Simulation and Validation Study of Intelligent 4WS By-Wire Drive and Handling Control Embedded System

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ABSTRACT

The purpose of this study is to establish an Intelligent Four-Wheel-Steer (4WS) By-Wired embedded Hardware-In-Loop, (HIL) platform environment. Matlab/Simulink program was used to establish 4WS vehicle dynamic control module and program was written into embedded MotoHawk ECU. The 4WS dynamic program was validated by commercial vehicle dynamic program CarSim under different vehicle handling operating conditions. The results showed the module predictions and errors are within engineering acceptable ranges. On the HIL, the steering wheel angle and vehicle speed signals were sent to LabView through CAN-Bus by using the NI PCMCIA CAN/2 card. BOSCH front and real steering wheel angle sensors also send feedback signals to CAN-Bus simultaneously. MotoHawk Read CAN block reads the steering wheel angle command, vehicle speed command, front and real steering wheel angle senser message. Input information are decoded and entered into intelligent 4WS By-Wired handling control and embedded system from there calculate the output front and real-time EPS By-Wired angle command, and output through the MotoHawk Send CAN Block send to CAN-Bus. NI PCMCIA CAN/2 card was used with LabView to read the message of front and real EPS By-Wired steering angle commands on CAN-Bus. The command message was decoded and turned to PWM signals to drive the SSR H-Bridge by NI USB-6251 DAQ card to control the front and rear steer motor output. Feedback signals from the front and rear steering wheel angles sensors to MotoHawk ECU which can be monitored and acquisitioned real-time information through MotoHawk support software MotoTune. This study used the MotoHawk for HIL embedded controller which was tested under three different vehicle handling test conditions including the Double Lane Change, (DLC), Sine Wave Steer, (SWS), and Step Steer Test, (SST). Results can be used for evaluating handling performance and improve handling steer control system parameters. Different vehicle design parameters and control parameter effects on the performance can be tested in this HIL environment. The rapid proto-type controller in this study can be used to develop the related 4WS vehicle target control modules for shorter time and lesser expanses.

Keywords : Intelligent 4WS By-Wired system、4WS Handling Dynamic Simulation and Control System、4WS By-Wired Embedded Hardware-in-Loop

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