Seminario de Análisis Numérico y Modelación Matemática

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Título de la Charla:

(EDG-)HDG methods for incompressible flows

Fecha y Hora:

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Lugar:

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Resumen

The error in the discrete velocity for many finite element methods for incompressible flow depends on the product of the best approximation error in the pressure and the inverse of the viscosity of the flow. As a result, the smaller the viscosity, the more degrees of freedom are required to achieve a certain level of accuracy in the velocity solution. This may result in expensive simulations when the viscosity is small. To address this issue we have introduced a new class of Hybridizable Discontinuous Galerkin (HDG) finite element method for incompressible flows. Our HDG method is exactly mass conserving. An immediate consequence of this is that we can show that the error in the discrete velocity does not depend on the viscosity nor the pressure: our method is "pressure-robust". To be of practical use we have also developed optimal preconditioners specifically for HDG methods. For this, we used that static condensation is trivial for HDG discretizations. In this talk, I will discuss the construction of our preconditioner for HDG discretizations of the Stokes equations. Unfortunately, compared to for example using Taylor-Hood finite elements, the computation time to solve the linear system is still large. To reduce the computation time of our HDG method, we therefore made a minor modification to the function spaces. We call the resulting method an Embedded- Hybridized Discontinuous Galerkin (EDG-HDG) method. I will show by numerical simulation that the EDG-HDG method is up to 10 times more efficient than the HDG method. Finally, I will discuss the extension of our HDG and EDG-HDG methods to solve the incompressible Navier-Stokes equations and how to ensure the methods are exactly mass-conserving even on timedependent domains with moving meshes.

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