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Uncertainty of RANS mixing model prediction for an underexpanded jet in a supersonic cross flow[1] CATHERINE GORLE, Center for Turbulence Research, Stanford University, GIANLUCA IACCARINO, Stanford University — The complex phenomena involved in scramjet propulsion can be investigated using RANS simulations, but the simulations do not fully represent all the physics involved. The mixing of fuel and air inside the supersonic combustion chamber is one of the critical processes that requires modeling. The goal of the present work is the development of an uncertainty model for the RANS modeling of mixing that can be used to characterize the safety and operability limits of scramjet engines. To this end, RANS simulations of an underexpanded jet in a supersonic cross flow are considered. Experimental data and an LES database are available from literature. The uncertainties in the RANS simulations are related to the models for the Reynolds stresses and the mixture fraction fluxes. The sensitivity of the model outcome to all sources of uncertainty in these models is characterized and quantified by introducing perturbations in the Reynolds stresses and the mixture fraction fluxes. Through comparison of the RANS and LES results it is attempted to quantify the required range of perturbations to correctly represent the model uncertainties.

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