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From finite volume and finite element methods to discontinuous Galerkin approach – applications in fluid dynamics

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The discontinuous Galerkin (DG) method exhibits an amazing technique for the numerical solution of partial differential equations. DG method employs the advantages of more classical finite element (FE) and finite volume (FV) methods, particularly the high order of accuracy and discontinuous approximation. The later property significantly improves the stability of numerical scheme which is beneficial namely for problems of fluid dynamics when the convection is dominating.

We briefly mention the conection of DG method to FV and FE discretization sand discuss additional favourable properties of this approach: the realization of boundary conditions through boundary penalty, the hp-mesh adaptation, the use of dynamically changing grids for time dependent problems and two-level domain decomposition preconditioners.

Finally, we present several numerical examples for practical problems arising in porous media flows and non-hydrostatic mesoscale atmospheric modeling.

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