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Higher Order Unfitted Space-time Finite Element Methods for PDEs on Moving Domains

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The methodology of unfitted finite element methods, i.e. methods which are able to cope with interfaces or boundaries which are not aligned with the grid, have been investigated for different problems in recent years. However, the development of numerical methods which are flexible with respect to the geometrical configuration, robust and higher order accurate at the same time is still challenging. One major issue in the design and realization of higher order finite element methods is the problem of accurate and stable numerical integration on time-dependent (level set) domains. In this talk, we firstly present a discontinuous-in-time space-time finite element method which allows for a higher order accurate and robust numerical treatment of domains that are prescribed by level set functions. [3, 1] To obtain higher order accuracy in space we use an approach that is based on specifically tailored isoparametric mappings. [2] In order to handle ill-posed cut configurations, a Ghost penalty stabilisation is used. For illustration, the method is applied to a convection-diffusion problem. Secondly, we introduce a continuous-in-time or Petrov-Galerkin variant of the method. For the two methods, different geometries in 1,2, and 3d are used to demonstrate high order convergence. Thirdly, a Galerkin collocation method is also briefly considered.

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