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A Spatio-Temporal Decomposition of the Coherent Structures in the Three-Dimensional Wall Jet[1] JOSEPH HALL, DANIEL EWING, McMaster University — The most noteworthy feature of the turbulent three-dimensional wall jet is that the growth of the jet parallel to the wall is roughly 5 times larger than the growth of the jet normal to the wall. This makes this flow particularly attractive for film cooling applications. The dynamics of the organized turbulent motions in the three-dimensional wall jet were examined using simultaneous measurements of the velocity and fluctuating wall pressure field. A Proper Orthogonal Decomposition (POD) of the fluctuating pressure field in the lateral direction indicated that the majority of energy was relatively evenly split between a symmetric and antisymmetric mode. The interplay of these two modes caused poor correlation of the fluctuating pressure across the centerline of the jet. A combined spatial and temporal decomposition of the reconstructed pressure field using the contribution of the first two POD modes revealed the presence of two types of large-scale structures in the flow: one with a higher characteristic frequency located near the the centreline of the jet, and a second with a much lower characteristic frequency that was coincident across at least one half of the jet. Pressure-velocity correlations of the temporally bandpass filtered contribution of the dominant POD modes indicated that these two events were significantly different.

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Joseph Hall
McMaster University

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