Experimental and Computational Analysis of Fuel Mixing in a Low Pressure Direct Injection Gasoline Engine

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Abstract

An experimental and computational investigation of the fuel spray mixing in an optically accessible single-cylinder direct-injection engine under realistic operating conditions was performed. High speed flow visualization in the optical engine was performed with images taken at a rate of 10,000 frames per second. The numerical simulations were carried out using the KIVA-3V software, which uses the discrete particle method for modeling the spray, with the secondary droplet breakup modeled by the Taylor Analogy Breakup (TAB) model. The nozzle configuration, jet orientation, injection flow rate and other injection parameters were matched with the experimental conditions. The simulated spray patterns in the cylinder were shown to compare well with the fuel distribution images obtained from the high speed flow visualization. The computational and experimental results for the fuel impingement on the cylinder walls, piston and valves, and those for the spark plug wetting and evaporated fuel mixing indicate the strong dependency of the fuel-air mixing to the spray pattern.

Key words: high speed flow visualization, spray modeling, in-cylinder mixing, fuel impingement, spray pattern

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