Capillary surfers on a vibrating bath

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Capillary surfers are hydrophobic, millimetric bodies whose bottom surface is pinned to the air-water interface of a vertically oscillating bath [1]. The relative vertical motion of the body and the interface leads to the generation of propagating capillary waves. When the mass of the particle is unevenly distributed, the particle self-propels along the interface with constant speed. Self-propulsion is due to the difference in momentum of the waves generated by the fore and the aft of the surfer. In the steady propulsion regime, the surfer speed can be rationalized by balancing the force from radiation pressure [2] with the friction force arising from viscous stress on its base.

Capillary surfers interact with one another through their mutual capillary wavefield and resultant fluid flows, and exhibit a rich set of collective modes characterized by a discrete number of equilibrium spacings for a given set of experimental parameters. Our theoretical model consists of coupled equations for the surfers' positional and orientational dynamics, in which a surfer is modeled as a source of capillary waves. The model predictions exhibit good agreement with experimentally observed interaction modes between two surfers.

Our results open the door to further investigations of this novel active system at the fluid interface.

Références

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