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Simulation of a Control System for an Adaptive Suspension System for Passenger Vehicles

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Abstract : In the process to cope with the challenges faced by the automobile industry in providing ride comfort, the electronics and control systems play a vital role. The control systems in an automobile monitor various parameters, controls the performances of the systems, thereby providing better handling characteristics. The automobile suspension system is one of the main systems that ensure the safety, stability and comfort of the passengers. The system is solely responsible for the isolation of the entire automobile from harmful road vibrations. Thus, integration of the control systems in the automobile suspension system would enhance its performance. The diverse road conditions of India demand the need of an efficient suspension system which can provide optimum ride comfort in all road conditions. For any passenger vehicle, the design of the suspension system plays a very important role in assuring the ride comfort and handling characteristics. In recent years, the air suspension system is preferred over the conventional suspension systems to ensure ride comfort. In this article, the ride comfort of the adaptive suspension system is compared with that of the passive suspension system. The schema is created in MATLAB/Simulink environment. The system is controlled by a proportional integral differential controller. Tuning of the controller was done with the Particle Swarm Optimization (PSO) algorithm, since it suited the problem best. Ziegler-Nichols and Modified Ziegler-Nichols tuning methods were also tried and compared. Both the static responses and dynamic responses of the systems were calculated. Various random road profiles as per ISO 8608 standard are modelled in the MATLAB environment and their responses plotted. Open-loop and closed loop responses of the random roads, various bumps and pot holes are also plotted. The simulation results of the proposed design are compared with the available passive suspension system. The obtained results show that the proposed adaptive suspension system is efficient in controlling the maximum over shoot and the settling time of the system is reduced enormously.

Keywords : automobile suspension, MATLAB, control system, PID, PSO
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