Technische Universität Dresden

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Wintersemester 2026/27

Dresdner Mathematisches Seminar

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Universität Duisburg-Essen, Fakultät Mathematik

Solvers for mixed finite element methods based on spanning trees

Mixed finite element methods are capable of respecting physical conservation laws at the discrete level, by preserving the structure of the governing PDEs. However, this leads to computationally demanding saddle point systems with a large number of degrees of freedom. Robust and reliable solvers are therefore essential to make these methods feasible for large-scale problems. Yet, such solvers can introduce errors in the conservation laws that we aimed to preserve.
In this talk, we consider a solver based on a decomposition of conventional finite element spaces, using spanning trees in the grid. With this decomposition, we form a new basis in which the mixed formulation of Darcy flow unravels from a large saddle-point problem into a sequence of smaller, symmetric positive definite systems. The resulting direct solver allows us to achieve a significant computational speed-up, without loss of accuracy.
We proceed by considering different variants of the solver. First, we consider a model in which fractures are represented by subdomains of lower dimensionality. We show that the theory directly applies to this case and observe similar computational gains. Second, we show the extension to domains that are topologically non-trivial, i.e. with holes. Finally, we conclude with the implications for designing inexact solvers that respect physical constraints.

Mittwoch, 04.11.2026, 17:00 Uhr – Willers-Bau, Raum **B 321 (!)**

Leitung: Prof. Dr. Dirk Pauly / Prof. Dr. Oliver Sander

Vor dem Vortrag findet **ab 16:30 Uhr** ein gemeinsames **Kaffee-/ Teetrinken** vor dem Vortragsraum WIL B 321 statt.

Stand: 02.11.2026

Bereich Mathematik und Naturwissenschaften
Fakultät Mathematik