Department of Mathematics Colloquium

Numerical solution of coupled nonlinear PDEs describing multi-phase multi-component compressible fluid flow in porous media with industrial application to gigantic systems

By

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Abstract: Giant oil & gas fields provide significant energy for the world. Since these fields are located several kilometers under the earth crust, their production management and prediction of future performance is only handled by mathematical models running on supercomputers. These mathematical models consist of coupled nonlinear partial differential equations describing multi-phase multi-component compressible fluid flow in porous media. Mass conservation equations combined with the momentum balance are used to construct the mathematical model. In addition to the continuum equations, nonlinear thermodynamics constraint equations need to be solved simultaneously with the relevant boundary and initial conditions to achieve unique solution. In general, the number of unknowns per element can vary between 2 to 10, and in some cases 40.

This talk will cover choice of space and time discretization methods which yield stable and convergent and computationally fast solutions. Some large-scale applications will be discussed including CO_2 sequestration using billions of computational elements and a fine grid multiphase simulation using nearly 400 billion elements on parallel computers on a supercomputer with 700,000 cores.

Date: 1 March 2023, Wednesday
Time: 15:30
Place: SA141 - Mathematics Seminar Room