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Bubbles and droplets in magnetic fluids PHILIP YECKO, Dept of Mathematical Sciences, Montclair State University — In this work, the behavior of ferrofluid droplets and of bubbles rising in a ferrofluid is studied using direct numerical simulations based on a volume of fluid (VOF) method. A ferrofluid is a suspension of small (5–15 nm) magnetic particles in a carrier liquid which may be water or a hydrocarbon oil, stabilized against settling by Brownian motion and against agglomeration by coating each particle with a layer of surfactant. Although their main application is the fluid O-ring found in computer hard disk drives, ferrofluids have been more recently recognized for their use in micro- and nano-fluidic pumping, and applications to drug delivery are under investigation. Because ferrofluids are opaque, numerical simulations offer a unique opportunity to visualize flows that cannot be easily visualized experimentally, yet little effort has been directed to numerical simulations of realistic magnetic fluids. In this work, we develop and test a multiphase simulation code, based on Surfer, which can dynamically follow the behavior of small numbers of droplets, bubbles or layers of ferrofluid and ordinary viscous fluid for so-called linear magnetic material. In the rising bubble tests, we quantify the vertical elongation of the bubble and the resulting reduction in drag and rise time. In the falling droplet experiments, we demonstrate the effect of variable magnetic properties on the shape and trajectory of the droplet, including the instability threshold where droplet fission occurs.

Philip Yecko
Dept of Mathematical Sciences, Montclair State University

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