Simulation and Analysis for Four-Stroke Motorcycle SI Engine Dynamic Performance

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ABSTRACT

The purpose of this study is to establish a simulation program to evaluate the performance of a four-stroke, spark-ignited gasoline motorcycle engine. From the relationship between the engine performance and the operation variable and control parameters, the dynamic characteristics of the engine can be implemented. The engine output performance was tested under different testing conditions to analyze the internal correlation between performance and variables such as engine speed, intake manifold pressure, and spark advance etc. The assumptions and the approaching methods were modified by the experimental data to validate and to improve the performance predictions. The simulation program was based on the specific motorcycle engine test data; the related control system principles were incorporated to modify the dynamic performance response of the engine. The output of this simulation program including the engine speed and manifold pressure variation according to the variation of model input variables such as throttle position, engine load torque and fuel and spark control settings. The simulation program contains several submodels to calculate the needed parameters such as air-fuel ratio; volumetric efficiency to ensure different fuel mixture requirement can be achieved. The models were implemented through the graphic interface program into an integration interface between the engine performance and the control parameters and operating variables. This tool can be used in future EMS controller design and evaluation. This study compared the different engine dynamic performance during acceleration and deceleration and it also compared with the available correlation method from literatures. Measured dynamic performance data correlation can be used for future reference of the engine design and engine management controller settings. This study simulates the ignition timing control system, the test conditions set with different external loads and no-load. Compare the response results of power, torque and speed, the variable ignition timing controller can adapted the engine speed and load variation thus gave better performance. The simulation provides tools for future ignition module design and calibration. The simulation of fail-safe fuel injection system can show the corresponding performance drop for each or combined sensors failure conditions. The proper makeup for the substitution for other working sensor ’ s information can reduce the danger of failed sensor so that the engine can be safely operated. This fail-safe simulation provides the basis for evaluation of the fuel injection system design and improvement. With this dynamic performance simulation program, engineer can evaluate the variation in engine dynamic performance due to design change and different control settings, reducing the corresponding trial-and—error effort, saving the research and development time and cost.

Keywords : Motorcycle Engine Dynamic Performance Simulation ; Engine System Control and Performance Integration Evaluation

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