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Tuning of the droplet motion in interconnected microfluidic devices GUOQING HU, LNM, Institute of Mechanics, Chinese Academy of Sciences, Beijing, PR China, KUI SONG, LI ZHANG — The problem of controlling the droplet motions in multiphase flows on the microscale has gained increasing attention because the droplet-based microfluidic devices provide great potentials for chemical/biological applications such as drug discovery, chemical kinetics study, material synthesis, and DNA/cell assays. It is critical to understand the relevant physics on droplet hydrodynamics and thus control the generation, motion, splitting, and coalescence of droplets in complex microfluidic networks. The operation of those applications sometimes requires the arrival of droplets from different branch microchannels at a designated location within a transit time. We propose a simple design for interconnected microfluidic devices that implement the feedback mechanism to synchronize the droplet motion via a passive way. Numerical simulations using the Volume of Fluid (VOF) algorithm are conducted to investigate the time-dependent dynamics of droplets in both gas-liquid and liquid-liquid systems. An analytical mode based on the electronic-hydraulic analogy is also developed to describe the transit behavior of the droplet traffic. Both the numerical and theoretical results agree well with the corresponding experimental results. Furthermore, we optimize the microfluidic networks to control the motion of a series of droplets.

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