A numerical parametric study of droplet deformation through a microfluidic contraction

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The deformation of a droplet as it passes through a microfluidic contraction is a fundamental flow problem having relevance to a broad range of Micro-Electro-Mechanical Systems (MEMS) applications. A characteristic of microfluidic flows is that surface forces assume greater importance than in conventionally scaled flows. For flows involving more than one liquid, this implies that capillary effects are more dominant than in conventional flows, and this presents new challenges when modeling such multiphase microfluidic systems.

In this study we analyse and discuss the effect that the Weber number, Reynolds number and fluid viscosity ratio have on the deformation of a droplet as it passes through an axisymmetric contraction. We consider parameter ranges that are relevant to liquid-liquid systems and characteristic of MEMS applications, and perform the simulations using a transient Volume of Fluid (VOF) finite volume algorithm.