Higher order variational time discretisations for convection-diffusion problems in time-dependent domains

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We consider convection-diffusion equations in time-dependent domains where the movement of the domain boundary is prescribed. The time change of the domain is handled by the Arbitrary Lagrangian-Eulerian (ALE) formulation. It prevents strong mesh distortions which may occur for pure Lagrangian formulations since the given velocity of the domain boundary is extended to the mesh velocity inside domain in such a way that the mesh quality is preserved.

We will present conservative and non-conservative formulations of time-dependent convection-diffusion equations in time-dependent domains where special attention is paid to the time derivative and the mesh velocity.

To discretize in time, continuous Galerkin-Petrov methods (cGP) and discontinuous Galerkin methods (dG) as higher order variational time discretisation schemes are applied. These methods are known to be A-stable (cGP) or even strongly A-stable (dG).

The convergence properties of dG and cGP methods will be studied numerically. In the view to free boundary value problems, we will investigate how different approximations of the mesh velocity will influence the accuracy of the time discretisation schemes.

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