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Modal decomposition of free and forced circular jets at low and high Reynolds numbers MURALIDHAR KRISHNAMURTHY, Professor, TRUSHAR GOHIL, doctoral student, ARUN SAHA, Assistant Professor — Free and forced jets are important in applications such as combustion, propulsion, mixing, and aero-acoustics. Jet control for noise reduction and mixing efficiency can be achieved by manipulating the flow structures. The most energetic structures of a flow field can be objectively recovered by proper orthogonal decomposition. POD extracts a basis for modal decomposition as eigenfunctions from an ensemble of signals. In the present work, the snapshot POD method is applied to data recorded from direct numerical simulation as well as large eddy simulation in three dimensions. Free jets are reported at a Reynolds number of 1000 and 10000 and 4300 for forced jets. Results show that all of the kinetic energy of laminar flow is stored in large-scale structures while for the turbulent jet, a broader distribution of kinetic energy is obtained. At Re = 1000, 40 snapshots of the flow field are adequate to resolve the major flow structures. For Re=10000, at least 100 snapshots are required for a good spectral representation. Blooming jets arising from dual mode forcing show the formation of odd-even pairs. The first pair contains the details of branching. In addition, the higher order modes capture the inherent jet instability mechanisms.

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