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Fluid Dynamics in Porous Media

Wednesday, November 26, 2025 9:15 AM (1 hour)

The motion of fluids is modeled by various systems of partial differential equations, depending on the properties of the fluid, the medium through which it moves, or the space-time scales on which the motion is studied. I will start by discussing two of the most fundamental of these models: the 2D Euler equations modeling motions of ideal fluids, and the incompressible porous media equation (IPM) for fluids in porous media such as oil or ground water in an aquifer. These are also some of the most elementary fluid models because they can each be re-stated as a single scalar transport equation for either the vorticity or the density of the fluid. Nevertheless, their analysis is far from elementary due to non-local dependence of the transporting velocity on the transported quantity. In the second part of the talk I will present a recent result that shows development of finite time singularities for the two-fluid IPM. It is based on the observation that for a large class of initial data, certain physically relevant quantities - the maximal slope of the interface between the two fluids as well as the potential energy of the system - always decrease in time.

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