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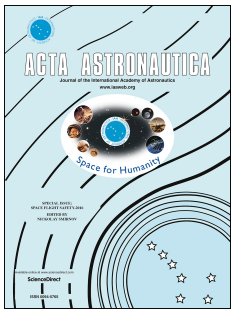

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Design Methodology of the Waverider with a Controllable Planar Shape

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Abstract

A novel design method of waverider with a controllable planar shape is proposed as a further development of the conventional osculating cone/flowfield method. The present method is run based on a newly established geometric relationship, represented by a differential equation set, involving the flow capture curve (FCC[1]), the inlet capture curve (ICC[2]) and the planar shape curve (PSC[3]). As two of the three curves are known, the last one is easily determined by following the relationship. Therefore, the couples of FCC-PSC or ICC-PSC are introduced as design-driving parameters whereas the conventional methods just employ the couple of FCC-ICC, and then the waverider planar shape is directly specified in the design process instead of other indirect parameters. Two predefined planar shapes are employed to generate waverider configurations as test cases. The planar shapes of the design results are precisely controlled by the predefined curves, verifying the correctness of the geometric relationship. Furthermore, the numerical simulations show that customizing the planar shape does not destroy the excellent characteristics of waverider, and thus the high lift-to-drag ratio on hypersonic conditions is maintained. Since the used planar shapes are suitable for low-speed flight to the engineering point of view, the low-speed performance is significantly improved as well. The present method improves the waverider design flexibility by introducing the planar shape as a design parameter, and the ideal of planar shape customization also inspires to the design of wide-speed-range configurations.

Keywords: Hypersonic; waverider; planar shape; low speed; numerical simulation

1. Introduction

A waverider is one of the most promising configurations flying at hypersonic speeds because of the excellent performance of high lift-to-drag ratio[1], and the design method on it always attacks the attention

[1]FCC: Flow Capture Curve
[2]ICC: Inlet Capture Curve
[3]PSC: Planar Shpae Curve

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