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AERODYNAMIC FORCE AND HEAT FAST PREDICTION FOR HIGH SPEED VEHICLES BASED ON EFFECTIVE NUMERICAL AND ENGINEERING METHODS

Abstract

A fast aerodynamic characteristics prediction technique was developed in the paper for predictions of aerodynamic force and heat, which combines effective space marching numeric method with engineering method based on tracking the surface stream trace. The hypersonic aerodynamic forces were obtained effectively by numeric solving the Euler equations with fast space marching method. In order to calculate the heat flux, then an engineering method called tracking the surface stream trace, which was based on the axisymmetric analogue technique and boundary layer theory, was adopted to the complex geometry. Ihe inviscid flow parameters and surface stream lines required in the engineering method were obtained from above inviscous numeric flow fields. The forecast methods for aerodynamic force and heat were applied to high speed vehicles, it's showed that the space marching method used can save the computational cost enormously, approximately one order decrease compared to the time marching method, and the two methods have similar precision in aerodynamic force evaluation. The predicted error of heat flux is within 20% compared to the test data from wind tunnel. The technique promoted is an effective approach suitable for the needs of fast aerodynamic configuration design and optimization.