

**University of California at Berkeley
College of Engineering
Mechanical Engineering Department**

ME138/238, Spring 2018

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Lab #2

Assigned: February 1, 2018; Due: March 1 (Thursday)

Lab 2: Design, Fabrication & Assembly of a Micro Robot

In this lab, we are going to make an electrostatic actuator to propel an insect-sized crawling robot across multi-surface terrains. You will need to design and fabricate the structure, assemble the components and conduct experiments to make the robot crawl forward. After the completion of the design and fabrication process, you will need to make mechanical and electrical connections, and test the robot on different kinds of surfaces. Please read through paper #2 carefully as lab #2 is based on the same process. Specifically,

- (1) Go to 1113 Etcheverry at the time you are assigned and the GSI will show a demonstration of a finished micro robot. You will get the fabrication drawings and raw materials (carbon fiber plate, plastic membrane, and super-elastic NiTi wires) for your own robot.
- (2) Under the guidance of the GSI, cut the raw materials into the individual components (electrodes, supporting structure, additional mass, and legs) of the robot manually or by laser cutting machine similar to paper #2.
- (3) After the cutting process, assemble/connect your own robot as described in paper #2 (you should have your own specific leg design before the lab). The assembly process requires fine manual operation with thin beams or plates.
- (4) Apply a high DC voltage (around 2000 volts) to power your robot, and try to adjust its structural parameters if it couldn't work well. Please be careful with this high voltage and wear gloves to conduct the experiment.
- (5) Test your robot on different surfaces such as smooth ground, foam board, and sandpaper, and think about how to improve the leg design for better crawling speeds.
- (6) Measure the small operating current of your robot under different high DC voltage, calculate the power consumption, and think about the similar situation or phenomenon of high voltage, low current in our daily life.
- (7) Try to make your robot stand on water.
- (8) Write an individual report about this lab, including experiment results, discussions and other observations.

For Graduate Students:

- (9) Calculate the mechanical output and energy efficiency of your robot.
- (10) Try to establish a dynamic model to describe the operation of your robot.
- (11) Can one power the flying robot for a few seconds in the air without wires?