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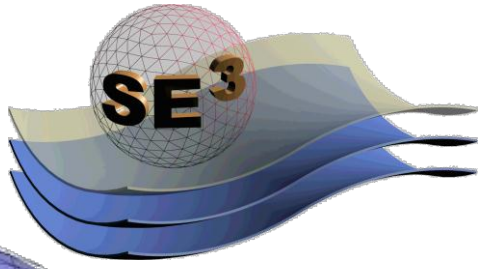

Vortrag

Exactly divergence free finite elements for the Darcy-Brinkman equations

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Referent:	Prof. Dr. Friedhelm Schieweck Institut für Analysis und Numerik Otto-von-Guericke Universität Magdeburg
Ort:	Mathematikgebäude Raum 614

Verwaltung SFB708
Michael Wedekind
Tel.: 0231 755 - 7312
E-Mail: sfb708@udo.edu
Fax: 0231 755 - 4079

Exactly divergence free finite elements for the Darcy-Brinkman equations

Prof. Dr. Friedhelm Schieweck
Institut für Analysis und Numerik
Otto-von-Guericke Universität Magdeburg

Abstract

For the Darcy-Brinkman equations, which model porous media flow, we present a new H^1-conforming exactly divergence free finite element for approximating the velocity based on composite quadrilateral or hexahedral elements which consist of triangular or tetrahedral subelements.

The pressure is approximated by corresponding discontinuous finite elements in such a way that the divergence of a discrete velocity function is contained in the discrete pressure space. As a consequence, the discretely divergence free velocity functions are exactly divergence free. Moreover, the inf-sup-condition is satisfied uniformly with respect to the mesh-size.

Due to the exactly divergence free property of the velocity approximation, the discretization error of the velocity does not depend on the approximation error of the pressure and we get an error estimate which is uniform with respect to the viscosity coefficient in the model. This property is also satisfied if the proposed element pair is applied to the numerical solution of the Navier-Stokes equations.

We present optimal a priori error estimates for the velocity- and pressure-approximation of the Darcy-Brinkman model. Furthermore, we discuss the efficient solution of the arising mixed linear system for the nodal vectors of velocity and pressure.