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A high order semi-implicit discontinuous Galerkin method for the two dimensional shallow water and incompressible Navier-Stokes equations on staggered unstructured meshes

Abstract
In the first part of this talk a spatially arbitrary high order accurate semi-implicit discontinuous Galerkin scheme is presented for the numerical solution of the two dimensional shallow water equations on staggered unstructured grids. The semi-implicit method is derived in such a fashion that all relevant integrals can be precomputed and stored in a preprocessing. In the presented approach we extend the semi-implicit DG scheme presented in Dumbser, Casulli 2013 for the solution of the shallow water equations on 2D Cartesian grids to the general case of curved unstructured triangular meshes using an edge-based grid staggering.
Subsequently, we will extend this method for the solution of the two dimensional incompressible Navier-Stokes equations on the same type of grid. Formal substitution of the discrete momentum equation into the discrete continuity equation yields one sparse linear equation system with four non-zero blocks per element for only one scalar unknown, namely the pressure. For the incompressible Navier-Stokes case, the resulting system is not only very sparse but also symmetric and positive definite for appropriate boundary conditions. The flexibility of high order DG methods on curved unstructured meshes allows to discretize even complex physical domains on rather coarse grids as will be shown in this seminar.."