**Title of the thesis**:

Biomimetic Pneumatic Soft Actuator and Microfluidic Imaging System for Analyzing Nematodes Locomotion

**Abstract**:

Traditional hard-bodied robots’ abilities are always limited by their rigid structures. In some highly congested environments, conventional robot manipulators encounter difficulty operating because of their rigid links. Researchers has been inspired by a variety of animals exhibit complex movement with soft structure, to design and fabricate soft robots, to replace traditional robots with rigid components. With a soft structure and redundant degrees of freedom, these robots can be used for delicate tasks in unstructured environments. The elephant trunk is one of the most used models due to its high flexibility. Its shape can be changed when pressurized by osmosis. Our study focuses on designing and fabricating a pneumatic soft actuator inspired by elephant trunk, and testing pneumatic actuations with a focus on achieving its multiple freedom of degree movement. Normally, Soft robots are always actuated by variable length tendons embedded in the soft segment. Compared to the traditional approach, pneumatic actuation does not damage the actuator because no more complex components need to be fabricated in the actuator.

Studying genetics of development with small model organisms such as Caenorhabditis elegans provides great opportunities for understanding diseases in humans. C. elegans is easily grown in the laboratory, with maintained routinely in agar-filled petri plates. Those small model organisms also have huge potential for use in drug delivery and image-based screening. There have been lots of developments in microfabrication and microfluidic technologies for designing and imaging small model organisms. Due to severe constraints of volume and power, Shadow-imaging is one of methods that can record the locomotion of nematodes. The microfluidic device is directly stuck on top of the imaging sensor or the camera chip, and the light source is put on the top of the device. Our study focuses on designing a microfluidic device to facilitate high-throughput, imaging-based screening of microscopic nematodes. It involves fabricating microfluidic device, designing and integrating siphon-based suction mechanism with multiple channels, and using the raspberry-pi camera to record the movement of nematodes in channels.