

# Microfluidic Lab-on-a-Chip

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## *ABSTRACT*

Recent advances in microfluidics and computer-aided design techniques have enabled the development of a tiny device called lab-on-a-chip, which is capable of implementing, in a cost-effective manner, several biochemical assays for rapid chemical analysis or medical diagnosis. To make such a chip operational, one has to integrate microfluidic platforms with optical and electronic sensors. An automated control mechanism is also needed to execute various fluidic operations on-chip in space and in time. These chips are likely to bring a complete paradigm shift in the area of biochemical diagnostics, DNA detection, or drug design system, to name a few. Digital microfluidic biochips (DMB) are a special class of chips where fluid transport and various operations are performed with discrete droplets of integral-size volumes. They offer many convenient solutions because of their ease of controllability and reconfigurability.

In this tutorial, we will first introduce the basic concepts of a digital microfluidic biochip, the underlying mechanism of operation, and the associated hardware platform required to support such a device. Next, we will discuss how biochemical assays can be mapped on a biochip, and address related algorithmic issues of sample and mixture preparation. Finally, we will talk about the design and test problems in such systems and demonstrate their performance for various real-life examples.