Optimal boundary control for steady motions of a self-propelled body in a viscous incompressible fluid

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Abstract

Consider steady motions of a self-propelled rigid body into an infinite viscous incompressible fluid in 3D. We say that a body undergoes a self-propelled motion if the external force and external torque acting on fluid-body are zero so that the body moves only by a mechanism produced by itself at the boundary through fluid-body interaction. Given translational and angular velocities being assumed to be small, we show the existence of many boundary controls subject to a physically relevant side condition (such as tangential control or localized control) which generate the self-propelled motion of the body with target velocity and then discuss minimization of the work to overcome the drag. We next derive a necessary condition for optimal boundary control in terms of a variational inequality, where the adjoint state associated with the optimal control is involved as a Lagrange multiplier. This talk is based on a joint work with Ana Silvestre (Lisbon) and Takeo Takahashi (Nancy).