The Summer Undergraduate Research Fellowship (SURF) Symposium
3 August 2017
Purdue University, West Lafayette, Indiana, USA

Finite Element Analysis and Biological Growth Realization using Robot Swarms

Cody W. Dorbin
School of Mechanical Engineering, Purdue University

ABSTRACT

Our understanding of growth and remodeling of biological systems has increased in the past two decades; however, this knowledge has not yet been used in human-designed systems or engineering applications. This project studies designing and building a network of robots that mimics the biological behavior of growth driven by cell-cell communication and control networks. The objective of this research is to harness the principles that govern tissue adaptation and morphogenesis, where peer-to-peer local communication determines global properties, to create human-made engineering systems with life-like capabilities. We used Arduino microcontrollers to control an individual robot in an expandable 3d-printed cuboid shell. Each individual cuboid robot will be able to communicate with up to 6 robots, one connected to each of its faces. Through local data communication, and enlarging and shrinking of individual robots, one would be able to model growth and other biological systems using a large assembly of these identical robots. Additionally, we expect (through additional research) to be able to physically demonstrate biological simulations of processes such as growth or morphogenesis to other researchers/laypersons, allowing quicker and deeper understanding of these complex processes to a large audience.

KEYWORDS

Robotics, Robot network, Arduino, Biological Growth, Finite Element Analysis