Model-based control of soft robotic systems

Dr. James Bern

Abstract: Unlike their rigid cousins, soft robots conform naturally to the environment. This makes them inherently safe and robust to uncertainty, and therefore promising for applications requiring close interaction with people, such as elderly care, medicine, and rehabilitation. However, these benefits are not for free. The same softness that makes soft robots so exciting also renders them unintuitive to design, and difficult to control. For example, to answer the seemingly simple question of calculating a soft robot's inverse kinematics, we must account for highly nonlinear soft body physics and contact dynamics. A fundamental challenge in soft robotics therefore is to make it easy to predict and control soft robot motion. We propose a differentiable soft robot simulator based on the Finite Element Method. I will show how to leverage this simulator to answer not only the classic questions of forward kinematics and inverse kinematics for soft robots, but also to start answering the harder questions of soft locomotion, soft manipulation, and more.

Bio: Dr. James Bern is starting as a Postdoctoral Associate at MIT CSAIL with Professor Daniela Rus. He completed his Ph.D. in Computer Science at ETH Zurich, advised by Professor Stelian Coros. He received his M.S. in Robotics from Carnegie Mellon University, and his B.S. in Mechanical Engineering with minors in Computer Science and Control and Dynamical Systems from Caltech. He is the winner of the ACM Siggraph 2019 Thesis Fast Forward, and the recipient of the JTCF Novel Technology Paper Award for Amusement Culture at IROS 2017.

978-1-7281-6211-9/20/$31.00 ©2020 IEEE