Programming Bacteria in Time and Space

Lingchong You
Duke University

Microbes are by far the most dominant forms of life on earth. In every imaginable habitat, they form complex communities that carry out diverse functions. Microbial communities drive the geochemical cycling of diverse chemicals and through these activities shape the earth's climate and environment. They are also intimately tied to human physiology and health. Members of each microbial community may compete for resources, collaborate to process the resources or to cope with stress. They communicate with each other by producing and responding to signaling molecules. And they innovate by exchanging genetic materials. These interactions raise fundamental questions regarding the evolutionary and ecological forces that shape microbial consortia. Our lab has adopted a combination of quantitative biology and synthetic biology to explore these questions. We engineer gene circuits to program dynamics of one or more *Escherichia coli* bacterial populations and use them to examine questions in cellular signal processing, evolution, ecology, and development. Analysis of these systems has provided insights into bacterial tolerance to antibiotics, developmental pattern formation and scaling, as well as strategies to use bacteria to fabricate functional materials by exploiting programmed self-organization.