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Motion of Ferrofluid Droplets Under Oscillating Magnetic Field[1]

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Ferrofluids are stable, colloidal suspensions of single-domain ferromagnetic particles of nanometer size. Because of their good sealing properties and ease of actuation, ferrofluids are ideal for applications in Lab-On-Chip, or micro-total analysis systems (μTAS). In particular, because of their changing viscosity and surface properties under magnetic fields, as well as previously reported nonlinear behavior in bulk volumes, understanding the periodic movement of ferrofluid droplets for applications in pumping, valving and switching is important. We characterize the movement of ferrofluid droplets with volumes from 80 nL to 200 nL under oscillating magnetic fields in the frequency range 1Hz to 100Hz. Oil-based ferrofluid droplets are placed in circular cross-sectional capillaries and motion is recorded using a high-speed camera, then distilled using computer-assisted image analysis. Kinematics variables such as the position and velocity of the droplets' centers of mass are observed. Nonlinear behaviors in droplet shape and travel distance per cycle of actuation are also presented.

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