Detection of a moving rigid solid in a perfect fluid

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In this lecture we will consider a moving rigid solid immersed in a potential fluid. The fluid-solid system fills the whole two-dimensional space and the fluid is assumed to be at rest at infinity. Our aim is to study the inverse problem that consists in recovering the position and the velocity of the solid assuming that the potential function is known at a given time.

We will see that this problem is in general ill-posed by providing counterexamples for which the same potential corresponds to different positions and velocities of a same solid. However, it is also possible to find solids having a specific shape, such as ellipses for instance, for which the problem of detection admits a unique solution.

Using complex analysis, we prove that the well-posedness of the inverse problem is equivalent to the solvability of an infinite set of nonlinear equations. This result allows us to show that when the solid enjoys some symmetry properties, it can be partially detected. Besides, for any solid, the velocity can always be recovered when both the potential function and the position are supposed to be known.

The talk is based on joint work with co-authors Muslim MALIK and Alexandre MUNNIER.