Light-Powered Microrobots for Future Microfactories

Award #1734383, Award Date: Aug 20, 2017, University of Louisville, PI: Dan O. Popa

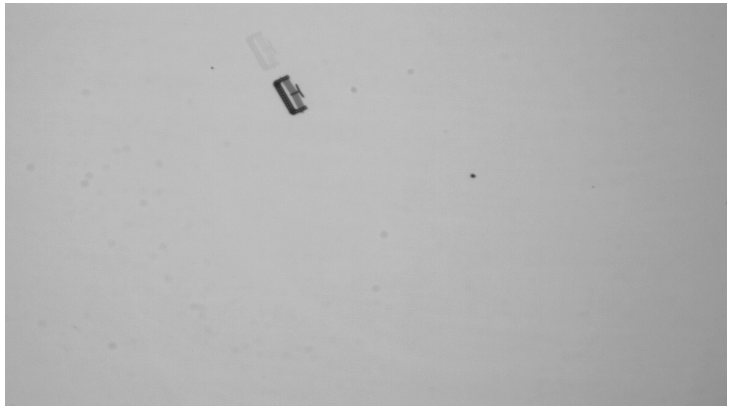
Challenges

- Design and fabricate light powered microrobots that operate in dry environments.
- Achieve controlled multi-legged microrobot locomotion with a single laser source.
- Coordinate operation of multiple microrobots in cooperative manipulation tasks.

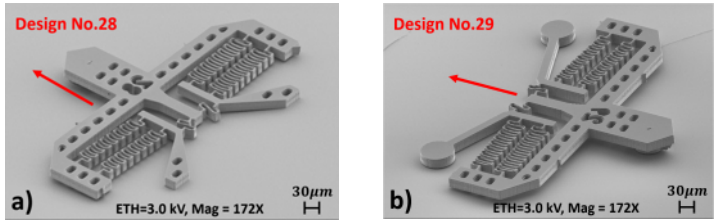
Solutions

- Differential leg design with resonant frequency addressing (ChevBot).
- Off-axis and on-axis illumination with visual servoing.
- Intergarted energy harvester with Solar Cell (SolarPede)
- New photo-thermo-dynamic robot models.

ChevBot locomotion



SEM images of assembled ChevBot



Scientific Impact

- Light/laser as new energy source for microrobots and microrobot swarms.
- Micro scale autonomy in dry environments.
- New learning control algorithms suitable for physical inter-robot cooperation.

Broader Impacts

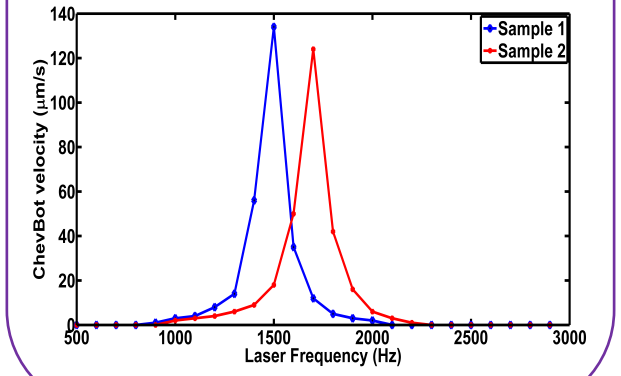
- Future microfactory for nanoscale science and manufacturing.
- Support for mobile Microrobotics Challenge competition.
- Collaboration with REU Site at UofL's Micro Nano Technology Center.

Presented by
Sri Sukanta Chowdhury, PhD
Postdoctoral Researcher

Key Results

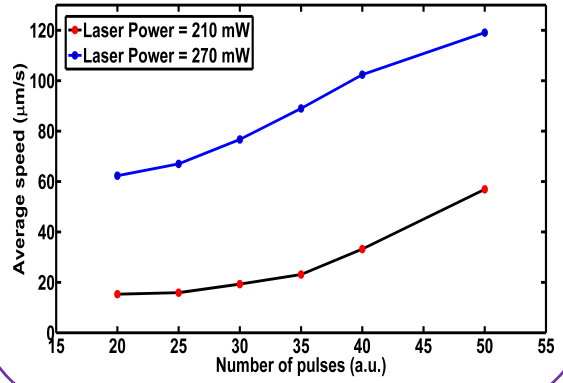
Differential Resonance Leg Design

- Resonance frequency of the ChevBot is determined by sweeping the laser frequency from 500-3000 Hz
- Two samples have resonance at 1500 Hz and 1700 Hz with respective avg. speed of 134 and 124 µm/s



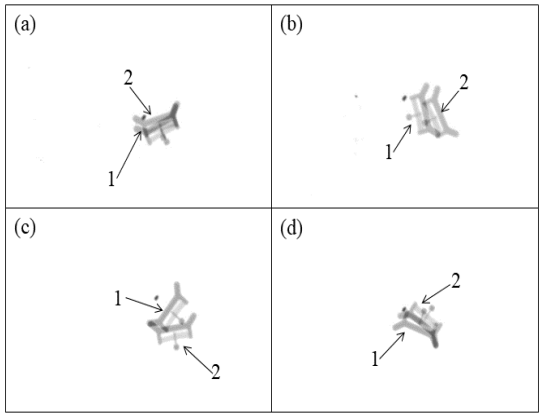
Control of speed by power and pulses

- Average speed can be varied between 15-119 134 µm/s by increasing the total number of pulses from 20-50
- Changing the laser drive current shows a positive correlation with the average speed



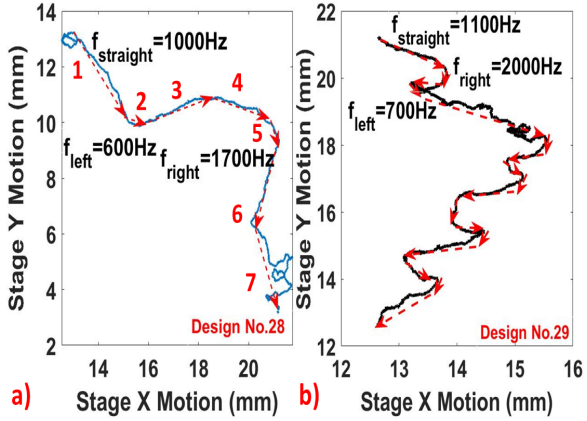
Steering Abilities

- Off axis illumination is used to turn the microrobots left and right
- Rotation angle 8-40 degree is achieved by laser spot repositioning with 1 sec illumination



2D Open-loop Trajectory

- 1000 Hz moves forward
- 600 Hz turn left
- 1700 Hz turn right
- Angle of rotation can be adjusted by varying the duration of illumination
- ChevBot is kept in the FOV of the laser beam



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