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On the outer flow field and 'episodic' entrainment in a round turbulent jet SACHIN SHINDE, Indian Institute of Technology Kanpur, India, PRASANTH PRABHAKARAN, Max Planck Institute for Dynamics and Self-Organization, Goettingen, RODDAM NARASIMHA, Jawaharlal Nehru Center for Advanced Scientific Research, Bangalore, India — We study a round turbulent jet at a Reynolds number of 2400 using Direct Numerical Simulation (DNS), with focus on the flow field outside the turbulent core and on its relevance to the entrainment process. Using DNS flow imagery, we present a detailed analysis of this outer flow field, which is found to exhibit considerable order in sub-regions whose location near the jet boundary varies with time. This order is shown to be largely governed, at any given time, by the vorticity field associated with elements of the coherent structures within the turbulent core at the time. This is particularly clear in the simpler cases, where the coherent vorticity on the core side of the boundary of the jet is (e.g.) of only one sign, and the instantaneous outer flow velocities are inversely proportional to the radial distance from an effective vortex center as required by the Biot-Savart relation. Interestingly, the outer flow velocities can be as high as more than a third of the mean centerline velocity. Such high velocities are shown to appear as part of strong inrush events, and their intermittent occurrence in space and time favors an episodic view of the entrainment process.

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