Embedded 3D Printing of Autonomous and Somatosensory Soft Robots

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Recent advances in soft robotics motivate the need for new fabrication strategies that enable the heterogeneous, programmable assembly of soft matter with disparate mechanical, electrical, and/or chemical properties into functional architectures. Here, I will present a free-form, multimaterial 3D printing technique for manufacturing soft robots. In this approach, known as embedded 3D (EMB3D) printing, functional and fugitive inks are extruded through a nozzle that is translated omnidirectionally within a soft, viscoplastic matrix material that surrounds and supports the printed features (e.g. catalytic, sensing, and pneumatic networks). I will first briefly describe how we have used EMB3D printing to create entirely soft, hardware-free robots and soft sensors. I will then present our work in EMB3D printing soft somatosensitive actuators innervated with multiple conductive features for haptic, proprioceptive, and thermoceptive sensing in soft robotic end effectors. This integrated design, materials, and manufacturing approach can be readily extended to other soft robotic systems that are entirely soft, require somatosensory feedback for improved control, or cannot be made with traditional manufacturing methods.