Analysis of a local surface model as applied to the triple line dynamic

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We study in a mathematical and numerical point of view, the Shikhmurzaev's model established in [4], [1] and treating of the dynamic contact line problem (motion of an advancing liquid on a solid surface, eg. coating of solids by liquids). The model describes the main features of the advancing contact line: i) local rolling motion feature, [3]; ii) the dynamical contact angle derives from its static value and depends on the fluid velocity in the bulk.

The model is composed by a macroscopic Hydrodynamic Free Surface Model -HFSM- (Navier-Stokes incompressible with curvature terms) fully coupled with a mesoscopic Local Surface Model -LSM-. The dynamic contact angle is a response of the model.

The LSM is a surface time-dependent nonlinear degenerated equation. Its unknown is the surface density which describes the state of the free surface and provides the surface tension variations. We present a full mathematical and numerical analysis of the LSM 1D version.

Then, we consider a 2D plunging tape configuration and numerical computations are performed. First, the 1D LSM is solved and provides some surface tension profiles near the triple point. Second, the 2D HFSM with the corresponding local Marangoni term given (mesoscopic scale) is solved by a Finite Element method and an ALE formulation. We obtain the flow near the triple point and the dynamic of the wetting angle.

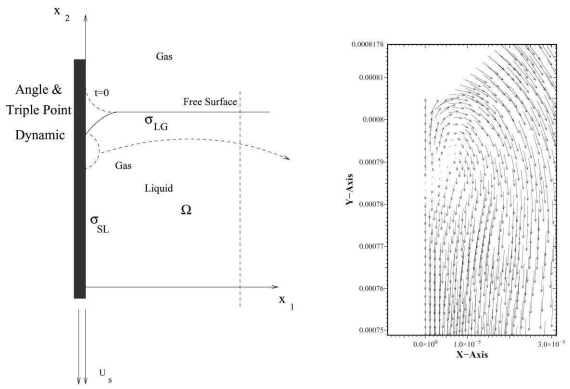

Figure 1: *Left:* Plunging tape configuration. *Right:* Zoom. $\vec{u}$ near the triple point; Local Marangoni effect

References

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[3] V.E.B. Dussan, S.H. Davis, *On the motion of a fluid-fluid interface along a solid surface*, J. Fluid Mech. **65**, 71-95 (1974).

[4] Y.D. Shikhmurzaev, *The moving contact line problem on a smooth solid surface*, Int. J. Multiphase Flow, **19** (4) (1993) 589-610.