Controlling Natural gas combustion timing in the HCCI engine with synthetic gas enrichment using a chemical kinetic model

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Abstract
In recent years, HCCI engines have been in the center of attention due to their high thermal efficiency, low emission rate (e.g. NOx), and low fuel consumption. The main drawback in these engines is combustion control which happens in limited operation range between knock and misfiring. Natural gas is a commonly used fuel in ICES. However, using natural gas in HCCI engines is challenging due to its low tendency to self-ignition. Hence, approaches like reformer gas enrichment should be employed. In this paper, a zero dimensional model which is compiled stand alone is introduced in order to predict combustion timing and investigate the effects of variable composition reformer gas with different content of H2 and CO. Experimental results from a single cylinder CFR engine is used to validate the proposed model. Results show that the addition of RG and changes in H2 content of RG can affect ignition timing and can be used in combustion control in HCCI engines which expand limit of operation, increases engine efficiency, and reduces fuel consumption especially in lower air/fuel ratio and inlet temperature.

Keywords: Homogeneous Charge Compression Ignition, Single-zone model, Start of combustion, Combustion control, Reformer Gas enrichment