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Numerical Study on Convective Heat Transfer Enhancement by Vortex Interactions

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ABSTRACT Miniaturization and performance augmentation of heat transfer equipment calls for heat transfer enhancement methods with minimal pressure loss. Flow manipulators such as vortex generators used in a flow field can enhance heat transfer without any external interference. A novel passive heat transfer enhancement mechanism based on vortex interactions of longitudinal vortex generators is analyzed in the present study. Extensive computational study has been carried out to explore the effect of the interactions of identical and distinct vortex interactions in promotion of convective heat transfer. Role of multiple vortex generators and interaction of various kinds of vortices generated by them over a flat plate placed in high speed flow in promotion of passive heat transfer are analysed in detail. Advection Upstream Splitting Method available in a FVM based commercial solver is used for the inviscid flux computations in three dimensional compressible turbulent flow field. Method of images and potential flow theory are used to develop a one to one relation for the vortex trajectory and heat transfer distribution in the flow field. A performance parameter, which compares heat transfer enhancement with associated pressure loss, is used in the present study to evaluate the overall performance of the system.

KEYWORDS: Longitudinal Vortex Generators, Passive Heat transfer enhancement, Secondary flows, Method of images, Vortex trajectory, Pressure loss parameter.