Low-Cost, High-Throughput, Cyber-Physical Synthesis of Encrypted DNA

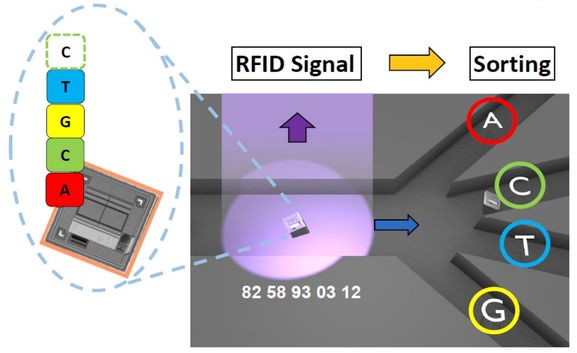
Award #1740052| *wgrover@engr.ucr.edu*| **William H. Grover, Victor G. J. Rodgers, Philip Brisk | University of California, Riverside**

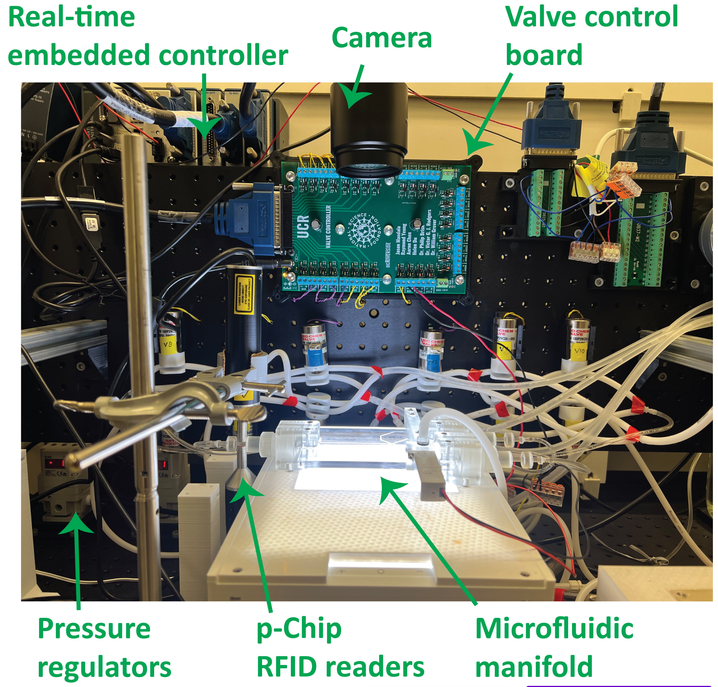
Challenges

- **Large-scale solid-phase DNA synthesis** requires substantial improvements in **throughput**, **accuracy**, and **robustness**

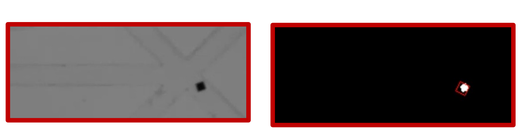
Solution

- Solid-phase DNA synthesis system involving **sorting identifiable p-Chip microtransponders** (PharmaSeq, Inc.) acting as synthesis supports to reaction reservoirs for parallel synthesis
- Cyber-physical co-design process employing computational simulations and experimental studies to evaluate optimal parameters for high-throughput
- FPGA-accelerated implementation for real-time detection, tracking, and sorting of p-Chips

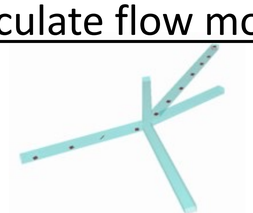


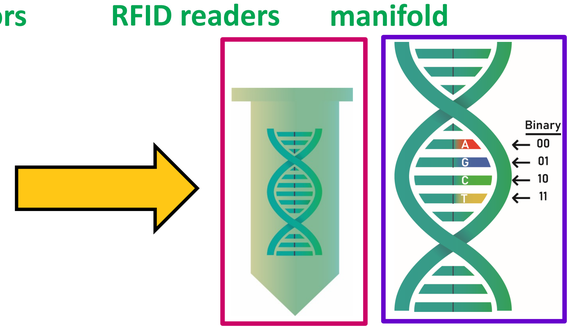


Experimental validation studies



Computational particulate flow models





Scientific Impact

- Large-scale manufacturing of synthetic DNA constructs needed in synthetic biology and computer science research
- Fundamental understanding of particulate flow behavior of flat-plate, non-neutrally buoyant particles
- Design and implementation of vision-based, real-time systems for actuations and control

Broader Impact

- Yield synthetic constructs including primers, genes, and **therapeutic products**
- Facilitate realization of DNA as a viable medium for **digital data storage**
- Train students in the co-design paradigm for fluidic cyber-physical systems
- Engage the public in learning about the broader applications of DNA

- The project will **reduce the cost** of synthesized DNA oligonucleotides by **3-4 orders of magnitude**