Abstract:
Both Finite Element methods of higher order and Lattice Boltzmann methods have been shown to be an efficient approach for computing the behavior of structures and fluids respectively. In an effort to combine the advantages of these methods, a framework for a partitioned fluid-structure interaction with large deflections has recently been developed by the authors. A difficulty hereby is a conservative transfer of the loads from the fluid onto the structure. In a first approach, the forces were transferred onto the structural surface by means of an interface mesh whose corner nodes coincide with the Gaussian integration points of the structure. The LBM solver then interpolated its boundary forces onto this mesh and the structural high order FEM solver integrated the values at the corner nodes directly by means of a Gaussian integration. A disadvantage in this approach is that the mesh density and thus the resolution of the fluid forces as seen from the structural point of view is dependent on the structural Gaussian points. This contribution will introduce a force conservative transfer of the fluid boundary loads onto the structure by means of a composed integration. For this type of integration a surface mesh is still needed but it may be chosen independently of the discretization of the structure. An ideal mesh, taking into account the discretization of the fluid-lattice, is an equidistant mesh and can be considered as a discretization adaptor between the large FEM elements and the very fine finite-difference discretization of the Lattice Boltzmann equation. The method will be discussed, its conservativity will be demonstrated, and the results will be compared to FSI-Benchmarks.