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INTERNAL PRESSURE DESIGN OF HYPERSONIC REUSABLE SPACE VEHICLE

Abstract

Hypersonic Reusable Space Vehicle (HRSV) is a kind of reusable space vehicle which can quickly access to the space, maneuver in-orbit, reenter the atmosphere and finally land on the earth ground. Because HRSV has to quickly access to the space and return, its dynamic environment is quite different from the one of traditional launch vehicle, manned spacecraft and recoverable satellite. Although lots of Computational Fluid Dynamics (CFD) analysis and flight experiments have been achieved to study the distribution of external pressure on space vehicle surface, the research on internal pressure inside space vehicle has not been widely discussed. Based on plenty of theoretical analysis and practical measurements, the active and passive air inflation/deflation system has been considered as an important part of HRSV to avoid the vehicle damage induced by the internal pressure. Focus on the full flight trajectory of HRSV, this article is dedicated to the internal pressure design. Combining the CFD and quasi one dimensional isentropic flow design methods, the effects of passive air inflation/deflation system on the internal pressure and pressure load on HRSV is studied and the design requirement for the passive air inflation/deflation system is also proposed according to the pressure limits of space vehicle structure. The results reveal that the maximum peak value of flight pressure load induced by the internal and external pressure will appear when the flight height and speed violently change, and the space vehicle loading and structure designs should be modified according to the internal pressure design results.