
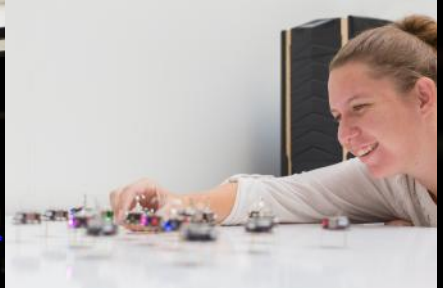


Physics colloquium

A Cargo-sorting DNA Robot

Lulu Qian
Department of Bioengineering
California Institute of Technology

Date: 5/3/19
Time: 10:30 AM
Location: COB2 170

For more information contact

William Delmas
wdelmas@ucmerced.edu

Abstract: Two critical challenges in the design and synthesis of molecular robots are modularity and algorithm simplicity. We demonstrate three modular building blocks for a DNA robot that performs cargo sorting at the molecular level. A simple algorithm encoding recognition between cargos and their destinations allows for a simple robot design, a single-stranded DNA molecule with one leg and two foot domains for walking, and one arm and one hand domain for picking up and dropping off cargos. The robot explores a two-dimensional testing ground on the surface of DNA origami, picks up multiple cargos of two types that are initially at unordered locations and delivers them to specified destinations, until all molecules are sorted into two distinct piles. The robot is designed to perform a random walk without any energy supply. Exploiting this feature, a single robot can repeatedly sort multiple cargos. Localization on DNA origami allows for distinct cargo-sorting tasks to take place simultaneously in one test tube, or for multiple robots to collectively perform the same task.

Bio: Lulu Qian is a Professor of Bioengineering and affiliated faculty of Computer Science at the California Institute of Technology. She received her bachelor's degree in Biomedical Engineering from Southeast University in China, and her Ph.D. in Biochemistry and Molecular Biology from Shanghai Jiao Tong University. She then worked as a postdoctoral scholar at the California Institute of Technology, and as a visiting fellow at Harvard University. Her interests lie in engineering molecular systems with intelligent behavior. Specifically, she is interested in exploring the principles of molecular machines in nature with the end goal of creating artificial molecular machines that approach the complexity and sophistication of life itself. To this end, she works on designing and constructing nucleic-acid systems from scratch that exhibit programmable behaviors from the basic level — such as recognizing molecular events from the environment, processing information, making decisions, and taking actions — to the advanced level, such as learning and evolving. She is a recipient of the Burroughs Wellcome Fund Career Award at the Scientific Interface, the Okawa Foundation Research Award, and the National Science Foundation Faculty Early Career Development Award.