Mathematics, Statistics, and Computer Science **@ UIC**

Analysis and Applied Mathematics Seminar

The Navier-Stokes-End-Functionalized polymer system

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Abstract: The problem of minimizing energy dissipation and wall drag in turbulent pipe and channel flows is a classical one which is of great importance in practical engineering applications. Remarkably, the addition of trace amounts of polymer into a turbulent flow has a pronounced effect on reducing friction drag. To study this mathematically, we introduce a new boundary condition for Navier-Stokes equations which models the situation where polymers are irreversibly grafted to the wall. For engineering applications, the effects of polymer on drag reduction are thought to be most pronounced near the boundary and therefore such wall-grafted polymer chains are often employed as drag-reducing agents. Our boundary condition - derived from a fluid-polymer stress balance - closes in the macroscopic fluid variables and becomes an evolution equation for the vorticity along the solid walls. We prove global well-posedness for the resulting system in two spatial dimensions and show that it captures the drag reduction effect in the sense that the vanishing viscosity limit holds with a rate. Consequently, we obtain bounds on energy dissipation rate and drag which qualitatively agree with observations of drag reduction in laminar flow. Talk is based on joint work with Joonhyun La.

Monday, May 6 at 4:00 PM in 636 SEO