# Challenges of extending a Discontinuous Galerkin cut cell immersed boundary method to three dimensions

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## ABSTRACT

A higher-order Discontinuous Galerkin immersed boundary solver with application to fluid structure interaction and particulate flow problems is currently under development at our department. In the beginning a simple Lie-Splitting approach was used to move the immersed interface. The Lie-Splitting approach renders the solver to be of first order in time only. Further, the boundary conditions at the interface were represented by Dirichlet values for velocity in the weak form.

Nevertheless of the temporal drawback, first numerical experiments, like the flow around a transversally oscillating cylinder and a single particle falling in a channel, have proven the benefit of our method: Good agreement with literature can be obtained by only using less than half the degrees of freedom than similar methods. Based on those results a first paper handling two-dimensional flow problems has already being submitted.

Currently the focus of development is to extend the solver to three-dimensional problems. As a consequence, some difficulties arise. Naming the efficient integration on cut cells by using the hierarchical moment fitting integration in three dimensions and a reasonable cell agglomeration strategy to avoid ill conditioned matrices, which is not straight-forward. Additionally challenges in terms of performance and efficient matrix solvers arise, due to the fact that the degrees of freedom in space will increase clearly.

The presentation will cover briefly the features of the method and show its advantages. Afterwards more details will be given in terms of the aforementioned challenges and how they have been tackled. In the end possible extensions and improvements will be discussed.

## ACHKNOWLEDGEMENT

The work of D. Krause is supported by the ’Excellence Initiative’ of the German Federal and State Governments and the Graduate School of Computational Engineering at Technische Universität Darmstadt. The work of F. Kummer is supported by the German DFG through Collaborative Research Centre 1194/B06.

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