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PROJECTION METHODS FOR ROTATING FLOW

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In many fluid dynamical applications there is the necessity to deal with moving boundaries. Examples include stirred tank-reactors and rotating flows in astrophysical and geophysical problems. Often it is possible to avoid moving the mesh in computational simulations and instead reformulate the problem with respect to a frame of reference where the boundary can easily be described.
Our interest lies in discretizing the resulting equations using projection methods. Therefore we modify the schemes proposed by Guermond et al. in [MS06] in a similar way as Sokolov in [Sok08] and obtain the same convergence results. We combine this temporal discretization with a spatial finite element discretization using the finite element library `deal.II` [BHK07] to obtain a massive-parallel, and therefore highly efficient implementation. In order to resolve the various occurring temporal and spatial scales we use adaptive mesh refinement and variable time step sizes. Furthermore we investigate the influence of various local projection stabilizations similar to those recently studied by Barrenechea et al. in [BJK13].
We apply the resulting numerical method to geophysical problems such as precessing ellipsoidal shells to demonstrate its abilities to resolve fluid instabilities.

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