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AN ISOGEOMETRIC FLUID-STRUCTURE INTERACTION MODEL FOR IMPLOSION

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The term *implosion* refers to a series of phenomena in which there is a violent collapse as a result of the difference between the internal and the external pressure. Here, we focus on the case in which a structure collapses as a result of the condensation of a complex fluid. Thus, the implosion phenomenon is treated as a high-speed Fluid-Structure Interaction (FSI) problem characterized by ultra-high compressions and large structural deformations.

In this work, we develop a new mathematical model based on Navier-Stokes-Korteweg equations [1], which is able to model phase change and therefore, capable of modelling all the relevant physics behind the implosion phenomenon. In addition to modelling, we propose a quasi-direct monolithic formulation for the FSI problem [2]. The structure is treated as a nonlinear hyperelastic solid in the Lagrangian description and governed by the equations of nonlinear elastodynamics. On the other hand, the fluid is a complex, viscous and compressible fluid, governed by the Navier-Stokes-Korteweg equations. The Arbitrary Lagrangian-Eulerian description is utilized for the fluid subdomain. The motion of the mesh is governed by the equations of elastostatics. A NURBS-based isogeometric analysis methodology [3] is employed for the spatial discretization of the fluid and the structural mechanics equations. Numerical examples are presented in both two and three dimensions.

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