CPS: Small: Geometric Self Propelled Articulated Micro-Scale Devices Award #: 1739308, Award Date: September 1, 2017

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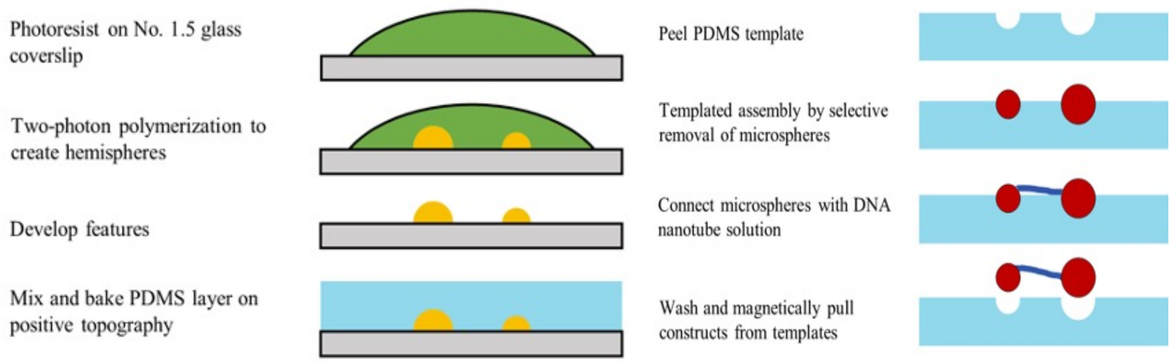
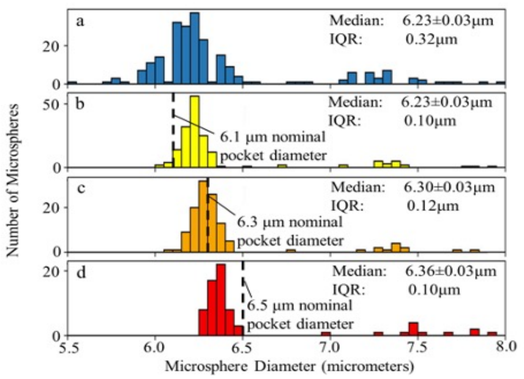
1: Carnegie Mellon: http://biorobotics.ri.cmu.edu/index.php 2: Carnegie Mellon: http://www.andrew.cmu.edu/user/bex/stories/welcome/

Objective:

Demonstrate geometry-based trajectory generation methods for self-propelled millimeter-scale devices. Prototype optimized micron-scale devices. Integrate robotics and microfabrication systems to fundamentally change cyber-physical system design and control.





Challenge:

Integrate motion planning and mechanical design for microscale devices

Scientific Impact:

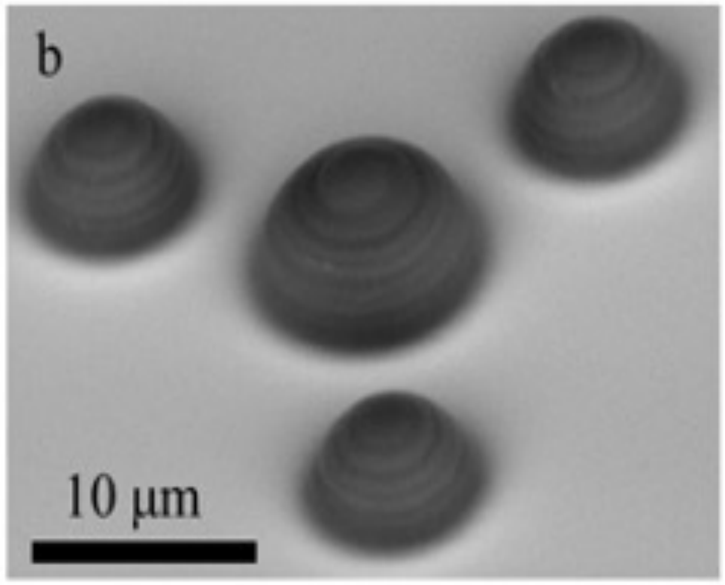
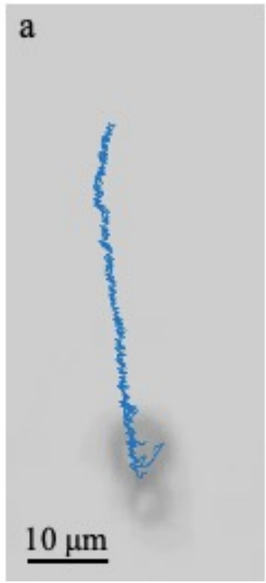
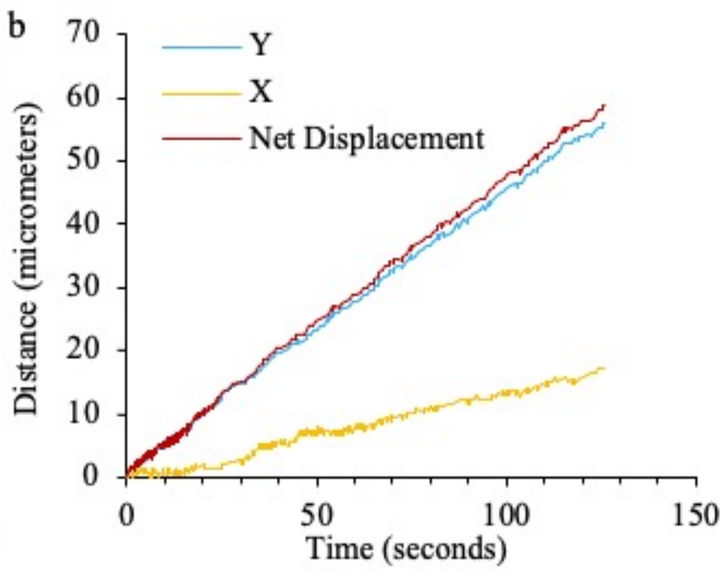
Develop cyber-physical system design process that informs the construction of mechanical prototypes via geometric modeling and optimal motion planning

Broader Impact – Society:

Establishes the foundation for novel medical device deployment. Enables non-invasive surgery, biosensing, targeted drug delivery

Broader Impact – Outreach:

- Implemented real-time, web-based control of Helmholtz Coils, devised workflow, and outlined user interface for public dissemination

Y3 Outcomes:

- Demonstrated magnetically actuated microswimmer constructed from DNA and microspheres in a hybrid top-down and bottom-up assembly technique that allows for submicron-level precision over microswimmer body construction
- Microscale features were fabricated via two-photon polymerization, from which polydimethylsiloxane templates were molded and used for selective removal to deposit microspheres of select size into the templates
- Published paper in JMES, “A customizable DNA and Microsphere-Based Magnetically-Actuated Microswimmer”