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Mesh-preserving methods for partial differential equations in deformable domains

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Abstract:
Solving PDEs on fixed domains have been subject of research for many years and various powerful computational tools and software exist in the literature to deal with these equations. In recent years, this field of research has become more attractive in the case of PDEs in deformable domains with moving boundaries and therefore, the focus is shifted in physical and engineering applications for which computational methods are challenging. Applications in this area include fluid dynamics, hydrology, groundwater flows, aeronautics among other applications in computational mechanics and computational fluid dynamics. In general, the domain deformation requires either changing the geometry of the domain or the governing equations of the model to suit the newly deformed problem. A change in the geometry would require remeshing the deformed domain while a change in the governing equations would require a mapping between the old and new coordinate systems. Both techniques have advantages and disadvantages in terms of accuracy, stability, and efficiency for which special attention should be given. In the present talk, we are interested in developing highly accurate and efficient numerical methods for solving PDEs on deformable domains of steady and unsteady types. Here, finite element and finite volume methods are considered for the spatial discretization and their implementations for PDEs on deformable domains are discussed. The main objective of this study is to develop mesh-preserving methods with high performance in terms of computational power. Several examples from engineering applications including dam-break flow over dry beds and heat transfer over vibrating beams are discussed.