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Novel air entrainment mechanism from a harmonically forced plunging liquid jet[1] SOPHIA RELPH, KENNETH KIGER, University of Maryland, College Park, AKASH DHRUV, ILIAS BALARAS, George Washington University — The process of pouring molten metal for castings is highly susceptible to air entrainment. This has major ramifications for the quality of cast metal parts, as air and oxide inclusions induced during pouring can impact part strength and fatigue life. The current literature on air entrainment by disturbed plunging jets has largely relied on passively forced, uncontrolled jets where surface disturbances arise from unforced velocity fluctuations and little attempt is made to quantify the disturbance state of the jet. This work uses a well-controlled plunging jet with harmonically driven axisymmetric disturbances in order to investigate the specific processes by which disturbed jets entrain air, thus allowing air entrainment properties to be correlated with a repeatable jet disturbance state. The harmonically forced jet has led to the discovery of a novel free surface instability, which forces a transition from an axisymmetric free surface response to a three-dimensional mode with a reduced entrainment threshold. Data on the free surface instability, as well as comparisons to the literature and to closely coordinated direct numerical simulations will be presented.

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