From Particles to Parts — Building Artificial Life from Multifunctional Composites

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Keynote Abstract

Soft robots have the potential to adapt their morphology, properties, and behavioral control policies towards different tasks or changing environments. This adaptive capability is often inspired by biological systems. For example, octopus tentacles can access nearly infinite trajectories, yet also form joint-like structures to adapt articulated limb control strategies. Caterpillars display undulation and inchworm gaits but can rapidly curl themselves into a wheel and propel themselves away from predators. The armadillo can change from a walking gait on legs to a rolled-up ball as a defense mechanism. During this talk, I will present recent work towards particulate composites that address distributed sensing, variable stiffness properties, and variable trajectory motions inspired by these capabilities in animals. I will contextualize the materials within robotic skins,which are thin, elastic membranes with embedded robotic function. Robotic skins can be wrapped around arbitrary deformable objects to induce the desired motions and deformations, therefore enabling a multitude of robots with different morphologies and functions. Finally, I will show how merging these material discoveries with robotic skins can be used to achieve new shape-shifting capabilities in next-generation soft robots.