ABSTRACT

Braking Controller Parameter Optimization of Adaptive Cruise Control System based on Multi-objective Genetic Algorithm

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As the development of autonomous driving technology has accelerated in recent years, the ACC (Adaptive Cruise Control) system that gives the driver safety and reduces anxiety has been applied to most vehicles. The ACC braking controller receives the target deceleration from Radar and brakes the vehicle by generating pressure. It is important to select optimum parameters to minimize the error of the actual acceleration with respect to the target acceleration.

Currently, the parameter tuning method is to find the parameter that minimize the

error through repeated actual vehicle tests. However, the actual vehicle test requires a lot of time and resources such as vehicle preparation and equipment installation and it is not known whether the selected parameters may be the global minimum. In addition, in order to reduce the error, excessively large parameters cause overshot, discomfort to the driver with excessive braking power, and small parameters cause vehicle collision with insufficient braking power. To resolve these problems, the simulation-based tuning method is proposed to obtain optimum parameters of ACC braking controller.

The ACC braking controller was designed, a simulation environment was established in connection with the vehicle dynamics analysis program and the consistency of the simulation results was verified through a real vehicle test. Objective functions for optimization were selected in consideration of response time, overshoot, and ITAE (Integral of the Time-weighted Absolute Error) for securing the performance of the ACC braking controller. The surrogate model was created to reduce the simulation time and multi-objective genetic algorithm was applied to search optimum parameters. One of Pareto parameters are implemented in the real vehicle test and compared with the reference data. It is note that the response time is shortened by 4.0%, overshot is reduced by 47.6% and ITAE is reduced by 2.1%.