IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Technologies for Future Space Transportation Systems (5)

Author: Mr. Sambit Supriya Dash
Indian Institute of Technology, Madras, India, sambitd0@gmail.com

Mr. Kevin Dankhara
Omspace Rocket and Exploration Pvt Ltd, India, kbdankhara03@gmail.com
Mr. Ravindra Raj B M
Omspace Rocket and Exploration Pvt Ltd, India, admin@omspace.in
Mr. Aditya Virkar
Embry-Riddle Aeronautical University, United States, adityagvirkar@gmail.com
Mr. R S G Shanmukh
India, mail2shanmukh98@gmail.com

INTENSIVE STUDY ON SLV'S NOVEL NOSE CONE SHAPES IN VARYING SPEED REGIMES FOR LANDING SAFETY, LAUNCH SPEEDING AND ENHANCING EFFICIENCY

Abstract

Since ages, aerodynamic drag and heating in re-entering, planetary landing and launching has been a point of major concern. Thus far, witnessing through studies and practicality shown the evolution of usages from hemispherical series, ellipse, hack and ogive series for space launch vehicle nose design. This research work comprises of study of aerodynamic and heat flux parameters intensively in subsonic, transonic and supersonic regimes that's along a journey of a SLV. Crux of the article highlights its novelty through proper design in CAD software CATIA V5 and computational comparative analysis with the aid of ANSYS platform on Fluent method, of various unique nose cone shapes such as (i) blended shape nose cones (blending and tapering the combination of parabolic concave, parabolic convex, elliptic and hemispherical), (ii) embarked tipped nose cones, (iii) dimpled-biased nose cones and (iv) spiked nose cones, with variation in individual sizes. The basis of performance quantification has been taken in terms of aerodynamic parameters and heat conduction parameters for SLV's nose cone shape along the varying speed range of the vehicle. The qualitative relations and results would facilitate in prototyping possible design to provide the control/balance of both aerodynamic drag coefficient and surface heat flux for SLV. In case of required fast orbital launching the shape of cone should be penetrating the shock barrier to gain an increase rate of momentum, in contrast the landing case requires the drag as alliance and a much blunt cone would be used. In any operating condition, the heat transfer to the surface of vehicle shouldn't be significant, through the aspect of nose shape analysis optimum proportion of both parameters would be upraised. This study would mostly useful for in-operation convertible nosecones in future via technological advancements(e.g shape memory alloy, mechanical sensors) for enhancing efficiency and increasing safety of vehicle, crew/astronauts/systems from heating by adapting the shape required for varying surrounding conditions.

Keywords - Variable Nose Cone, Own Defined Nose Cones, Aerodynamic Drag, Heat Transfer, Conditional Shape Analysis