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A Design Approach of Wide-Speed-Range Vehicles Based on the Cone-Derived Theory

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Abstract:

The hypersonic gliding vehicle is attracting an increasing attention because of its high lift-to-drag ratio and cruising velocity. This kind of vehicle may experience different airspaces as well as different speed environments. Based on the design theory of the cone-derived waverider, a novel design approach of the hypersonic gliding vehicle was proposed in this article, which is accommodated in a wide speed range. The parametric method employed in the ascender line design makes it possible to control the overall configuration of the vehicle, and there are four parameters chosen to describe the ascender line. The numerical approach has been employed to validate the property of this kind of HGV. By analyzing the pressure contour of the vehicles with different Mach numbers, we conclude that this kind of aircraft own good wave-ride properties in the designed speed range. Their aerodynamic performance makes a balance by comparing with the waveriders designed with the two ultimate speeds. Different design Mach number arrangements lead to different aerodynamic properties, and all of them seem to be suitable in the designed speed range. Therefore, this kind of vehicle is worth referring in the aircraft design. The simplified trajectory performance analysis is employed, and the vehicle is assumed to reentry with a given initial condition. With the angle of attack as well as the angle of slide is set to be zero, The CFD method obtained the aerodynamic coefficients of the vehicle at different speeds. The result shows a wavy trajectory with long range, which means that this kind of vehicle is suitable for long-distance transportation.

Keywords: hypersonic gliding vehicle, wide-speed-range, streamline-tracing technique, aircraft design

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