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Experimental investigation of periodic lines in 3D lid-driven cylindrical cavity flows JEMIL ZNAIEN, R.R. TRIELING, M.F.M. SPEETJENS, H.J.H. CLERCX, Eindhoven University of Technology, The Netherlands — Mixing of mass and heat by laminar flows occurs in many natural systems and industrial processes. Understanding of the basic mechanisms to enhance mixing efficiency is mostly based on mathematical analysis and numerical studies of prototype cases. Three-dimensional (3D) experiments, however, remain largely unexplored. The present investigation employs 3D Particle Tracking Velocimetry (3D-PTV) to investigate a few of these concepts in realistic experimental configurations. We focus on the observability of periodic lines in periodically lid-driven cylindrical cavity flows. Periodic lines play a central role in the transport properties. The fluid is set in motion via a time-periodic forcing protocol (piece-wise steady translations of one of the endwalls of the cylinder), 3D-PTV measurements have been performed to obtain the web of tracer paths. Experimental results confirm key features from theoretical analysis and numerical studies on the location and shape of the periodic lines. A hybrid method (numerical tracking of particles in an Eulerian flow field determined by experimental measurements) is used to extend the forcing to situations inaccessible by direct particle tracking via 3D-PTV.

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