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Density and Velocity Ratios Effects on the Structure of Transverse Jets in Supersonic Crossflow[1] MIRKO GAMBA, University of Michigan, VICTOR A. MILLER, M. GODFREY MUNGAL, Stanford University — It is generally accepted that the jet-to-crossflow momentum flux ratio, J, is the primary parameter describing the structure, penetration and mixing properties of transverse jets. The interplay between density and velocity ratios, that combined define J, on these properties is, however, seldom considered nor fully understood. The current experimental work explores this interplay on transverse underexpanded sonic jets in a supersonic nitrogen crossflow ($M = 2.25$, $T = 480\ K$). A single-excitation, dual-band detection PLIF imaging scheme of toluene seeded into the crossflow is used to mark the crossflow fluid mixing into the transverse jet fluid and to determine the local fluid temperature. Different values of density and velocity ratios, while maintaining a constant value of J (equal to 2.4), are investigated by injecting gases with different molecular weights. Notwithstanding the fact that all cases have the same value of J and some similarity on the penetration characteristics exists, the emerging picture of the instantaneous turbulent structure of the flow indicates that the dynamics of entrainment and local mixing might be altered by low (high) values of the density (velocity) ratio compared to the corresponding case at high (low) values.

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Mirko Gamba
University of Michigan

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