop with different sets of orifice diameter was generated. The result indicates the CVD shows a reduction in both body acceleration and vertical displacement contrasting with passive and On/Off sky-hook 73.4% and 53.8% respectively and also the settling time by 79% and 59% for a bumpy road. This considered an improvement toward the ride comfort and vehicle stability. The simulated results for the quarter car model are shows similar trends and within range when compared with reference research paper.

**Keywords:** Vehicle Suspension System; CVD; controllable; absorbers; orifice.

## 1. Introduction

The concentration of researchers and automobile manufactures on suspension system back to decades of time as it improves the car stability, handling characteristics and provide more comfort to both the car and the passenger. The suspension system considered one of the most important parts of the vehicle toward the dynamic behaviour [1-5]. The history drawback that the passenger cars are the main land transportation ever used by mankind. Base on the controllability, the suspension can be divided into three types: passive or conventional, semi-active and active suspension [3]. The passive or conventional suspension comes with a fixed damping ratio by the manufactures where the users cannot change or adjust its dynamics properties, this will draw up a conflict between ride handling and comfort [4-8]. Active suspension is very convenient in term of performance toward the enhancement of vehicle dynamic behaviour and mostly used in luxury vehicles, despite that, it requires high power consumption, control units and high cost due to the complexity, and required hardware and software [7,8]. Lastly, the semi-active suspension system dispenses better performance once compared with the conventional, while with the active in term of cost reduction and simplicity [6,7].