AN EXPERIMENTAL AND MODELING STUDY TO INVESTIGATE EFFECTS OF TWO-STAGE DIRECT INJECTION VARIATIONS ON HCCI COMBUSTION

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In this study, homogenous charge compression ignition (HCCI) combustion with two-stage direct injection (TSDI) strategies was modeled with stochastic reactor model (SRM) and validated by using the experimental results of the TSDI gasoline HCCI engine. For the experimental study, a diesel engine was converted to an electronically controlled HCCI gasoline engine. The effects of injection timings and injection ratios on the HCCI combustion characteristics were studied at high equivalence ratio and constant engine speed. The injection timings (first and second) and fuel quantity for each injection were adjusted to get desired mixture formation in the cylinder. During the experiments, the maximum cylinder gas pressure, pressure rise rate and start of combustion were directly controlled by using the second fuel injection timing and injection ratio. Using optimal second fuel injection timing and injection ratio caused a reduction on NOx and HC emissions. The model results of the HCCI combustion were in good agreement with the experimental results. Both of the experimental and modeling results showed that the second fuel injection timing had a strong effect on the HCCI combustion when compared to the first injection timing.

Keywords: 0D simulation; Experimental validation; Homogenous charge compression ignition; Stochastic reactor model; Two-stage direct injection

INTRODUCTION

Homogenous charge compression ignition (HCCI) is a form of internal combustion in which well mixed fuel and oxidizer are compressed to the point of auto-ignition. HCCI has characteristics of both homogeneous charge spark ignition (SI) and stratified charge compression ignition (CI), and has the potential to combine their best properties. The fuel and oxidizer are mixed together as in SI engines, but instead of an electric discharge to ignite the mixture, the pressure and temperature of the mixture are raised by compression until the entire mixture reacts simultaneously as in CI engines. The main characteristic of