National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Algorithms for droplet routing in digital microfluidic biochip: managing deadlock, route storage and contamination
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Venue	: Convention Room, CSE Department
Date and Time	: 18 Sep 2024 (11:00 AM)
Abstract	: A digital microfluidics Biochip (DMFB) is a small hand-held device capable of automating biochemical assays. It is used extensively in genetic research and medical diagnostics. It has features like portability, on-spot analysis, and result, nearly zero setup error and wastage. Biochemical synthesis is performed in three phases: scheduling, placement, and droplet routing. A biochemical reaction or assay is represented as a directed acyclic graph. Every node in it represents a biochemical operation e.g., mix, split, heat, etc, and the edges represent the interdependency among operations. In the scheduling phase, all the operations are assigned the beginning and ending time cycles. The placement phase allocates positions of various modules i.e., mixture, heater, detector, etc, on the chip. The modules are placed so that the droplets traveling distance is optimized. Droplet routing is an essential task in the synthesis. The goal is to transport all the droplets to their respective destination cells to perform the desired operation without mixing with each other. Fluidic constraints are defined to avoid unwanted mixing between two droplets. Deadlock occurs when two droplets stop advancing to the next cell due to the violation of fluidic constraints. Our work focused only on the droplet routing phase. It compromises deadlock detection, three droplet routing mechanisms, and a wash droplet routing method. First, work involves defining conditions for deadlock. The second work converts the droplet routing problem to the overlapping rectangle problem and an edge optimization problem. The third work involves converting the biochip to a bipartite graph and discovering routes. The fourth work adopts the MMMSPEED router defined for wireless sensor networks to DMFB. The contamination issue is resolved by introducing wash droplets in our final work. The simulation result analysis shows improvement in our proposed work's latest arrival time, number of shared cells, and memory requirement.