Regularity vs singularity for immiscible incompressible Navier-Stokes fluids.

Francisco Gancedo García.

Universidad de Sevilla.

The mathematical analysis of fluid mechanics models in PDEs is a classical topic of research since Euler's 1757 paper, where the equation of an ideal flow was first derived. For the well established models, such as Navier-Stokes and Euler, the incompressible case presents basic and important open questions such as regularity and finite time singularity formation of the solutions. In this talk we consider several scenarios involving the interaction among incompressible fluids of different nature. The main concern is the dynamics of the free boundary separating the fluids, which evolves with the velocity flow. The important question to address is whether the regularity is preserved in time or, on the other hand, the system develops singularities. We focus on Navier-Stokes models, where the viscosity of the fluids play a crucial role. At first showing results of finite time blow-up for the case of vacuum-fluid interaction. Later discussing new recent results on global existence for 1996 P.L. Lions' conjecture for density patches evolving by inhomogeneous Navier-Stokes equations.