Vortex Particle-Mesh methods: accurate and efficient handling of solid boundaries

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Vortex methods have been through many developments over the past decades, yet the efficient and accurate treatment of solid boundaries has remained a challenge. In this talk, we will discuss recent efforts aimed towards that goal, and in the context of a vortex particle-mesh (VPM) method. The VPM method is a state-of-the-art variant, which relies on a dual discretization: the particles handle the advection of vorticity, while the mesh is used, not only for the "remeshing" (i.e., the "particle redistribution" step, required in Lagrangian methods to maintain time accuracy), but also for the efficient evaluation of the differential operators (diffusion, vortex stretching) and the efficient solution of the elliptic problems (Biot-Savart law, re-projection step when in 3D). Specifically, this presentation will focus on the handling of solid boundaries, first through penalization methods, then through Immersed Interface techniques. We discuss the porting of such techniques to the context of vortex methods and some specific developments to ensure their efficiency [3, 5, 4]. Additional results for the handling of fluid-structure interaction problems will also be presented [2, 1].

Références

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