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Motion and Instability Properties of Lamb-Oseen Vortex in Particle-Laden Flows SHUAI SHUAI, Arizona State University, ANUBHAB ROY, Indian Institute of Technology Madras, M.HOUSSEM KASBAOUI, Arizona State University — We investigate the destabilization of a Lamb-Oseen vortex by dispersed inertial particles in Eulerian-Lagrangian simulations. We study the Lamb-Oseen vortex as presentative flow for the swirling motion of a vortex. The Lamb-Oseen vortex is an extremely resilient structure of single-phase flows, a property that falls from its proven hydrodynamic stability to 2D modal perturbations. Remarkably, we show that dispersing inertial point-particles triggers a novel instability, characterized by (1) rapid attenuation of the carrier flow vorticity at the core, (2) a structure of the flow vorticity field dominated by spiral fringes, (3) faster growth of the vortex size than in single-phase flows, and (4) transient growth ending when all particles have been ejected out of the vortex core. The simulations show the existence of the instability for a wide range of particle Stokes numbers (0.1 1.0) and mass loadings (0.1 2.0). Analyzing the perturbation growth rates, we show that the instability modes depend on the mass loading from $0.5 \sim 1.0$, and propose new scaling laws for the vorticity decay rate and radius growth rate that depend on the particle Stokes number.

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