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Perturbation of coherent structures in three-dimensional laminar flows: predictions versus experimental observations FAN WU, Temple University, Philadelphia, MICHEL SPEETJENS, Eindhoven University of Technology, Eindhoven, DMITRI VAINCHTEIN, Temple University, Philadelphia, RUBEN TRIELING, HERMAN CLERCX, Eindhoven University of Technology, Eindhoven — Coherent structures in the fluid trajectories of three-dimensional (3D) laminar flows are key to their transport properties These structures typically undergo qualitative changes upon introducing some geometric or dynamical perturbation However, insight into such response scenarios in realistic 3D flows remains limited. The present study seeks to deepen this by investigating the response of coherent structures within a 3D time-periodic lid-driven cylinder flow in its Stokes limit to various weak perturbations. Numerical predictions by a spectral flow solver are compared against experiments by 3D PTV. The computations consider perturbation by weak fluid inertia and by a slight asymmetry in flow forcing, both causing essentially the same change in coherent structures. This signifies, consistent with theory on idealized flows, a generic response to weak perturbations, irrespective of their particular nature. The experiments, instead of explicit perturbation, rely on natural departures from a perfect state as e.g. geometric imperfections and weak fluid inertia. This results in dynamics that closely agree with the numerical predictions, thus offering first experimental evidence that indeed a universal mechanism is at play in the response of 3D coherent structures to perturbations

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