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Magnetic actuation of immersed coupled droplets: Experiments and simulations JOSEPH OLLES, AMIR HIRSA, Rensselaer Polytechnic Institute, KRISHNARAJ SAMBATH, OSMAN BASARAN, Purdue University — A system of two droplets connected through a cylindrical hole in a plate, with pinned contact lines, shows promise in several engineering applications including fast adaptive optics, microscale actuators and pumps, and adhesion devices. Such coupled droplets, surrounded by a passive gas medium, have been studied extensively. With the motivation of advancing this technology, here we consider coupled-droplet systems comprised of ferrofluid immersed in an immiscible liquid. Nonlinear characteristics of the system are studied by exciting the ferrofluid using a small electromagnet at various frequencies. The responses, tracked by observing the interface motion through high-speed imaging, are analyzed. Fluid velocities measured using index matched PIV techniques are also characterized. To corroborate the experimental results, the ferrofluid system with a magnetic force on the coupled droplets is simulated with the magnetic force approximated by a uniform body force. The axisymmetric Navier-Stokes system, which governs the flow in both the ferrofluid and surrounding fluid, is solved using the Galerkin finite element method. By aligning the simulations with experimental data, a novel method of extracting interfacial fluid properties is elucidated. Operational parameters where experiments are contradicted by simulations are also discussed.

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