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Stabilization and Optimal Control of a 3-D fluid-structure interaction with a weak damping.

Abstract

We consider an interface problem consisting of a 3 D- fluid equation interacting with a 3 -D dynamic elasticity. The interface is moving according to the speed of the fluid. The PDE system is modeled by system of partial differential equations describing motion of an elastic body inside an incompressible fluid. The fluid is governed by Navier-Stokes equation while the structure is represented by the system of dynamic elasticity with weak dissipation. The interface between the two environments undergoes oscillations which lead to moving frame configuration, the latter giving rise to a quasilinear system. It is shown that under small disturbance hypothesis solution exist globally in time. Stability [in time] of such solutions is also considered. The obtained results depend on topological properties of the spaces under consideration. Control problems corresponding to minimization of vorticity or hydrodynamic pressure subject to constraints or minimization of drag are discussed. The problem is motivated by applications arising in bio-mechanics, aeroelasticity and industrial processes. In the presence of weak damping affecting the solid the control-to-observation map is proved global-so that the size of the data can be chosen uniformly in time. This allows consideration of an infinite time horizon optimal control problem. The latter depends critically on the *global existence* results obtained recently with M. Ignatova, I. Kukavica and A. Tuffaha in the case of 3-D fluid structure interaction. The estimates are then used in the study of optimal control problem in a joint work with L. Bociu and A. Tuffaha.