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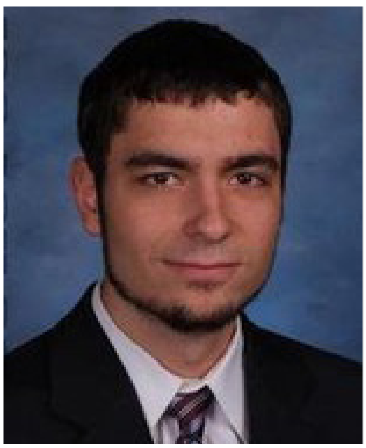
MODULAR ROBOTIC SYSTEMS FOR THERAPEUTIC ENDOSCOPY



Friday, November 17, 2017 | 12:00pm
2164 Martin Hall, DeWALT Seminar Room

JOSHUA GAFFORD

Ph.D. Candidate, Surgical Robotics
John A. Paulson School of Engineering & Applied Sciences
Harvard University

ABSTRACT

Nascent endoscopic therapeutic procedures, such as endoscopic submucosal dissection, enable unparalleled access to and removal of mid-size cancerous neoplasia from within the gastrointestinal tract. However, the remote locations of these lesions often require substantial dexterity which imparts appreciable cognitive loading on the clinician and opens up the possibility of adverse events such as intestinal perforation due to limited dexterity and a lack of sensory feedback. In this work, we introduce a mm-scale, tip-mounted robotic system, EndoMODRA (Endoscopic Module for On-Demand Robotic Assistance), which interfaces with commercially-available endoscopic tools and provides additional dexterity and feedback sensing using on-board actuators and sensors. Leveraging alternative high-energy-density actuation strategies and monolithic, printed-circuit-inspired manufacturing processes, all actuation and sensing is fully contained within the distally-mounted module, obviating the need for a continuous mechanical transmission to a proximal actuation source. Closed-loop position-controlled trajectory execution is demonstrated using on-board actuation and sensing, realizing fully-distal loop closure in an endoscope-mounted robotic module with no proximal actuation or sensing component. System efficacy is demonstrated through in vitro and ex vivo tests on appropriate analogs. This research lays the groundwork for a new class of endoscopic robot modalities that bridge the gap between simplistic, low-cost endoscopic add-on devices and sophisticated flexible endoscopic robotic systems.

BIO

Joshua Gafford received the B.S. degree in mechanical engineering from Massachusetts Institute of Technology, and M.S. degree in mechanical engineering from Stanford University. He is currently pursuing his Ph.D. at the Harvard School of Engineering and Applied Sciences. His research focuses on the application of printed-circuit-inspired manufacturing techniques to the design of next-generation surgical end-effectors with integrated kinematics, sensing and actuation, with direct applications in therapeutic endoscopic interventions. His broader interests include precision engineering and design, mechanism design, robotics, circuit design, sensor design, control theory, state/parameter estimation and machine learning.

A. JAMES CLARK
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