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A CARTESIAN EXTENDED DISCONTINUOUS GALERKIN SOLVER FOR CONJUGATE HEAT TRANSFER

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The discontinuous Galerkin (DG) method is well known in the research community for its high convergence order/accuracy, its computational efficiency and its conservation properties. While DG is traditionally used on body-fitted meshes, its application to Cartesian meshes in combination with immersed interfaces has recently been the subject of several publications in the context of multi-physics fluid-related problems with a priori unknown, complex or moving boundaries [1, 2, 3, 4]. On the one hand, the method provides the high accuracy required to properly resolve solution features around complex geometries. On the other hand, the immersed approach allows the use of simple background meshes, even for complex geometries, and avoids remeshing when the interface is moving.
This work presents a DG discretization for conjugate heat transfer with immersed interfaces. The fluid-solid interface is described by a level set function, resulting into extended-DG elements, *i.e.*, elements that have separate degrees of freedom for both physics. The emphasis of the work is set on the spatial discretization, showing accurate but efficient integration algorithms for implicitly cut elements and interfaces [5], stability of slender elements through cell-agglomeration [6] and conditioning of the discretization with better calibrated interior penalty factors for cut-cells. Then, taking advantage of the simultaneous enforcement of Dirichlet and Neumann conditions allowed by DG, a bi-directional exchange between the two physics is introduced, thus ensuring a strong coupling. Finally, the solver is assessed on canonical test cases of forced convection over heated geometries.

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