

Steven Stangle

November 7th 2013

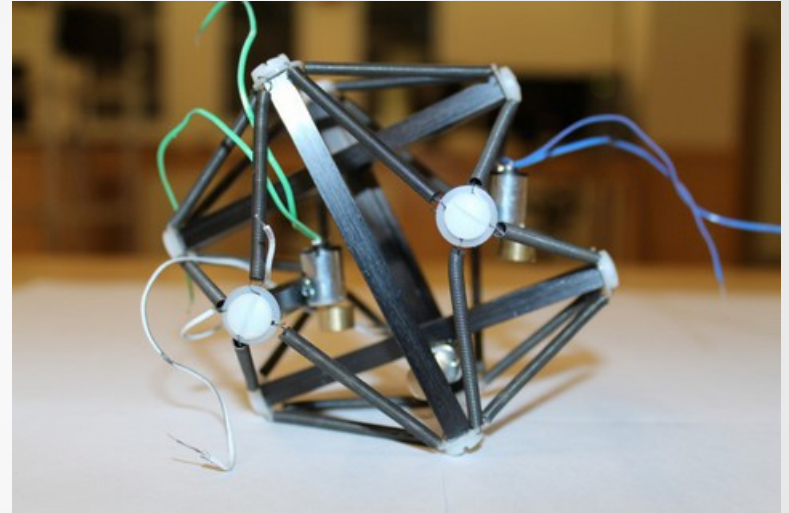
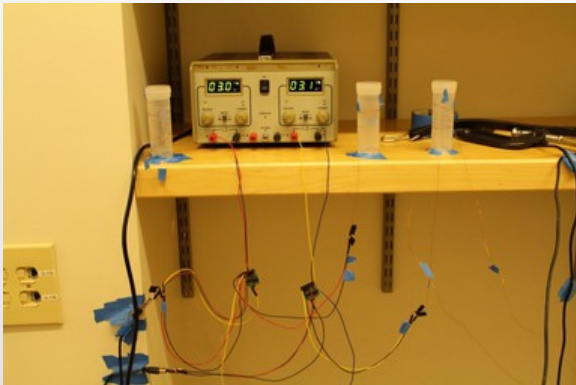
Electrical Engineering and Computer Science
Union College '14

Learning Locomotion Using a Spiking Neural Network and Genetic Algorithm on a Wireless Modular Tensegrity Robot Strut

Advised by Prof Traver (Electrical Engineering) and Prof Rieffel (Computer Science)

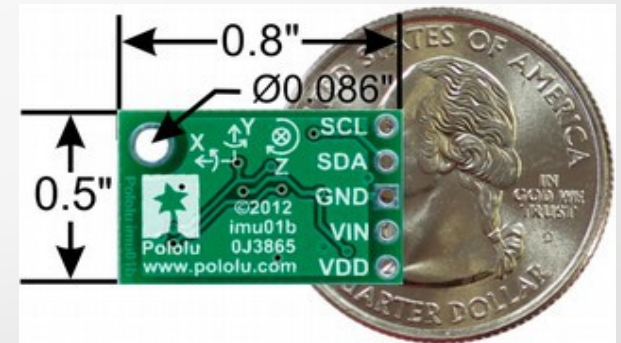
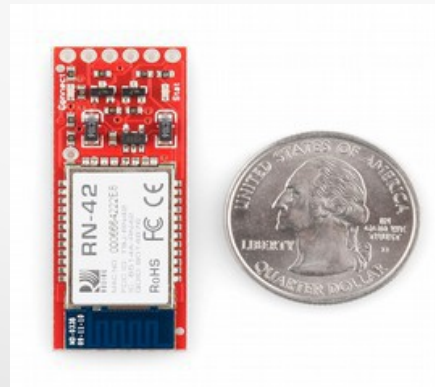
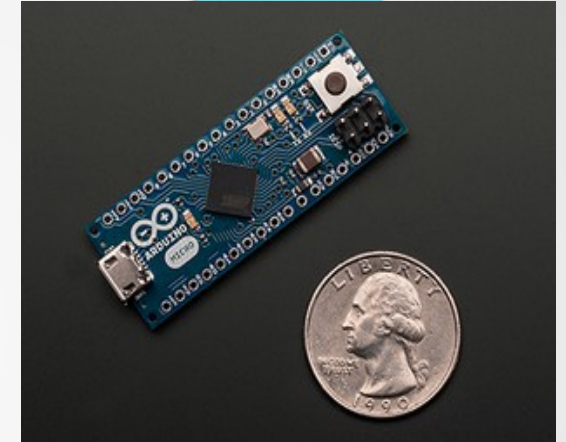
Tensegrity Robots

- What is a Tensegrity Robot?
- What research is being done?
- <http://goo.gl/Z7KQKL>
- What are the limitations?



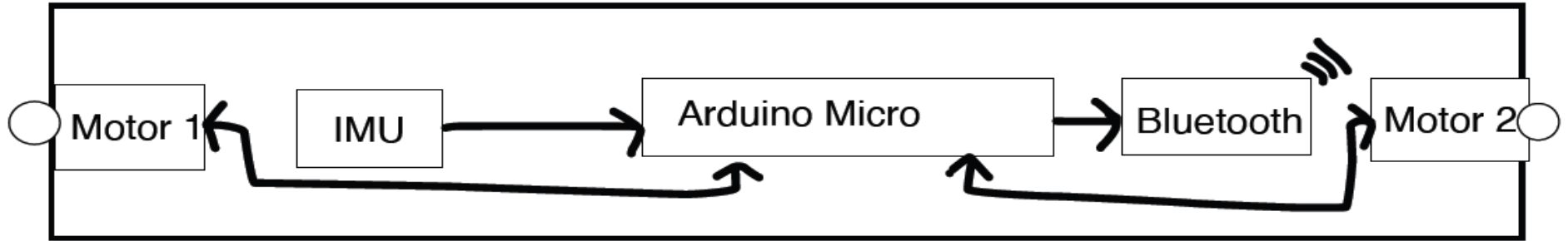
Electrical Engineering Design

- Size: The smaller the better
- Cost: The cheaper the better
- Power: The more efficient the better
- Modular: Designed to be multiplied



Sketch of a strut

Front



Battery

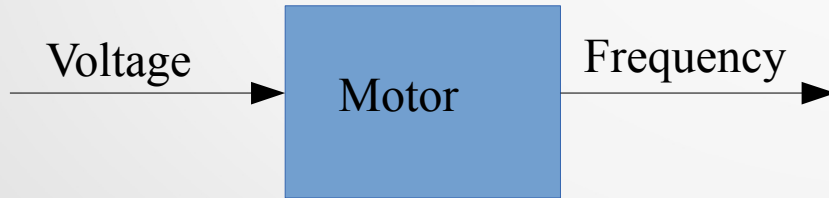
Back



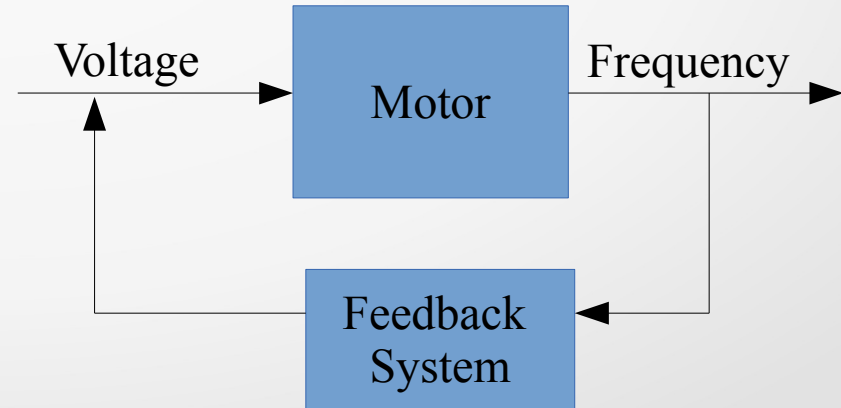
Research Question

- To what extent does a closed loop system improve on an open loop system to exploit tensegrity's natural resonance to promote locomotion?

Open Loop

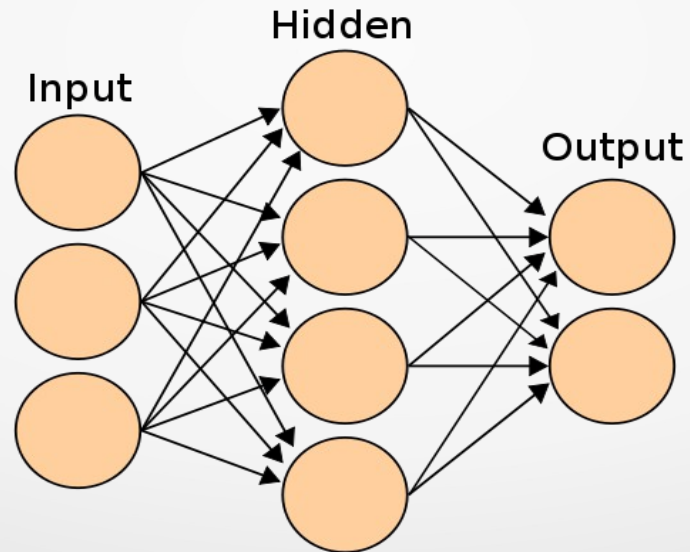


Closed Loop

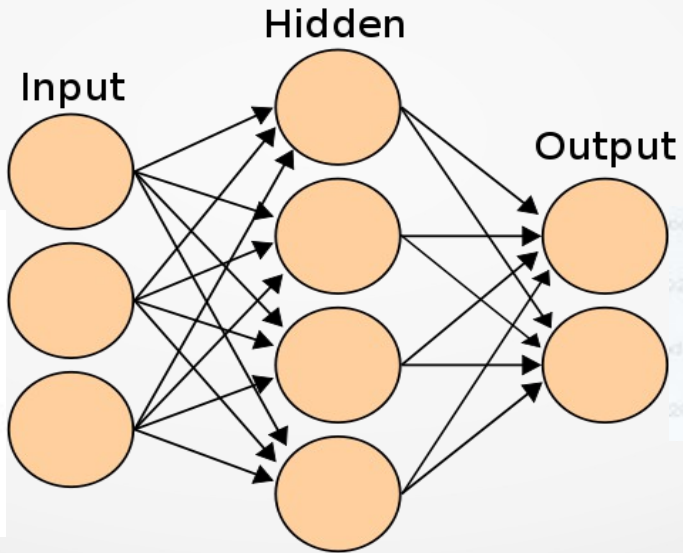


Spiking Neural Networks

- What is a neural network?
- What does Spiking mean? How does it improve NNs?

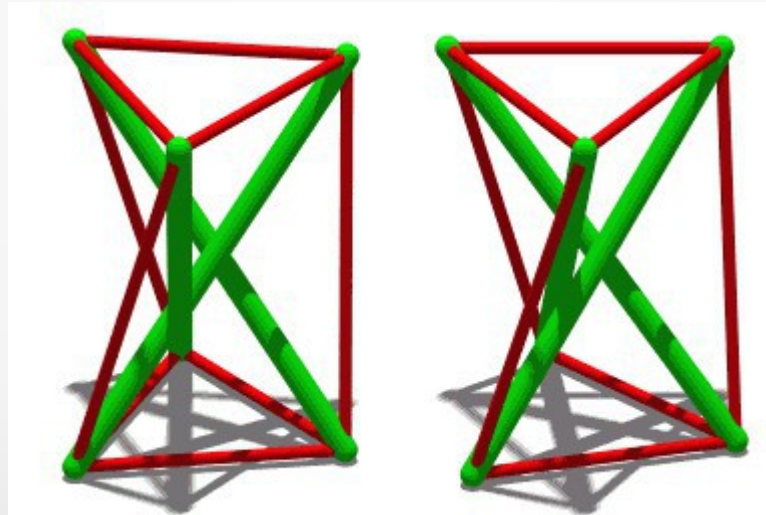


Inputs and Outputs of the SNN



Genetic Algorithms

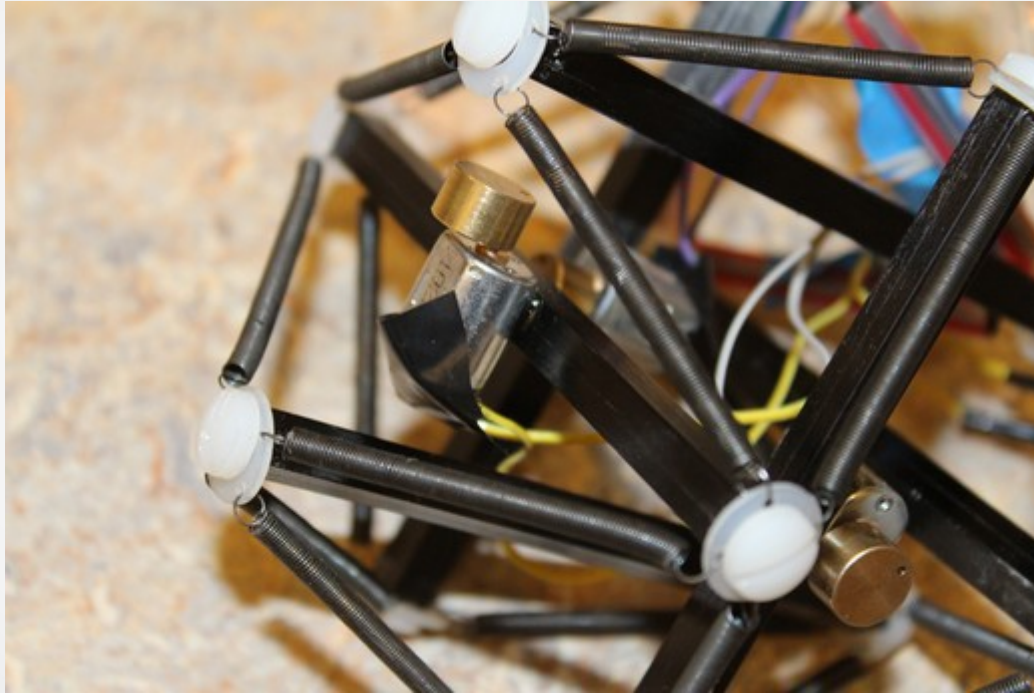
- Why use a Genetic Algorithm?
- Why not simulate the motion?



Answering the Research Question

	Timeline
Can I implement a spiking neural network on Arduino	Week 1
How does the SNN Perform with actual inputs	Week 3
How well does a genetic algorithm perform a simple motion on a singular strut	Week 6
How does a genetic algorithm perform with several struts in a tensegrity robot	Week 8
To what extent does the closed loop system improve on the open loop system	Week 10

Questions?



References and Acknowledgments

- Khazanov, Mark, et al. "Exploiting Dynamical Complexity in a Physical Tensegrity Robot to Achieve Locomotion." *Advances in Artificial Life, ECAL*. Vol. 12. 2013.
- Rieffel, John, et al. "Evolving soft robotic locomotion in PhysX." *Proceedings of the 11th Annual Conference Companion on Genetic and Evolutionary Computation Conference: Late Breaking Papers*. ACM, 2009.
- Rieffel, John A., Francisco J. Valero-Cuevas, and Hod Lipson. "Morphological communication: exploiting coupled dynamics in a complex mechanical structure to achieve locomotion." *Journal of the royal society interface* 7.45 (2010): 613-621.

- Mark Khazanov
- Julian Jocque
- William Keat, Mechanical Engineering, Union College