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Self excited oscillations in swirling jets: Stability analysis and empirical mode construction KILIAN OBERLEITHNER, MORITZ SIEBER, CHRISTIAN NAVID NAYERI, CHRISTIAN OLIVER PASCHEREIT, Technical University Berlin, Germany, CHRISTOPH PETZ, HANS CHRISTIAN HEGE, Zuse Institut, Berlin, Germany, BERND NOACK, Institut Pprime, Poitiers, France, ISRAEL WYGNANSKI, University of Arizona, Tucson, USA — Swirling jets undergoing vortex breakdown are known to be dominated by strong harmonic oscillations. Our experiments suggest the existence of a self-excited global mode having a single dominant frequency. The wave-maker of this oscillatory mode is found to be located in the jet center causing the swirling jet to precess. The oscillations trigger a convectively unstable co-rotating counter-winding helical structure that is located at the periphery of the recirculation zone. The resulting time-periodic 3D velocity field is predicted theoretically by employing linear stability analysis. It compares remarkably well to empirical 3D-modes that were constructed from uncorrelated 2D snapshots of PIV data, using proper orthogonal decomposition (POD). Stability analysis is further employed to detect regions of absolute instability and to derive the temporal growth-rate of the global mode. Results are compared to time-resolved measurements of the transient growth of the global mode.

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