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論　文　要　旨
Thesis Abstract

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主論文題名　(Title)

Cylinder Pressure-Based Adaptive Air-Fuel Ratio Control and Compression Heat Transfer Analysis

内容の要旨　(Abstract)

This thesis presents cylinder pressure-based adaptive air-fuel ratio control and compression heat transfer analysis. In the first main part, we focus on the air-fuel ratio (AFR) estimation and control. The static AFR calculation model based on in-cylinder pressure data and on the adaptive AFR control strategy is presented. The model utilizes the intake manifold pressure, engine speed, total heat release, and the rapid burn angle, as input variables for the AFR computation. The combustion parameters, total heat release, and rapid burn angle, are calculated from in-cylinder pressure data. This proposed AFR model can be applied to the virtual lambda sensor for the feedback control system. In practical applications, simple adaptive control (SAC) is applied in conjunction with the AFR model for port-injected fuel control. The experimental results show that the proposed model can estimate the AFR, and the accuracy of the estimated value is applicable to the feedback control system. Additionally, the adaptive controller with the AFR model can be applied to regulate the AFR of the port injection SI engine. For the second part, we present an estimation method for the compression heat transfer and its application. Based on the first law of thermodynamics, ideal gas law, and some assumptions, the state-space model for the compression process can be derived. During the compression stroke, the heat transfer to, or from, the cylinder walls can be computed using the least squares regression. The identification results show that the proposed method can estimate the amount of heat transfer and its direction. Additionally, these results can be applied to evaluate the polytropic exponent variation, which is affected by heat transfer. This variation is mainly attributed to both the quantity and direction of heat transfer. Moreover, we also discuss the analysis methodology and possible ways for improvement of the heat transfer estimation method.

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