

E.ENG.29

MODEL-BASED DESIGN/TESTING (AT THE H-I-L LEVEL) OF THE SPEED CONTROL SUB-SYSTEM OF AN ADAPTIVE CRUISE CONTROL IN AN AUTOMOBILE

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Speed control is one of the major activities done by automobile drivers. In a conventional vehicle, the driver has to adjust the braking and acceleration according to the situation. It can be a difficult and risky task when driving under heavy traffic conditions. So, having an automated speed and braking control system in vehicles is very useful for a driver to have a safe and comfortable journey. Adaptive Cruise Control (ACC) is such an automated system available in modern vehicles. However, ACC must be made error-free first.

Currently available ACC systems have a driver convenience feature to maintain a pre-set following distance from the preceding vehicle. When there is no vehicle in front, it controls the vehicle speed by adjusting throttle position to maintain a speed set by the driver. When a preceding vehicle is detected, ACC controls the acceleration and braking operations to maintain the set distance between vehicles without driver intervention. The ACC is expected to provide a safe way of driving and reduce the chance of accidents. However, there is a problem here: if the vehicle immediately behind is too close and accelerating, the risk of an accident is still very high, because the trailing vehicles may not have enough time to react to a sudden braking action of the ACC. We want to incorporate this aspect into the controller. Our objective has been to develop a speed control sub-system of an ACC along with a test-bed for testing its integrity using a model-based design/testing process on Matlab/Simulink/Stateflow and then to demonstrate the process through a Hardware-in-the-Loop (H-I-L) test using XPC-Target and Time Partition Testing (TPT). The speed controller sub-system of an ACC measures the actual vehicle speed, compares it with the desired one and corrects any deviations by accelerating or decelerating the vehicle within a predefined time interval. Afterwards, the vehicle velocity should be maintained constant, if the desired speed does not vary. The speed of the vehicle can be maintained by using a PI controller. PI controller calculates an "error" value as the difference between an actual vehicle speed and a desired vehicle speed. The controller attempts to minimize the error by adjusting the throttle position to maintain a speed set by the driver.

In this project, a simplified speed control sub-system is built using a model-based design process and tested to ensure the safety of the system. The system is tested at several testing levels using TPT test scripts before it is tested on the final hardware in order to identify the errors at early stages in the development cycle.