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THE PID AND LQR ACTIVE CONTROL ASSESSMENT IN A SMART AUTOMOTIVE SUSPENSION SYSTEM WITH A FULL CAR MODEL

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Abstract. The noteworthy goal of the automotive industry and its engineers is to develop cars with better performance. Hence, this work aims to assess active control for active suspension development, offer-ing superior comfort for the driver. With this intention, the mathematical formulation of a full car model was developed and im-plemented in the MATLAB environment. For the road input, the bump input and road class excitation models were considered, according to ISO Standard 8608. Additionally, a performance comparison of two control strategies: the PID and LQR controllers are proposed. In respect to the bump input excitation, a more pronounced reduction of the vertical displacement with the LQR than the PID and a general smoothing of the response signal with the LQR were noted. Regarding the control analysis for the road class excitation, the LQR controller reduced the driver seat RMS acceleration from an uncomfortable assessment, as indicated by ISO Standard 2631.
Keywords. Vehicle dynamics; Full car model; Active control; PID, LQR; ISO Standard 2631.

1 Introduction

A comprehensive understanding of the physical phenomena involving vehicle dynamics leads to contemplating the possibilities in terms of developing and optimizing car systems. Implementing new technology or rethinking and improving an existing one are common tasks of an engineer. In this way, car performance is enhanced, lighter, safer, more comfortable, with less fuel consumption, and so forth.

To analyze the behavior of vehicles in movement, either to understand, predict or rectify its trajectory, it is necessary to grasp the physics involved and elaborate a mathematical model that rep-resents the real situation. In general, there are three study groups on vehicular dynamics: lateral dynamics, longitudinal dynamics, and vertical dynamics, as shown by Rajamani [1]. Depending on the analysis objective, the use of one or more types of models are applied. Thus, when the interest is in the lateral forces, on the vehicle stability and yaw, the lateral dynamics models fit better. When vehicle