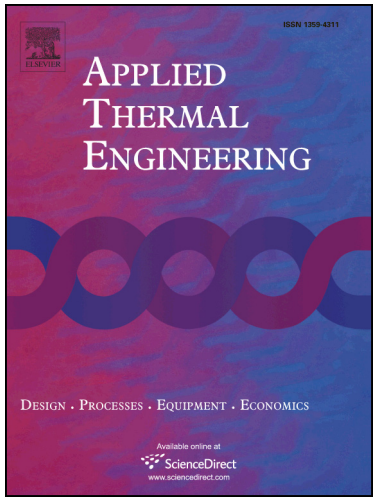

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Aerothermodynamic Considerations for Energy Deposition Based Drag Reduction Technique

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Abstract

Numerical investigations are carried out for understanding the real gas effects for energy deposition based drag reduction technique for hypersonic flow over a blunt body. Computations are performed to compare the effectiveness of this active drag reduction technique using perfect, frozen and non-equilibrium gas flow models. It has been noticed that the deposited energy gets utilised more effectively in case of perfect gas flow. A loss up to 15% is observed in percentage drag reduction as a consequence of real gas effects over the range of energies considered herein. At low levels of deposited energies, drag predicted for frozen and non-equilibrium flows agrees well; however differences are observed at higher energy levels. It is concluded that thermal non-equilibrium plays a dominant role at low energy levels and chemical non-equilibrium at higher energy levels. The study is further extended to see the effect of energy density and free stream total enthalpy. A significant reduction (up to 74%) in power effectiveness is noticed as the total enthalpy of free stream increased. The present studies also revealed that requirement of non dimensional energy for attaining peak power effectiveness has close match at different stagnation enthalpies.

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