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Numerical simulation of Faraday wave patterns

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In 1831, Faraday described the standing wave patterns that form on the surface of a layer of fluid subjected to periodic vertical vibration. These waves usually take the form of stripes, squares, or hexagons. However, other phenomena have been observed numerically, such as quasipatterns, supersquares, heteroclinic cycles, and oscillons.

Until recently, numerical simulation of Faraday waves was out of reach. Since 2009, however, we have simulated not only simple wave patterns but also patterns which involve large-scale modulation. To do so, we have developed a massively parallel multiphase code, BLUE, whose treatment of the free surface uses a hybrid Front-Tracking/Level-Set technique, defining the interface both by a discontinuous density field on the Eulerian grid and by triangles on the Lagrangian interface mesh.

We will discuss the various Faraday wave configurations we have studied: regular square and hexagonal lattices, patterns composed of spherical harmonics on a vibrated drop, and supersquares consisting of a four-by-four array of smaller squares.

Presenter: Prof. TUCKERMAN, Laurette (Ecole Supérieure de Physique et de Chimie Industrielle (Paris))