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Numerical Studies on Thrust Vectoring Using Shock-Induced Self Impinging Secondary Jets

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Abstract : The study of the primary flow velocity and the self impinging secondary jet flow mixing is important from both the fundamental research and the application point of view. Real industrial configurations are more complex than simple shear layers present in idealized numerical thrust-vectoring models due to the presence of combustion, swirl and confinement. Predicting the flow features of self impinging secondary jets in a supersonic primary flow is complex owing to the fact that there are a large number of parameters involved. Earlier studies have been highlighted several key features of self impinging jets, but an extensive characterization in terms of jet interaction between supersonic flow and self impinging secondary sonic jets is still an active research topic. In this paper numerical studies have been carried out using a validated two-dimensional k-omega standard turbulence model for the design optimization of a thrust vector control system using shock induced self impinging secondary flow sonic jets using non-reacting flows. Efforts have been taken for examining the flow features of TVC system with various secondary jets at different divergent locations and jet impinging angles with the same inlet jet pressure and mass flow ratio. The results from the parametric studies reveal that in addition to the primary to the secondary mass flow ratio the characteristics of the self impinging secondary jets having bearing on an efficient thrust vectoring. We concluded that the self impinging secondary jet nozzles are better than single jet nozzle with the same secondary mass flow rate owing to the fact fixing of the self impinging secondary jet nozzles with proper jet angle could facilitate better thrust vectoring for any supersonic aerospace vehicle.

Keywords : fluidic thrust vectoring, rocket steering, supersonic to sonic jet interaction, TVC in aerospace vehicles
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