Multifunctional magnetic origami robots

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Abstract: Millimeter/centimeter-scale origami robots have recently been explored for biomedical applications due to their inherent shape-morphing capability. However, they mainly rely on passive or/and irreversible deformation that significantly hinders the clinic functions in an on-demand manner. Here, we report magnetically actuated origami robots that can crawl and swim for effective locomotion and targeted drug delivery in severely confined spaces and aqueous environments. We design our robots based on the Kresling origami, whose thin shell structure 1) provides an internal cavity for drug storage, 2) permits torsion-induced contraction as a crawling mechanism and a pumping mechanism for controllable liquid medicine dispensing, 3) serves as propellers that spin for propulsion to swim, 4) offers anisotropic stiffness to overcome the large resistance from the severely confined spaces in biomedical environments. These magnetic origami robots can potentially serve as minimally invasive devices for biomedical diagnoses and treatments.

Bio: Renee Zhao is an Assistant Professor of Mechanical Engineering, a Terman faculty fellow, and a Gabilan faculty fellow at Stanford University. Renee received her PhD degree in Solid Mechanics from Brown University in 2016. She spent two years as a postdoc associate at MIT working on modeling of soft composites. Renee’s research concerns the development of stimuli-responsive soft composites for multifunctional robotic systems for miniaturized biomedical devices, active metamaterials, and deployable and morphing structures. Renee is a recipient of the AFOSR YIP (2023), NSF Career Award (2020), ASME Journal of Applied Mechanics award (2021), the 2022 ASME Pi Tau Sigma Gold Medal, and the 2022 ASME Henry Hess Early Career Publication Award.