Assessment of fundamental flow pattern inside a liquid immersion droplet

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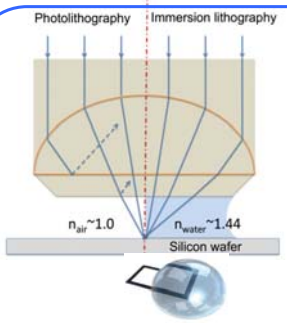
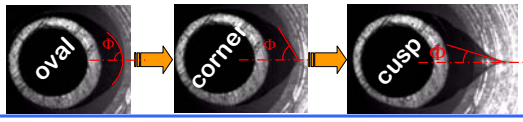
Immersion droplet ??

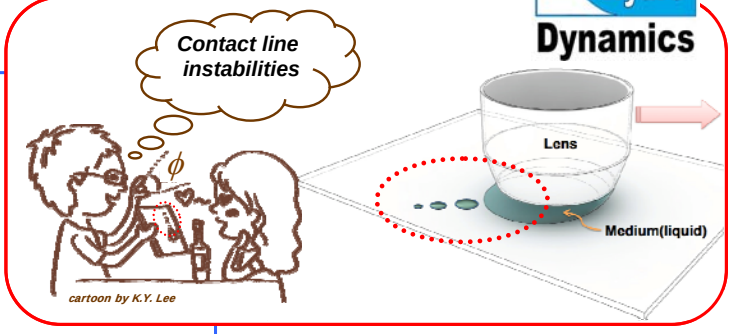


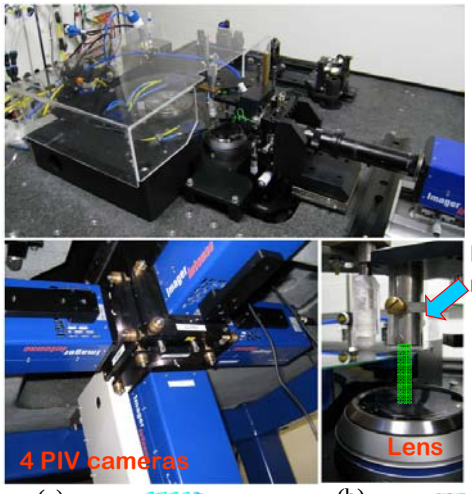
- Spatial resolution : $\delta = k\lambda / NA$

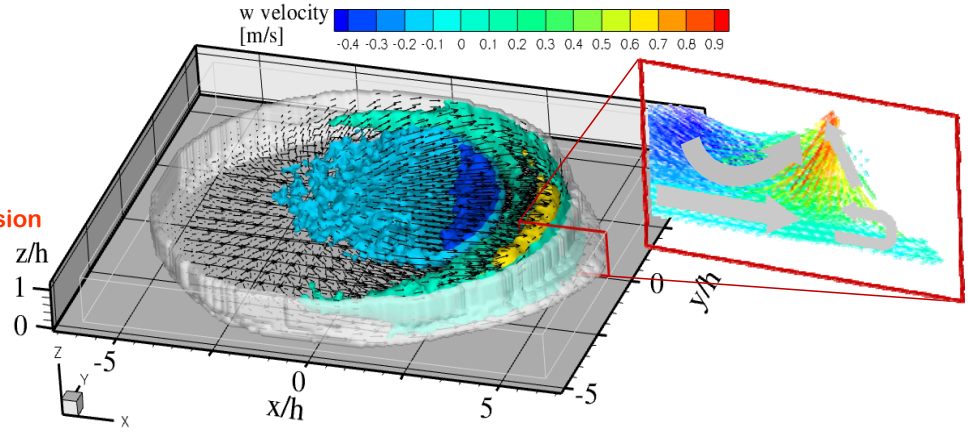
where $NA = n \cdot \sin\theta$

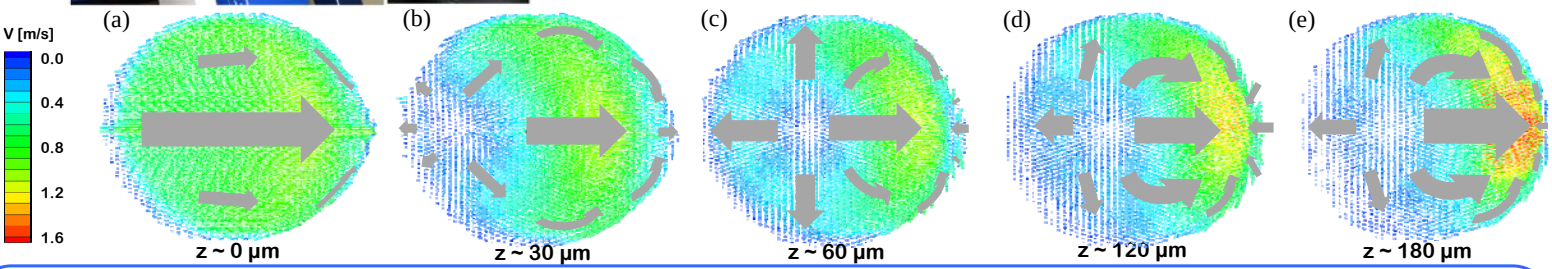
- The droplet corner shapes evolve from a round to a cusp shape when the substrate as long as the substrate speed increases











Measurement accuracy

1) By the volumetric self-calibration, the final disparity error vectors are less than 0.1 pixel (0.4 μm in the actual dimension)

2) To assess the dynamic range, reliability, and accuracy of the results, $\overline{\left(\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}\right)^2} \cong \left(\frac{\sigma_{\Delta x}}{D_I \Delta t}\right)^2$

➔ Random error : 0.2 pixel

3) Check the mass conservation : 2% relative error w.r.t the inlet flow @ the middle plane of the droplet (without moving the substrate)

References

1) H. Kim, S. Große, M. Riepen, and J. Westerweel, "Experimental investigation of internal flow in an immersion droplet by 3D PTV," Proc. of the 14th Int. Sym. on Flow Vis., Daegu, Korea, June 2010

2) H. Kim, S. Große, G. Elsinga, and J. Westerweel, "Full 3D-3C velocity measurement inside a liquid immersion droplet," under review by Exp Fluids

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