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

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6
7 **Abstract:** The mixing process plays a very important role in the engineering realization of the scramjet engine, and
8 sufficient mixing between the incoming supersonic air and the fuel relates to improve the overall performance of the
9 airbreathing hypersonic propulsion system. In the current study, the delta wing is placed in front of the injector to
10 promote the mixing of fuel and supersonic crossflow, and the effects of the delta wing height and the jet-to-crossflow
11 pressure ratio have been investigated numerically based on grid independency analysis and code validation. The
12 obtained results predicted by the three-dimensional Reynolds-average Navier – Stokes (RANS) equations coupled with
13 the two equation $k-\omega$ shear stress transport (SST) turbulence model show that the delta wing has a highly remarkable
14 improvement on mixing characteristics such as mixing efficiency and fuel penetration depth. However, the delta wing
15 also shows additional losses of stagnation pressure. In the case of higher values of delta wing height and jet-to-crossflow
16 pressure ratio, higher penetration and more losses of stagnation pressure are shown. At the same time, the mixing
17 efficiency decreases with the increase of the jet-to-crossflow pressure ratio irrespective of the height of the delta wing,
18 and there is an optimum height of the delta wing for each jet-to-crossflow pressure ratio to achieve the maximization
19 of rapid fuel-air mixing. In addition, the hydrogen content in the recirculation region between the orifice and the delta
20 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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