JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

Weekly CEAFM Seminar: Fall 2013

Date: **Friday, September 20, 2013**

Time: 11:00 AM

Location: Gilman 50 (Marjorie M. Fisher Room)

Speaker: **Dr. Tamer Zaki** (JHU | MechE)

Title: ***"Streaks in Viscoelastic Couette Flow"***

Abstract

The fluid dynamics of viscoelastic liquids often defies intuition gleaned from the study of Newtonian flows. Common examples include turbulent drag reduction at high Reynolds numbers and the presence of linear instabilities in zero-Reynolds number flows with streamwise curvature. In this work, we study the combined effect of inertia and elasticity on transient streak amplification in planar Couette flow of an Oldroyd-B fluid. The linear perturbation equations are examined in the form of a forced-response problem:

A decaying vortex provides the initial condition, and the wall-normal vorticity response governs the dynamics of the streak response. With significant disparity between the solvent diffusion and polymer relaxation timescales, two distinct responses are possible. The first is termed "quasi-Newtonian" because the streak evolution can be shown to collapse onto the Newtonian behaviour. The second response is labelled "elastic", and explains the origin of streaks in zero-Reynolds-number flows. If the diffusion and relaxation timescales are commensurate, the streaks are able to re-energise in a periodic cycle within an envelope of overall decay. This behaviour is enhanced in the instantaneously elastic limit, where the governing equation reduces to a wave equation with harmonic forcing. The streak re-energisation is demonstrated to be a superposition of trapped elasto-inertial shear waves.

Bio

100 YEARS JOHNS HOPKINS ENGINEERING

Dr. Tamer Zaki's research focuses on simulations of transitional, turbulent and complex flows. His work combines numerical simulations are complementary theoretical models of the flow dynamics. His current activity spans the development of predictive models of instability waves, analysis of the rare events which trigger the onset of turbulence, and flow control and drag reduction.