Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Simulation of Droplet Spreading Dynamics by Particle Finite Element Method Based Model and Hydrodynamic Lubrication ELAF MAHROUS, R.VALERY ROY, University of Delaware, ALEX JARAUTA, MARC SECANELL, University of Alberta, PAVEL RYZHAKOV, Cimne: International Centre for Numerical Method in Engineering — Modeling droplet dynamics is an active area of research. Of particular interest is the prediction of spreading rates and spatio-temporal evolutions of droplets of varying physical properties such as surface tensions on substrates with different wettability. We adopt two distinct numerical approaches: Particle finite element method (PFEM) and hydrodynamic lubrication. PFEM is advantageous due to its ability to track evolving fluid domains and provide an accurate mesh-based boundary description which facilitates the computation of the surface tension in droplet problems. An alternative modeling approach is hydrodynamic lubrication which is based on a small slope approximation, thus requiring small contact angles. The key advantage of this approach is its low computational requirements. Using a no-slip prevents any contact line movement, and applying perfect slip leads to unrealistically large velocities. A particular challenge is to relieve this singularity while accounting for dynamic contact angles. We show how this can be resolved for both methods. Also, we compare their contact line velocities with hydrodynamic analytic model, as well as with experimental results of capillary driven water droplets on substrates with widely differing properties.

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Date submitted: 30 Jul 2019 Electronic form version 1.4