IAF SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic Air-breathing and Combined Cycle Propulsion, and Hypersonic Vehicle (7)

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AERODYNAMIC STUDY OF LARGE-SPACE INTEGRATED MORPHING AIRCRAFTS

Abstract

With the development of science and technology,atmosphere,near-earth space and outer space have aircrafts.Aircrafts in the atmosphere but different height or speed are different.One kind of aircrafts can only be used in specific airspace,the others need to cross the spaces.However,space is a continuous system of the atmosphere,near earth space and deep space.There are some physical changes in the inner and outer space of the atmosphere,but there is no absolute boundary.It can be regarded as an integrated space with changes.For flying better,we need to study the integration of the different spaces.

Aircrafts flying in different spaces have different characteristics.From the perspective of aerodynamics,they have the following characteristics:

(1)Wide speed range:from low speed to supersonic and hypersonic;

(2)Seamless:from ground to space;

(3)Complex shape:single body,multi-body,complex;

(4)Multiple physical factors:gas,electricity,magnetism,high temperature,material,control system,signal transmission,etc.

The integration of different spaces is a comprehensive problem.One way is to continue the previous researches,combine or expand again to eliminate the "boundary".For example,multi-body separation is an example of passive adaptation to the integration of large-space and aerospace with combination and superposition of different aircrafts in different areas.

Another way is that there is no boundary between spaces,and they are "integrated".The concept of integration is used for research and application,such as reusable spacecraft,morphing aircrafts,etc.The physical model includes different velocities, continuous flow,rarified flows,etc.

The aerodynamic characteristics of morphing aircrafts are used to study the integration of large-space and aerospace. In general,the following problems need to be solved:

(1)The numerical model for morphing vehicle;

(2)The dynamic grid method suitable for small and medium displacement of rigid bodies;

(3)The numerical simulation technology for unsteady aerodynamic;

(4)The dynamic integrated numerical calculation technology for morphing aircrafts;

(5)Rigid body active deformation method;

(6)Aerodynamic mechanism of active deformation around the body surface;

(7)Comprehensive system of aerodynamic characteristics numerical simulation technology for large-space and wide speed range morphing aircrafts.

According to the characteristics of subsonic,transonic and supersonic, develope the numerical model of morphing airfoil suitable for different velocities,establish the dynamic grid technology and the numerical simulation method of morphing aircrafts preliminarily.On the basis of the above,study the rigid active morphing method and the morphological mechanism,the influence of the time sequence of morphing wings,such as speed,height,the change mode and the change rate of morphing wings on the aerodynamic characteristics,the change process of morphing wings,such as linear,a specific function or law on aerodynamic performance.The influence of unsteady aerodynamic characteristics on flight control caused by the dynamic boundary effect under supersonic and hypersonic conditions,etc.