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Mixing augmentation induced by a vortex generator located upstream of the transverse gaseous jet in supersonic flows

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Abstract: The mixing process plays a very important role in the engineering realization of the scramjet engine, and sufficient mixing between the incoming supersonic air and the fuel relates to improve the overall performance of the airbreathing hypersonic propulsion system. In the current study, the delta wing is placed in front of the injector to promote the mixing of fuel and supersonic crossflow, and the effects of the delta wing height and the jet-to-crossflow pressure ratio have been investigated numerically based on grid independency analysis and code validation. The obtained results predicted by the three-dimensional Reynolds-average Navier – Stokes (RANS) equations coupled with the two equation k-ω shear stress transport (SST) turbulence model show that the delta wing has a highly remarkable improvement on mixing characteristics such as mixing efficiency and fuel penetration depth. However, the delta wing also shows additional losses of stagnation pressure. In the case of higher values of delta wing height and jet-to-crossflow pressure ratio, higher penetration and more losses of stagnation pressure are shown. At the same time, the mixing efficiency decreases with the increase of the jet-to-crossflow pressure ratio irrespective of the height of the delta wing, and there is an optimum height of the delta wing for each jet-to-crossflow pressure ratio to achieve the maximization of rapid fuel-air mixing. In addition, the hydrogen content in the recirculation region between the orifice and the delta wing is a result of both the jet-to-crossflow pressure ratio and the height of the delta wing. In conclusion, the design of

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