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An Intelligent Controller Augmented with Variable Zero Lag Compensation for Antilock Braking System

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Abstract : Antilock braking system (ABS) is one of the important contributions by the automobile industry, designed to ensure road safety in such way that vehicles are kept steerable and stable when during emergency braking. This paper presents a wheel slip-based intelligent controller with variable zero lag compensation for ABS. It is required to achieve a very fast perfect wheel slip tracking during hard braking condition and eliminate chattering with improved transient and steady state performance, while shortening the stopping distance using effective braking torque less than maximum allowable torque to bring a braking vehicle to a stop. The dynamic of a vehicle braking with a braking velocity of 30 ms^{-1} on a straight line was determined and modelled in MATLAB/Simulink environment to represent a conventional ABS system without a controller. Simulation results indicated that system without a controller was not able to track desired wheel slip and the stopping distance was 135.2 m. Hence, an intelligent control based on fuzzy logic controller (FLC) was designed with a variable zero lag compensator (VZLC) added to enhance the performance of FLC control variable by eliminating steady state error, provide improve bandwidth to eliminate the effect of high frequency noise such as chattering during braking. The simulation results showed that FLC- VZLC provided fast tracking of desired wheel slip, eliminate chattering, and reduced stopping distance by 70.5% (39.92 m), 63.3% (49.59 m), 57.6% (57.35 m) and 50% (69.13 m) on dry, wet, cobblestone and snow road surface conditions respectively. Generally, the proposed system used effective braking torque that is less than the maximum allowable braking torque to achieve efficient wheel slip tracking and overall robust control performance on different road surfaces.

Keywords : ABS, fuzzy logic controller, variable zero lag compensator, wheel slip tracking
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