NRI: Mobile Microrobots for Precision Medicine

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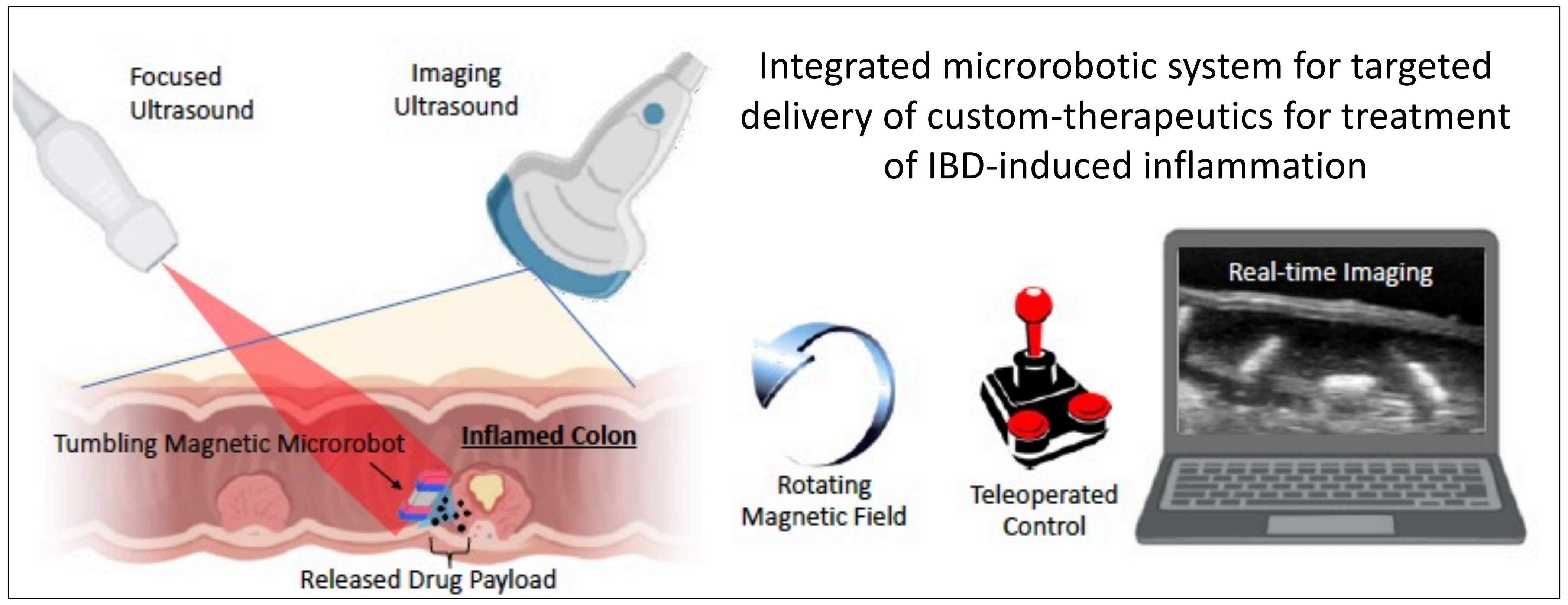
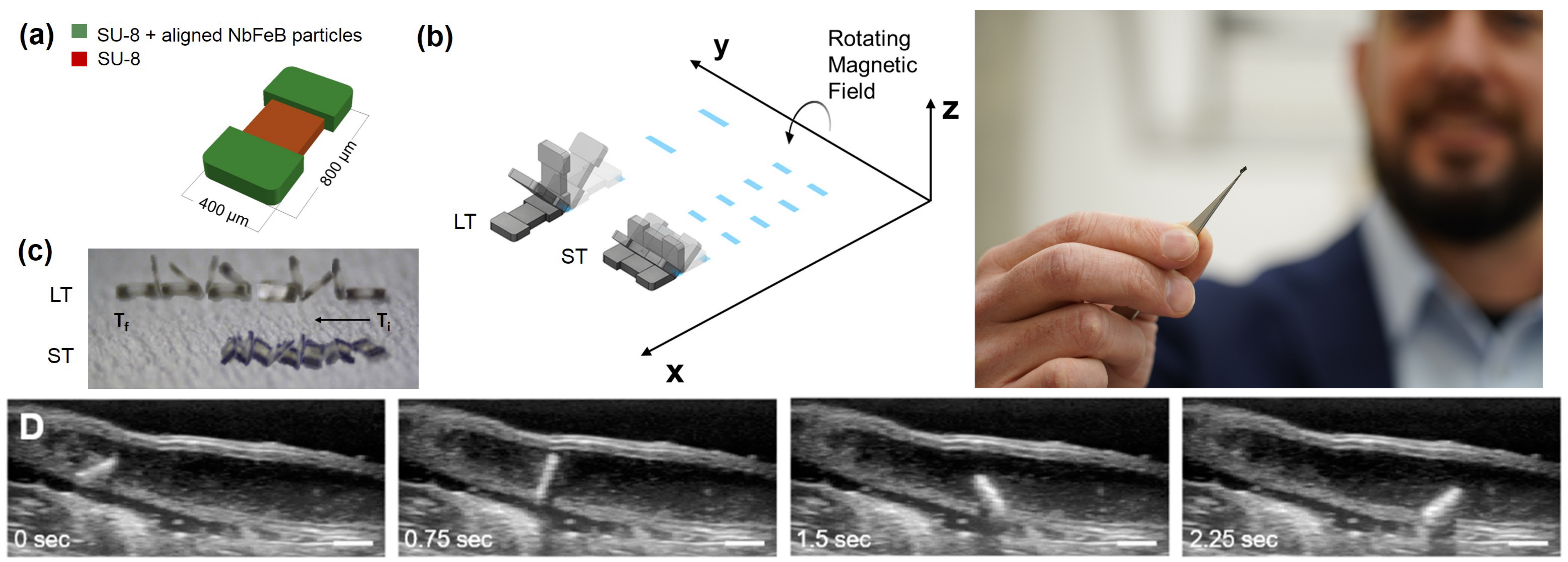
Motivation: Patients with inflammatory bowel disease (IBD) are at significantly increased risk of colorectal cancer (CRC), principally resulting from the effects of chronic intestinal inflammation. Current treatment of IBD is suboptimal despite the array of available pharmacotherapeutics. There is an unmet clinical need for more efficacious and less toxic therapies. A powerful, targeted therapy that could be delivered locally with reasonable precision, would represent a major breakthrough for colorectal disease.

Hypothesis: A combined imaging/actuation system with high resolution, cross-compatibility, small footprint, and tissue penetration capabilities can be developed to actively guide, minimally invasive in vivo magnetic microrobots for the on-demand local delivery of compounds to treat IBD.

Research Approach: A tumbling magnetic microrobot, actuated with a rotating external magnetic field will be loaded with a thermally-responsive drug payload and controlled via teleoperation. Ultrasound will be used for real-time imaging of the microrobots in the colon. Once at a target location, a focused ultrasound system will be used to heat the microrobot and release the drug payload



Preliminary Work:



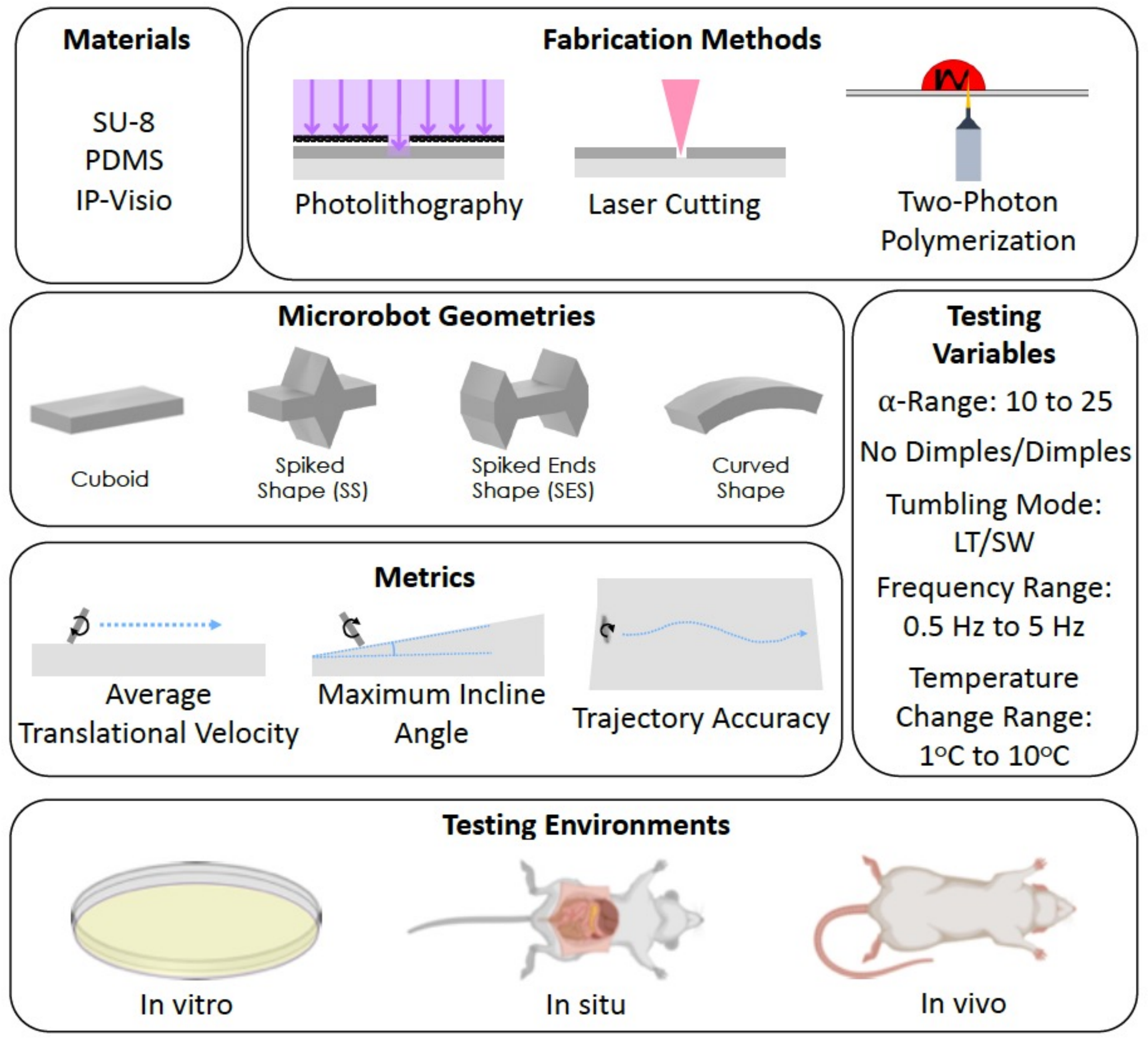
Broader Impacts: This project has great potential for impact in both the microrobotics and healthcare fields. Patients with IBD are at significantly increased risk of colorectal cancer. There is an unmet need for more efficacious and less toxic therapies, as proposed here. A systematic study of the optimal design features and operating modes for microscale robots in unstructured, complex terrains will enable exciting new applications in medicine and advanced manufacturing.

Specific Aims

Aim 1. Design a mobile microrobot system for *in vivo* locomotion within the GI tract of rats (Cappelleri)

Aim 2. Design a release system capable of delivering a therapeutic payload from mobile microrobots (Solorio)

Aim 3. Design a focused ultrasound heating system for active *in vivo* targeting and delivery of a therapeutic payload from mobile microrobots (Goergen)



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