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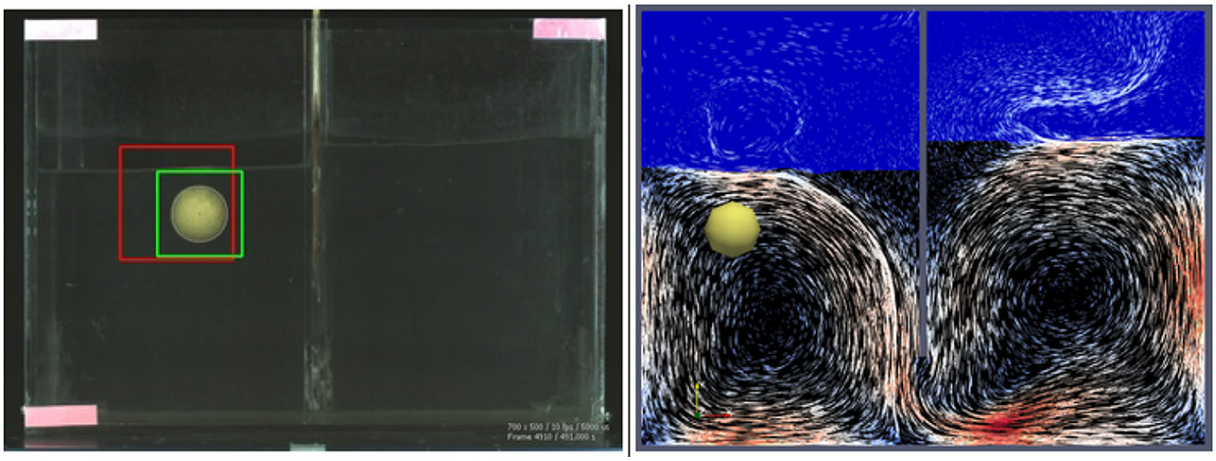
Researchers modeled the motion of a rigid sphere in a chaotic fluid and the coupling between the two bodies.



When transporting fluids, trucks often use baffles — panels and vanes to control fluid flow — to maintain stability by managing the sloshing of the fluid. To understand how a rigid body behaves in such a system, a new paper by Zamora et al. compares simulations and experimental results of the motion of a sphere immersed in water and sloshing between two communicating vessels.

The group found this system behaves chaotically. The motion of the sphere is dominated by the strong flow generated at the bottom of the tank, due to the opening in the baffle, and the sphere interacts with the vessel walls and crosses the opening randomly.

To test this, the researchers ran a series of experiments in which the sphere was released at a random position at the bottom of a tank, which was split into two sections by a baffle with a lower opening. The tank was subjected to a controlled oscillation, and images of the system were taken to study the position and velocity of the sphere at various points in time.

Results from the experiment were compared with numerical simulations for fluid-structure interaction developed by the group. In the simulations, the researchers used a finite element method to study the coupling between the fluid and the rigid body, considering external forces, such as the sphere's drag. The researchers confirmed their simulations properly reproduce the dynamics of the sphere and its statistical distribution in space.

"This work allowed us to validate our in-house developed code," said author Laura Battaglia. "This code can be used in more general engineering situations involving dropping objects in fluids, floating bodies and granular material."

Source: "Numerical and experimental study of the motion of a sphere in a communicating vessel system subject to sloshing," by Esteban Zamora, Laura Battaglia, Mario Storti, Marcela Cruchaga, and Roberto Ortega, *Physics of Fluids* (2019). The article can be accessed at https://doi.org/10.1063/1.5098999.