Study of Design and Implement of the Multiple-Cylinder SI Engine Fuel Injection Controller

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ABSTRACT

The purpose of this study is to build the fuel injection control system dynamic model for multiple-cylinder SI engine. The object-oriented dynamical simulation programs were integrated to establish the fuel injection system performance evaluation methodology. The amount of fuel injected is controlled by the PI controller so that the specified air-fuel ratio (A/F) goal can be maintained. The multi-objective optimization Design of Experiment (DOE) method was applied to find out the optimized model and controller parameters. The engine performance was correlated to the control parameters and the effects of each parameter on the performance were compared. The final control parameter settings can thus be chosen and implemented into controller chip by model-to-chip technology. The controller chip was developed under the Hardware-in-Loop, (HIL) base environment which incorporated the Motorola MC68376 chip as the design platform. This approach for EMS fuel injection controller can shorten the research and development time and rapidly establish the controller prototype. This study focused on developing a SI engine fuel injection controller by a virtue engine signal environment. The related controller input signals from engine were simulated by proper signal generation program to test the engine fuel injection quantity and its timing so that engine A/F could be maintained closed to the specified value even under different operating conditions for lowering the engine fuel consumption and emission. With proper chosen time-varying adaptive PI controller parameters, the fuel injection system control the engine A/F by feedback signals from the exhaust oxygen sensor or state variables in order to give proper correction for fuel injection amount. The multi-cylinder SI engine's predicting A/F model and the simulation environment of the controller were cooperated to revise the parameters of the PI controller for reaching necessary performance. The controller model was then separated on another computer to test, the integrated HIL which including the model-based mutual platform of controller model and the multi-cylinder SI engine model. The integrated methodology for HIL environment developed by this study can accumulate precious experience which will be helpful for the vehicle electronic control system design and manufacture. The vehicle electronic control system parameter's effects on the engine or vehicle driving performance can then be simulated quickly and their correlation will be important practical information for controller design and parameter evaluation.

Keywords : Hardware In the Loop, SI Engine Fuel Injection Control, Air Fuel Ratio Control

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