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Shear Layer Interactions in the Helical Hydrodynamic Structures of Swirling, Reacting Jets TRAVIS SMITH, Georgia Inst of Tech, KIRAN MANOHARAN, Indian Institute of Science, BENJAMIN EMERSON, Georgia Inst of Tech, SANTOSH HEMCHANDRA, Indian Institute of Science, TIM LIEUWEN, Georgia Inst of Tech — Swirling jets with density stratification are a canonical combustor flow field. This work consisted of coupled experimental and theoretical analysis of the spatial structure of the most amplified modes in an annular jet, with a specific focus on the radial mode shapes of the shear layer disturbances, which we characterize as inner shear layer (ISL) motion relative to outer shear layer (OSL) motion. The stability analysis identifies spatial structures dominated by ISL motion, modes dominated by OSL motion, and modes with mixed ISL and OSL motion. These mixed modes are further classified as sinuous or varicose radial structures, depending on the relative motions of the two shear layers. The presence and spatial dependencies of these spatial modes are demonstrated experimentally with a 5 kHz stereo PIV measurement of a reacting swirling jet. In the experiment, we demonstrate that external excitations of various spatial configurations can be used to elicit hydrodynamic responses of axisymmetric and helical motions in either the ISL, the OSL, or the sinuous or varicose radial modes.

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