

Effects of Continuum Breakdown on Aerodynamics

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Attempt was made to analyse aerodynamics of hypersonic vehicle near space with slip NS methods. The applicability of several different slip boundary conditions was investigated. The difference between continuum and rarefied predictions for surface properties of cylinder and trapezoid wing was shown. The results show that present code was valid for predicting slip regime flow by comparing with results in reference. Type-2 slip model proposed by Gokcen had more extensive rarefied limit, and could give a best agreement with DSMC results in higher Knudsen numbers comparing with other slip models. Peak transfer rate differences range from over 1.6% for 50KM to almost 14.5% for 80KM. Pressure coefficient on the surface is little affected by rarefied gas effect, while heat transfer rate is most influenced by that.

Keywords: near space; hypersonic vehicle; aerodynamics; rarefied gas effect; slip model