New results on the collision issue

Matthieu Hillairet
Université de Montpellier, Montpellier, FRANCE
matthieu.hillairet@umontpellier.fr

22 juillet 2022

In this talk, I will consider the coupled system modelling the motion of solid bodies inside a container filled with an incompressible viscous fluid. The motion of the fluid is governed by the incompressible Navier Stokes equations and the motion of the solid bodies are computed by integrating the Newton laws of solid dynamics. The interactions between the two species are fixed by assuming that the fluid does not slip on boundaries and that only the fluid forces act on the solid bodies. This yields a coupled system of partial differential equations (for the fluid) and ordinary differential equations (for the solid bodies).

Such coupled systems have been thoroughly studied since the late 90's. First analysis show that classical well-posedness results for the fluid equation (namely the incompressible Navier Stokes equations) extend to this coupled system as long as no collision between the solid bodies and/or between one body and the container boundaries occurs. This raises the collision issue : "Are such collisions possible ?" This issue is tackled first in simplified context where the geometry of contact is easily parametrized. We refer to [Hil14] for a review on the Cauchy theory and the analysis of collision issue.

In this talk, I will recall the main mechanism and analytical tools enabling to discuss the collision issue. I shall present then new results extending the previous analysis to more general geometries : several spherical bodies moving in an unbounded fluid and a smooth convex body moving in an unbounded 2D channel.

Acknowledgment : The new results presented in this talk have been obtained in collaboration with Lamis Sabbagh (Université Libre de Bruxelles, lamis.sabbagh@ulb.be) on the one hand and Denis Bonheure (Université Libre de Bruxelles, denis.bonheure@ulb.be), Gianmarco Sperone (Université Libre de Bruxelles, gianmarco.sperone@ulb.be) and Clara Patriarca (Politecnico di Milano, clara.patriarca@polimi.it).

Références

[Hil14] Matthieu Hillairet. Topics in the mathematical theory of interactions of incompressible viscous fluid with rigid bodies. In *Fluid-structure interaction and biomedical applications*, Adv. Math. Fluid Mech., pages 257–320. Birkhäuser/Springer, Basel, 2014.