Master 2 internship proposal

Physique et Mécanique des Milieux Hétérogènes

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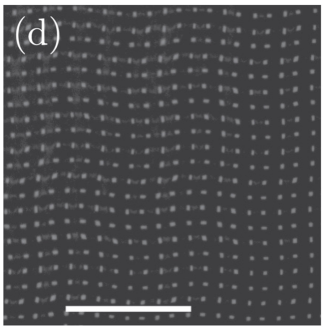
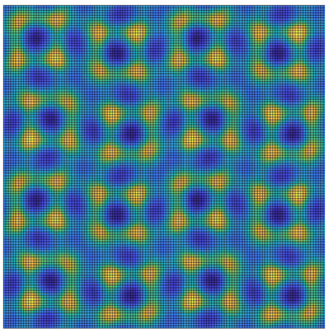
Secondary pattern of Faraday waves

In 1831, Faraday described the standing waves that appear at the surface of a fluid layer subjected to vertical oscillations of sufficient amplitude, This pattern often forms a square grid, and at a higher oscillation amplitude, these regular squares may rearrange themselves into larger structures. In 2009, our group was the first to simulate Faraday waves numerically [1] and since then we have simulated a supersquare pattern [2]. Domino et al [3] observed experimentally a wavy large-wavelength modulation of a square pattern of Faraday waves and proposed an interpretation in terms of the theory of elasticity. We have started to simulate this pattern numerically using the massively parallel code `BLUE` [4]. Numerical simulations produce accurate global quantities such as the kinetic energy and the total surface area as a function of time, as well as the complete velocity field and position of the surface. We hope to use this detailed information to learn more about the secondary pattern and to test the theory of the mechanism as an elastic instability.





Faraday pattern with wavy large-wavelength modulation. Left: experiments [3]. Right: simulations.

References

[1] N. Périnet, D. Juric & L.S. Tuckerman, *Numerical simulation of Faraday waves*, J. Fluid Mech. **635**, 1–26 (2009).
[2] L. Kahouadji, N. Périnet, L.S. Tuckerman, S. Shin, J. Chergui, D. Juric, *Numerical simulation of supersquare patterns in Faraday waves*, J. Fluid Mech. **772**, R2 (2015).
[3] L. Domino, M. Tarpin, S. Patinet, A. Eddi, *Faraday wave lattice as an elastic metamaterial*, Phys. Rev. E **93**, 050202(R) (2016).
[4] S. Shin, J. Chergui, D. Juric, *A solver for massively parallel direct numerical simulation of three-dimensional multiphase flows*, J. Mech. Sci. Tech. **31**, 1739-1751 (2017)

Expected skills: The applicant should be interested in numerical simulation, as well as either fluid dynamics or nonlinear dynamics or both.