SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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SHAPEABLE HYPERSONIC WAVERIDER FOR MARS ENTRY

Abstract

A preliminary analysis of atmospheric entry of a lifting vehicle suggests that the primary performance metric is mass divided by the lift coefficient and reference area, termed the *entry parameter*. Systems for which this metric is minimized yield the most advantageous entry conditions, reducing aerothermal heating and peak deceleration while the lift-to-drag ratio affects the glide distance and cross-range available for course correction. The hypersonic waverider is a class of vehicles for which a shock is attached everywhere along the leading edge and the post-shock conditions in the near-body flow field are everywhere supersonic. The high pressure, post-shock flow field is captivated between the body and the shock, yielding significant performance advantages in maximizing lift, the lift-to-drag ratio, and the entry parameter compared to other generic hypersonic vehicles, suggesting their desirability for atmospheric entry. Prior work has demonstrated the capability of waverider geometry for a flexible actuated lower surface to enable on-design performance across a range of Mach numbers rather than the conventional restriction of waveriders to single point design and operation. The present study considers a case study vehicle entering Mars' atmosphere from a low orbit and the resulting benefits that an example high-lift vehicle can provide for minimizing peak heat flux and deceleration. The present work is intended to establish the theory and provide a contextual example for entry into Mars' atmosphere, but does not represent the results of an optimization study.