May 17th, 11:00 AM - 11:20 AM

A long-wave model for film flow inside a tube with slip

Mark S. Schwitzerlett
msschwitzerl@vcu.edu

Ihsan Topaloglu
Virginia Commonwealth University, iatopaloglu@vcu.edu

H. Reed Ogrosky
Virginia Commonwealth University, hrogrosky@vcu.edu

Viscous liquid film flows in a tube arise in numerous industrial and biological applications, including the transport of mucus in human airways. Previous modeling studies have typically used no-slip boundary conditions, but in some applications the effects of slip at the boundary may not be negligible. We derive a long-wave model based on lubrication theory which allows for slippage along the boundary. Linear stability analysis verifies the impact of slip-length on the speed, growth rate, and wavelength of the most unstable mode. Nonlinear simulations demonstrate the impact of slip-length on plug formation and wave dynamics. These simulations are conducted for flows driven by gravity, core flow, or a combination of the two. We derive a second long-wave model to explore the effect of slip on fluid flow in a constricted tube. The results of simulations in such a tube will be discussed.