IAF SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic Air-breathing and Combined Cycle Propulsion (9)

Author: Dr. Yi Wang
Science and Technology on Liquid Rocket Engine Laboratory, Xi'an Aerospace Propulsion Institute, China, wangyi_x11@outlook.com

Dr. Baoyuan Wu
China, wuby_xa@qq.com
Mr. Sigang Yu
Northwestern Polytechnical University, China, sgyu@mail.nwpu.edu.cn

# CFD INVESTIGATION OF RAMJET FLAMEHOLDER NEAR-WAKE FLOW BASED ON OPENFOAM FRAMEWORK

**Abstract**

Bluff-body flameholder is widely used for stable combustion in ramjet chamber. As it creates a low-speed area to prevent flame blowoff, the unsteady near-wake vortex shedding phenomenon has a significant influence on performance of combustion. Based on the facts above, extensive CFD (Computational Fluid Dynamics) research on flameholder wake flow has been carried out since 1970's. However, there is still a great challenge to have an intensive CFD study of the turbulent flow, on account of the complex flow separation and vortex structure.

In this paper, the wake flow of Volvo bluff-body structure tested by Sjunnesson et al in 1991 is simulated based on OpenFOAM framework with different turbulence methods, varying from RANS (Reynolds Averaged Navier-Stokes), LES (large eddy simulation) to hybrid RANS/LES turbulent simulation methods. The simulation results are compared with experimental result to assess the suitability of relative turbulence simulation methods. With the results of simulation and experiment, the wake flow characteristic is analyzed.

The results show that RANS turbulent models are unsuitable due to the excess simulated turbulence dissipation in large-scale separation area; While LES methods can obtain the fine vortex structure, they are still limited by enormous computation burden; The hybrid RANS/LES methods which combine the advantages of both are appropriate in bluff-body flow with acceptable accuracy and controllable computation resources. Among different hybrid methods, SAS (Scale-adaptive simulation) method might a more reasonable approach.