Can a Mesoscopic Model Describe Stick-slip Flow?

Peter Daivis[1, S, C], Khanh Gia Pham[1] and Billy Todd[2]

[1]*Physics Discipline, School of Science, RMIT University, Melbourne, Vic, Australia*
[2]*Department of Mathematics, Swinburne University of Technology, Hawthorn, Vic, Australia*
peter.daivis@rmit.edu.au

Stick-slip flow is observed when the rheological properties of a lubricating fluid between two very closely spaced surfaces intermittently undergo a dramatic change. This phenomenon has been studied experimentally using the highly sophisticated surface force apparatus, and also by molecular dynamics simulations. Comparisons between experiment and simulation have been controversial. As the detail and realism of the molecular dynamics simulations has progressively improved, a better understanding of the subtlety of this effect has been achieved. However, this has also resulted in a loss of simplicity in the physical explanation for stick-slip flow. An alternative approach that may provide more insight is to construct a mesoscopic continuum model to describe stick-slip flow. While simple models that qualitatively reproduce the observed behaviour have been proposed before, little work has been done to test them quantitatively. In this presentation, I will describe our progress towards the goal of arriving at a quantitatively accurate and conceptually simple mesoscopic model of stick-slip flow with the capacity to incorporate the subtlety of the results obtained by experiment and molecular simulation.