Novel computational methods and modelling aspects for fluid-structure contact interaction problems

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ABSTRACT

Fluid-structure interaction (FSI) problems can be among the most challenging problems in computational mechanics. This is especially true when one needs to satisfy high demands on the representation of complex scenarios in both fields and when the whole coupled problem dynamics is essentially influenced by the behaviour and representation of the interface. These challenges are further boosted when topological changes needs to be taken into account. Topological changes happen through newly arising domains, like when cracks in the solid meet the wet fluid-structure interface, or through disappearing domains, when solid regions come into contact that where separated through a fluid region before. The latter case defines so-called fluid-structure-contact interaction (FSCI) scenarios that are the focus of this presentation. And while certain FSCI scenarios allow simplistic approximations (or even ignorance) of the actual contact of the wet surfaces, this is the crucial aspect for other cases like the computational modelling of valves, sealing gaskets, etc. that can very frequently be found in many technical applications. And despite its' importance currently no method exist that is able to appropriately cope with such scenarios.

In this talk we will present our approaches for the mentioned challenging FSCI and will focus both on novel methods as well as modelling aspects, since advances in both topics are crucial for the overall success. On the methods side we will briefly present a fixed-grid method for fluid-structure interaction [1, 3, 5] that is able to consistently handle vanishing gaps as well as a mortar based contact approach [4]. On the modelling side we will address both reduced models based on elasto-hydrodynamic lubrication as well as an approach able to consistently bridge from pure fluid to "dry" contact scenarios via a poro-elastic flow model [2].

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