Carnegie Mellon University

THE ROBOTICS INSTITUTE

THESIS DEFENSE

Robust Soft-Matter Robotic Materials

Thursday, July 12, 2018

Scaife Hall 224

1:00 p.m.

Thesis Committee:

Carmel Majidi
Chair

Chris Atkeson

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Abstract

Emerging applications in wearable computing, human-machine interaction, and soft robotics will increasingly rely on new soft-matter technologies. These soft-matter technologies are considered inherently safe as they are primarily composed of intrinsically soft materials---elastomers, gels, and fluids. These materials provide a method for creating soft-matter counterparts to traditionally rigid devices that exhibit the mechanical compliance and versatility of natural, biological systems. However, these soft-matter counterparts often rely on power and data communication tethers, limiting their use outside of a controlled laboratory environment. Furthermore, these soft-matter counterparts are increasingly susceptible (as compared to their rigid counterparts) to varying forms of mechanical damage such as cutting, tearing, or puncture that can result in operational failure. This thesis presents two new rapid (<3 hrs) fabrication methods that addresses current challenges of integrating surface mount microelectronics for signal processing, wireless communication, and power with soft and stretchable circuit interconnects. In addition, a new material architecture is introduced for creating soft and highly deformable circuit interconnects that are capable of autonomous electrical self-healing to maintain electrical functionality when damage occurs. Finally, this material architecture can be used as an artificial nervous tissue to electrically detect, localize, and respond to detrimental damage events within soft-matter inflatable structures and robotic systems.