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Bing Wang

Tsinghua University, China

Numerical analysis of combustion instabilities in different engines

Combustion instabilities, characterized by high amplitude pressure oscillations, widely occur in power devices and propulsion engines, especially under the extreme flow conditions. However, it is usually difficult to measure the pressure oscillations and heat release simultaneously. Therefore, numerical analysis has become one of important research approaches for study on combustion instabilities. Considered the flow compressibility of the unstable combustion, high-order numerical schemes are necessary for resolving the local high pressure oscillations, and moreover the careful treatments of chemical reaction should be taken for proceeding numerical simulation stable and fast. The present authors have tried to establish a high-resolution numerical solver for computing the incompressible/compressible reactive flows. This presentation will introduce and compare the numerical procedures acquired in this solver for computing the fluxes using different hybrid WENO schemes, dealing with chemical stiffness problems, and their interaction with the compressible fluids. As examples, the high pressure diffusion combustion in liquid rocket engine combustor is numerically simulated and the high frequency acoustics instabilities are detailed to reveal the physics mechanism, which is founded by the present authors that local quasi-constant volume combustion, regarded as local hotspots, will drive the high pressure oscillations. The similar analysis was done in the lean premixed combustion of a model turbine combustor. The present authors also find the local hotspots in the supersonic mixing layer flows which are employed in the combustor of the scramjet. Many other important characteristics of flow/flame structure and ignition/extinction are analyzed under the supersonic flow condition.

Biography

Bing Wang worked as a Visiting Researcher at Technological University of Munich as a Humboldt Fellow. He is now the Vice Deputy Director of School of Aerospace Engineering, Tsinghua University. He has published more than 40 papers in reputed journals and has been serving as an Editorial Board Member of *Journal of Engineering*. His research interests include fundamentals of turbulent combustion and multiphase flows, combustion instabilities and new conception propulsion, combined cycle power (RDBCC, RBCC, TBCC) and scramjets.

wbing@mail.tsinghua.edu.cn

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