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Large scale surface flow generation in driven suspensions of magnetic microparticles: Experiment, theoretical model and simulations
MAXIM BELKIN, ALEXEY SNEZHKO, IGOR ARANSON, Materials Science Division, Argonne National Laboratory — Nontrivially ordered dynamic self-assembled snake-like structures are formed in an ensemble of magnetic microparticles suspended over a fluid surface and energized by an external alternating magnetic field. Formation and existence of such structures is always accompanied by flows which form vortices. These large-scale vortices can be very fast and are crucial for snake formation/destruction. We introduce theoretical model based on Ginzburg-Landau equation for parametrically excited surface waves coupled to conservation law for particle density and Navier-Stokes equation for water flows. The developed model successfully describes snake generation, accounts for flows and reproduces most experimental results observed.

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