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NUMERICAL SIMULATION OF TURBULENT FLOW AND COMBUSTION IN RAMJET CHAMBER WITH NON-UNIFORM INFLOW

Abstract

With the development of Integral Ramjet Engine, many kinds of lateral air intakes have been widely used for higher performance and integration. But simultaneously the non-uniform outflow puts forward new demands and challenges for combustion chamber design. In the relative research, the simulation of the whole ramjet internal flow, which is computing resource intensive and simulation period long, has been carried out.

In this paper, a CFD (computational fluid dynamics) method combining steady and unsteady simulations is used to study the ramjet chamber flow and combustion situation with "real" inflow condition. A bluff-body stabilized chamber connected with chin inlet is studied. Firstly, the steady-state simulation of the whole internal flow is conducted to obtain the non-uniform chamber inlet boundary condition. The chamber transient flow fields with non-uniform and equivalent uniform inflow conditions are simulated respectively. The influence of inflow uniformity is estimated.

The results show that the uniformity of intake outflow increases with the reduction of chamber excess air coefficient. The comparison indicates that the non-uniform inflow leads to complex upstream and wake flow of flameholder, resulting in low combustion efficiency. The bluff-body flameholder is capable of reducing the inhomogeneity of downstream flow field, having a positive impact of combustion organization.