Synthesis of Biochemical Applications on Digital Microfluidic Biochips with Operation Execution Time Variability - DTU Orbit (05/12/2018)

Synthesis of Biochemical Applications on Digital Microfluidic Biochips with Operation Execution Time Variability

Microfluidic-based biochips are replacing the conventional biochemical analyzers, and are able to integrate all the necessary functions for biochemical analysis. The digital microfluidic biochips are based on the manipulation of liquids not as a continuous flow, but as discrete droplets. Several approaches have been proposed for the synthesis of digital microfluidic biochips, which, starting from a biochemical application and a given biochip architecture, determine the allocation, resource binding, scheduling, placement and routing of the operations in the application. Researchers have assumed that each biochemical operation in an application is characterized by a worst-case execution time (wcet). However, during the execution of the application, due to variability and randomness in biochemical reactions, operations may finish earlier than their wcets, resulting in unexploited slack in the schedule. In this paper, we first propose an online synthesis strategy that re-synthesizes the application at runtime when operations experience variability in their execution time, exploiting thus the slack to obtain shorter application completion times. We also propose a quasi-static synthesis strategy that determines offline a database of alternative implementations. During the execution of the application, several implementations are selected based on the current execution scenario with operation execution time variability. The proposed strategies have been evaluated using several benchmarks and compared to related work.

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