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Numerical Simulation of Droplet Breakup, Splitting andSorting in a Microfluidic Device

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Abstract: Droplet generation, splitting and sorting are investigated numericallyin the framework of a VOF technique for interface tracking and a finite-volumenumerical method using the commercial code FLUENT. Droplets of water-in-oilare produced by a flow focusing technique relying on the use of a microchannellequipped with an obstacle to split the droplets. The influence of several parameterspotentially affecting this process is investigated parametrically towards the endof identifying "optimal" conditions for droplet breakup. Such parameters includesurface tension, the capillary number and the main channel width. We show thatthe capillary number plays a crucial role in determining droplet properties and theefficiency of the related generation process. An obstacle configuration can be effectivelyused to split a droplet, with the droplets being naturally sorted at the endof the main channel. Larger values of the capillary number generally lead to anincrease in the droplet frequency and a decrease in its typical size.

Keywords : Water droplet, flow focusing, splitting, sorting, CFD, VOF, microchannel