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

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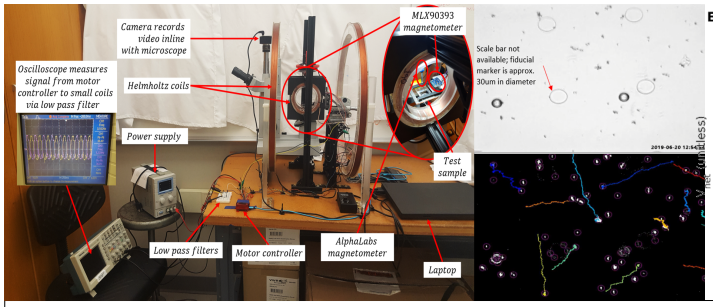
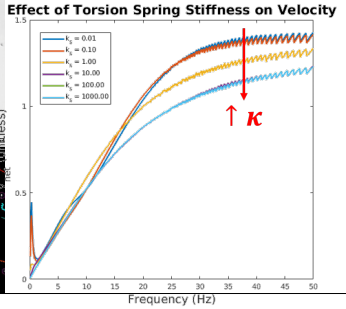
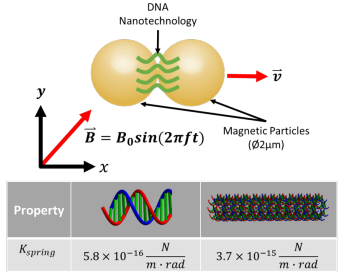
1: http://biorobotics.ri.cmu.edu/index.php 2: http://www.andrew.cmu.edu/user/bex/stories/welcome/

**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:**

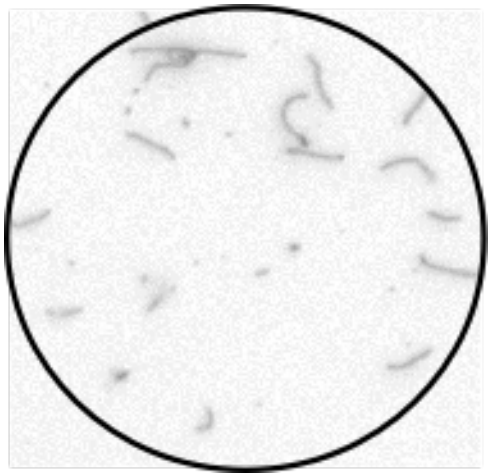
Establishes the foundation for novel medical device deployment. Enables non-invasive surgery, biosensing, targeted drug delivery

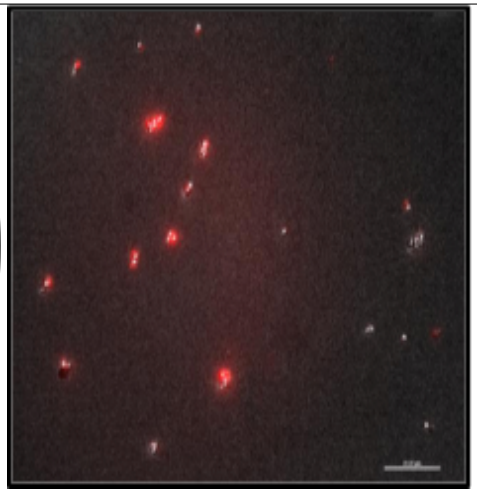
**Broader Impact – Outreach:**

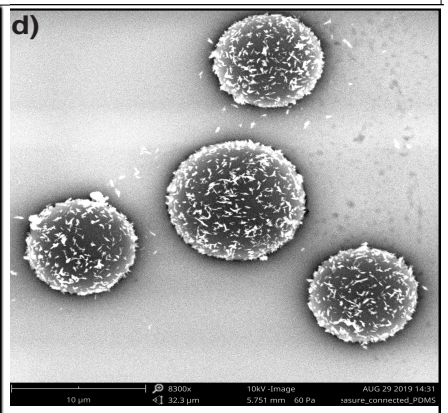
- Implemented real-time, web-based control of Helmholtz Coils, devised workflow, and outlined user interface for public dissemination

**Y2 Outcomes:**

- Completed an initial study that focused on optimizing the ``magnetization profile'' of elasto-magnetic filaments at the centimeter scale
- Studied the differences in magnetic particle chain formation in solution when using superparamagnetic and ferromagnetic particles
- Utilized two photon lithography techniques for the rapid construction of large-scale templates for microsphere arrangement








Pocketing into “rotor” construct demonstrates size-selective placement of 10 um inner bead and 8 um outer beads.