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Author: Prof. Shigeru Aso
Kyushu University, Japan

Dr. Yasuhiro Tani
Kyushu University, Japan
Mr. Kosuke Miyahara
Kyushu University, Japan

AERODYNAMIC STUDY OF ADVANCED SPACE TRANSPORTATION SYSTEM WITH MORPHING CONCEPT FOR WIDER CROSS RANGE AND DOWN RANGE

Abstract

The flight regimes of RLV must cover from hypersonic regime to subsonic regime. Therefore, conventional space transportation systems, whose geometry is designed mainly for reentry phase, could not always realize best aerodynamic performance in all flight conditions. In order to overcome those problems, a new concept of space transportation system named Morphing Space Transportation System, whose configuration changes in order to realize higher aerodynamic performance at each flight regime, has been proposed by the present authors. In our previous studies on fully RLV, the present authors discovered a vehicle, whose fuselage has cross section of triangle, has high aerodynamic characteristics in subsonic flight regime. By using this configuration as base line model the present authors have applied to morphing technique to all flight regimes. For strategy of development of promising configuration of morphing space transportation high lift to drag ratio (L/D) and high lift coefficient (CL) are important. Also the candidates of morphing configuration should satisfy the proposition that all candidate configurations should be realized by deforming baseline configuration. Higher L/D results in wide cross range and long downrange as well as higher levels of maneuverability. On the other hand, higher CL enables the vehicle to land at lower landing speed, and thus led to increase in safety and choices of runway. For subsonic flight regime experimental studies have been carried out for morphing reusable launch vehicle. Two wing-body model configurations of sharp-edge and strake configurations at bottom edge of triangle cross section fuselage are selected to improve aerodynamic performances. At same angle of attack CL of sharp edge configuration shows 40For supersonic/hypersonic flight regime sharp nose and high swept back wing configuration is selected in order to reduce wave drag. Various nose configurations and anhedral angle of wings or planform of wings are proposed. Some configurations are tested in supersonic wind tunnel. Also several models are investigated by numerical analysis with verification with supersonic wind tunnel testing. Through many simulations a combination of sharp nose and high swept back wings with blended connection between nose body and wing shows highest L/D of 5.8 at M=4 in the present numeical simulation.