Development of Nonlinear Real-Time Intelligent Controllers for Anti-lock Braking Systems (ABS)

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ABSTRACT

The objective of the Anti-lock Braking System (ABS) is to control the wheel slip to maximize the friction coefficient between the wheel and the road, irrespective of the road surface and condition. The introduction of new braking system in road vehicles such as the electromechanical brakes used in brake-by-wire (BBW) system, which has a more continuous braking operation with a high level of accuracy, necessitates the continual review and improvement of the anti-lock braking system. From the control view point, therefore, more refinement of the ABS operation could be achieved with these improved hardware components. This thesis proposes a hybrid controller; combining feedback linearization and *proportional, integral and derivative* (PID) controllers, and a neural network-based feedback linearisation wheel slip controller. Furthermore, the thesis investigated the viability of a hybrid system of the proposed neural network and a (PID) wheel slip controller system. The hybrid systems, combines the accuracy of slip tracking ability of the PID controller and the robustness of the feedback linearization controller to achieve shorter stopping distance and good slip tracking. The performance of the proposed ABS systems are validated in software simulation and on a laboratory ABS test bench. The results for both controllers revealed their robustness to different road conditions and good slip tracking. This work further confirms the feasibility of a future neural network-based ABS controllers in road vehicles.

Keywords: Anti-lock braking systems, Wheel slip, Friction models, Neural networks, PID controller, Feedback linearization controller, Intelligent controller, Hybrid controllers, Real-time embedded systems.