SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations (IP)

Author: Dr. Yi Wang
Xi'an Aerospace Propulsion Institute, China, wangyibuaa@126.com

Dr. Baoyuan Wu
China, wuby_xa@qq.com
Dr. Yuanqi Li
Xian Aerospace Propulsion Institute, China, liyq1_casc@163.com

THE TRANSIENT FLOW CHARACTERISTICS INVESTIGATION OF THE WAKE BEHIND A TRIANGULAR FLAMEHOLDER IN RAMJET COMBUSTOR

Abstract

Bluff body flameholders are widely used for stable combustion in ramjet combustors with high velocity flows. The relevant research has indicated that their flame-holding performance greatly depends on the wake flow structure behind the bluff body. The wake flow contains complex phenomena of separation and recirculation, shear layer flow, and vortex shedding dynamics. An in-depth knowledge of it can have certain guiding significance for the combustor design. However, as almost of the simulations were based on time-averaged methods and were generally limited to 2nd order accuracy, the study of the flow structure details has not been completely explored.

In this paper, in order to capture the transient flow characteristics accurately, the implicit large eddy simulation (ILES) with Discontinuous Galerkin method (DGM) based on open-source code Nektar++ is adopted. The method secures geometric flexibility through hybrid unstructured meshes, allows for high-order accuracy and has excellent stability properties. The compressible flow solver provided by Nektar++ is applied to simulate the transient wake flow behind a triangular flameholder with different inflow velocities. The transient wake flow structures and statistical flow quantities, especially the corresponding frequency spectrum are analyzed.

The simulation results show a fair agreement with the reference experiment. The analysis results indicate that the wake flow is a kind of quasi-periodic flow and the peak in the frequency spectrum becomes higher with the increase of inflow velocity.