

A Study on Lean Turbulent Premixed Flame and Its Nonlinear Controls by Multi-Dimensional/Multi-Variable Laser Diagnostics and Large-Scale DNS

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【Outline of survey】

To overcome the recent environmental problems, development of high efficiency and low emission combustors is required. Flow fields of various combustors are in turbulent state, whereas details of the turbulent combustion have not yet been clarified. Therefore, the combustors in many applications have been developed through a trial and error process. In this study, lean turbulent premixed flame, which is a promising combustion technology for high efficiency and low emission combustors, is investigated by multi-dimensional/multi-variable laser diagnostics and large-scale direct numerical simulation (DNS) to develop a nonlinear active control scheme based on a nonlinear relation between turbulent flame structure and pressure fluctuation in the combustor. Furthermore, a sensor for monitoring combustion state, a control device and an active control algorithm are comprehensively developed to realize high efficiency and low emission combustors based on the nonlinear active control scheme, and a simulator for turbulent combustion controls based on large eddy simulation with high accuracy turbulent combustion model is constructed for estimation of control efficiency and low cost design of the combustors in many engineering applications.

【Expected results】

In this study, a sensor, a control device and an active control algorithm, which are important for the nonlinear active control of the combustor, will be comprehensively developed. Nonlinear relations between local flame structure in turbulence and combustion oscillation (or combustion noise) will be clarified by large-scale DNS and multi-dimensional/multi-variable laser diagnostics, and an active combustion control scheme based on the nonlinear relations will be established. The results of this study will realize high efficiency and low emission combustors such as gas turbine, and will contribute to conquest of the environmental problems.

【References by the principal investigator】

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- M. Tanahashi, S. Taka, M. Shimura and T. Miyauchi, CH Double-pulsed PLIF Measurement in Turbulent Premixed Flame, Experiments in Fluids, in press.
- M. Tanahashi, Numerical Simulation of Combustion, Maruzen (2001).

【Term of project】 FY2008—2012

【Budget allocation】

75,800,000 yen (direct cost)

【Homepage address】

<http://www.navier.mes.titech.ac.jp/>