Automated Gait Optimization of a Centipede-Inspired Modular Robot

Sarah Koehler
Cornell University
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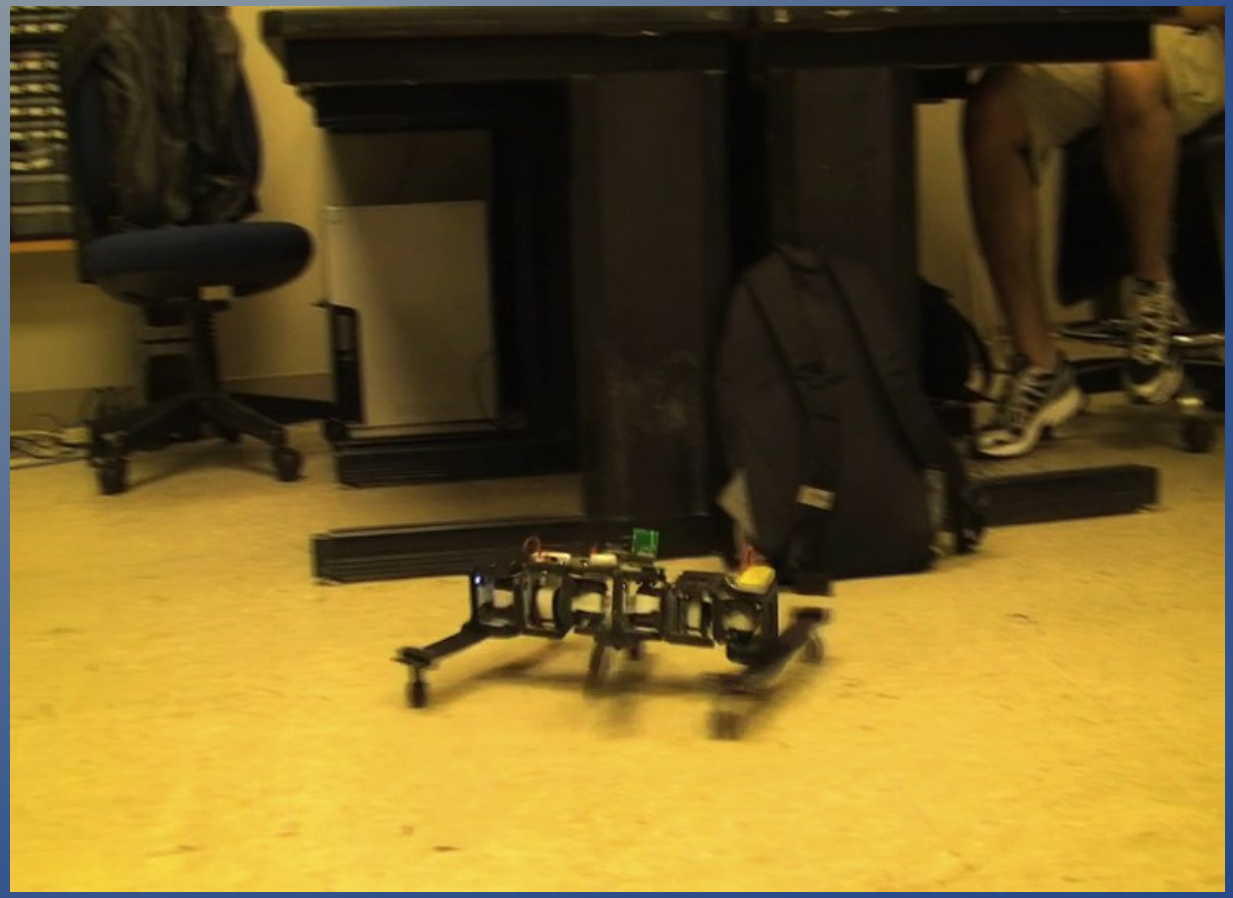
Advisors:
Dr. Mark Yim
Dr. Daniel E. Koditschek

Overview

- Centipede Robot
- SLIP Template
- Optimization Process
- Framework Set Up
- Conclusions

The Centipede Robot



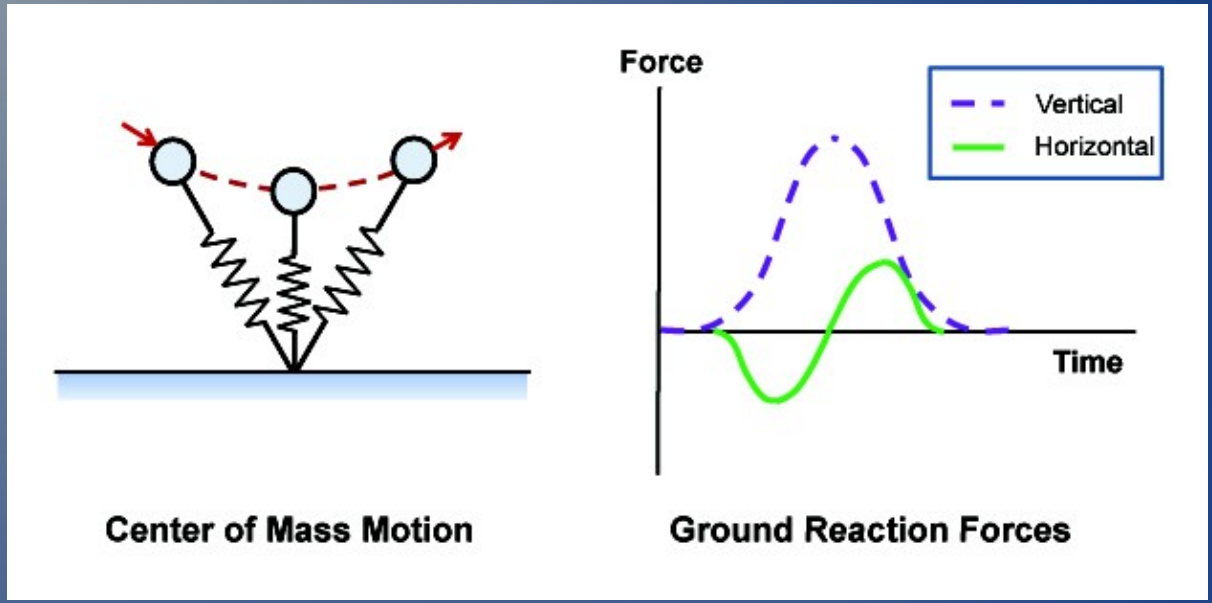
Configuration
- 6 Modules
- 6 Legs
- 2 DOF

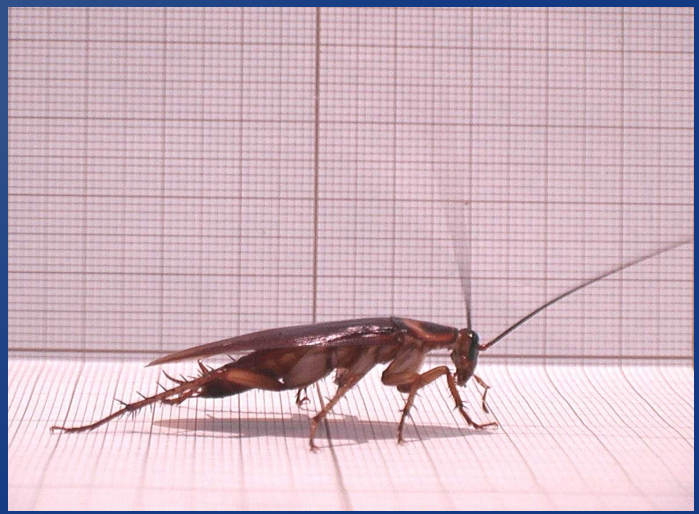
Gait
- Alternating Tripod

Parameters
- theta1, theta2, phi1, phi2, dt1, dt2

http://www.youtube.com/watch?v=DQTEAsKg8m

Spring Loaded Inverted Pendulum (SLIP) Template

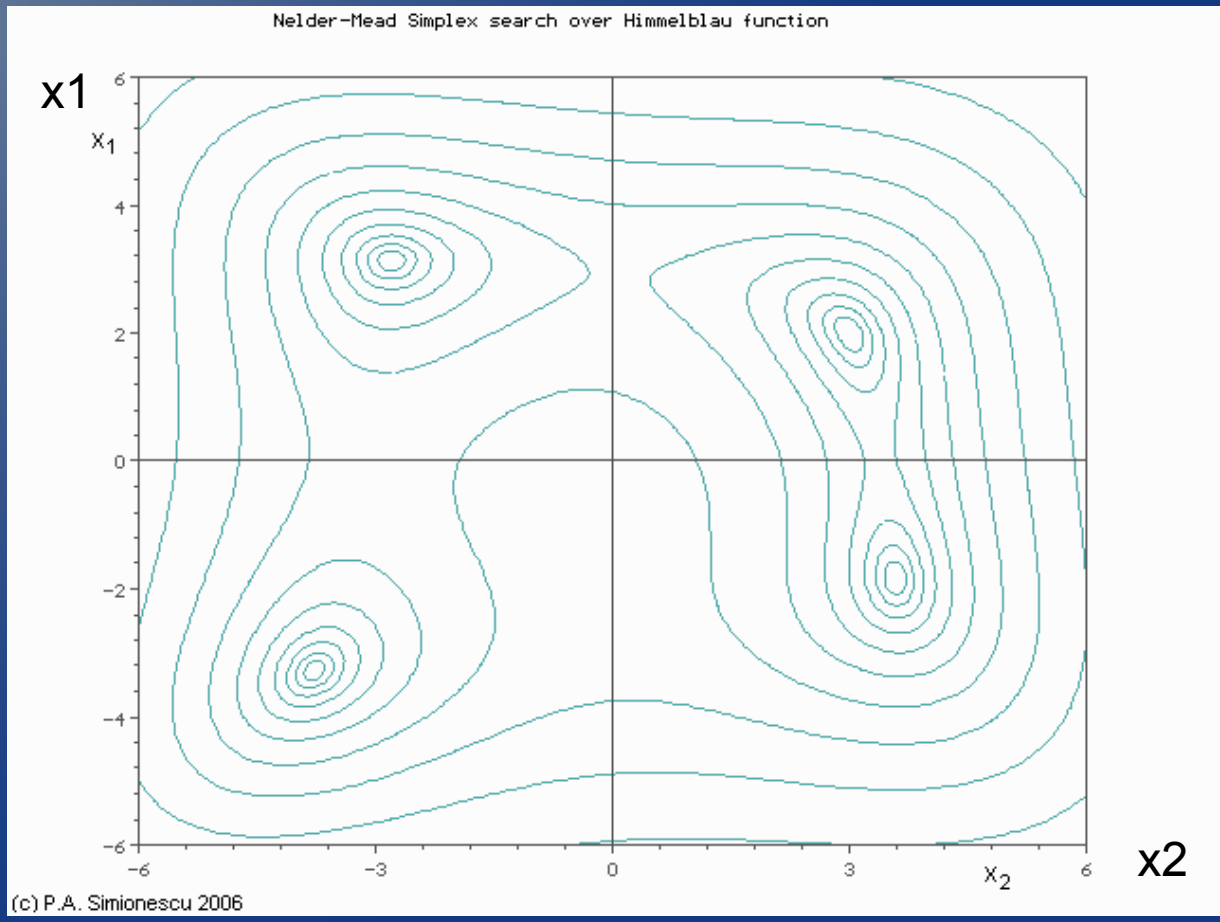




Nelder Mead Optimization

1 point = (theta1, theta2, phi1, phi2, dt1,dt2)
→ 6-simplex
→ describes one gait

Example – Himmelbau Function



Minimize Cost

$$Cost = \frac{Power}{mgv}$$

$$Cost = \frac{1}{Speed}$$

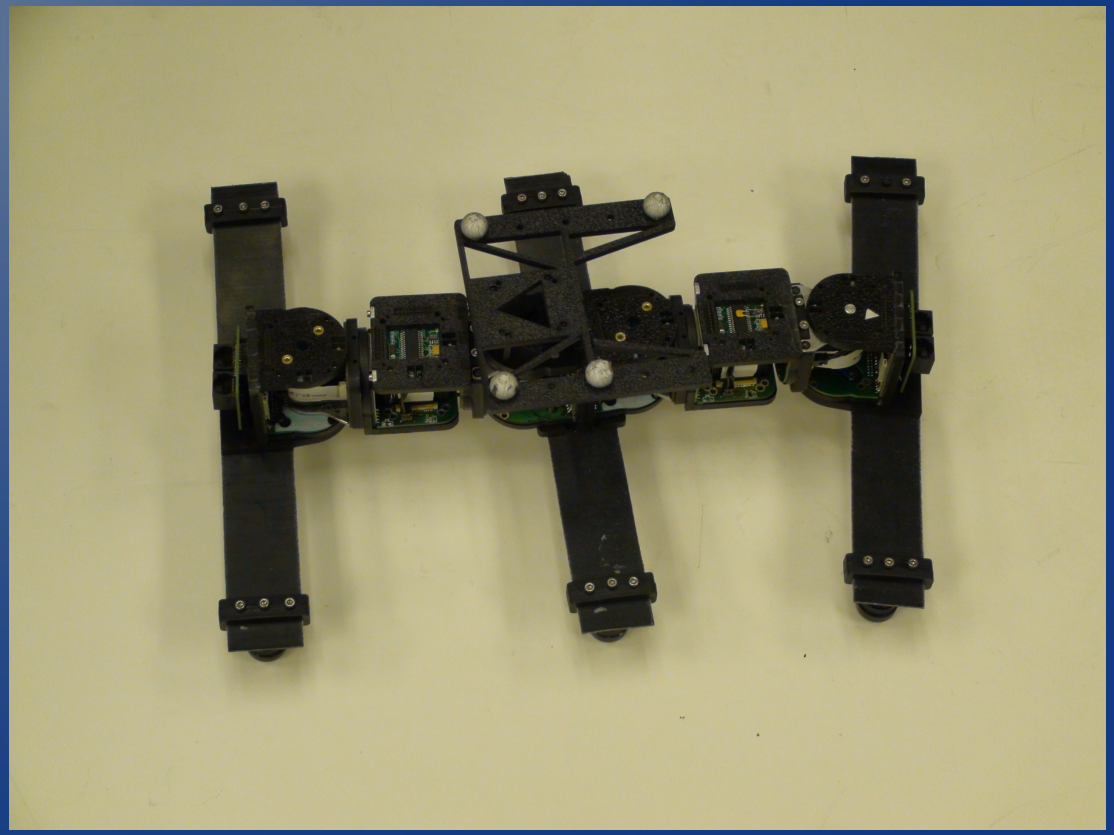
Optimization Process

1. Set up “endzones”
2. Run across
3. Calculate velocity, cost
4. Choose new parameters (Nelder Mead)
5. Repeat 2-4 until minimal cost found

Video Sped up 4x

Framework Set Up

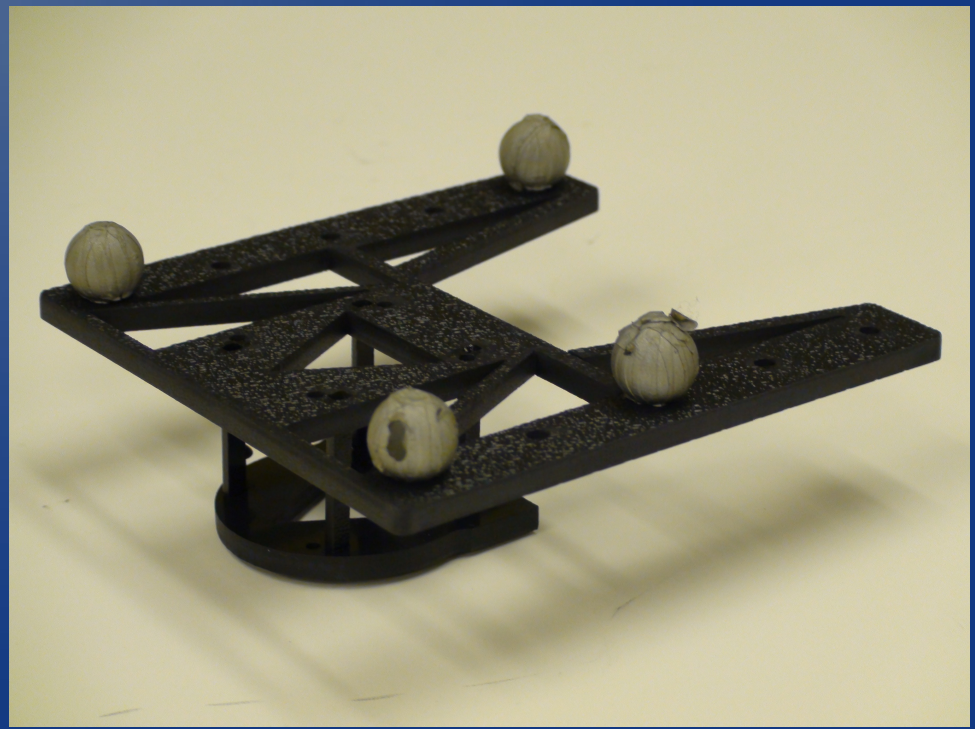
- Optimization Code - Dynamism
- Vicon Interaction
- Power Supply
- Communication



Vicon

- 6 DOF tracking system

- Tracks 4 reflective balls
  - Antisymmetric
  - Lightweight
  - Non-interfering

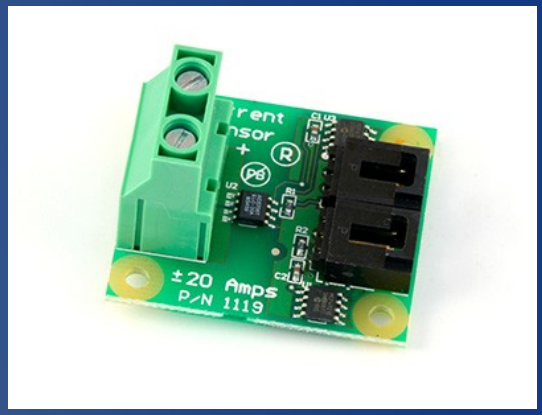


Phidgets

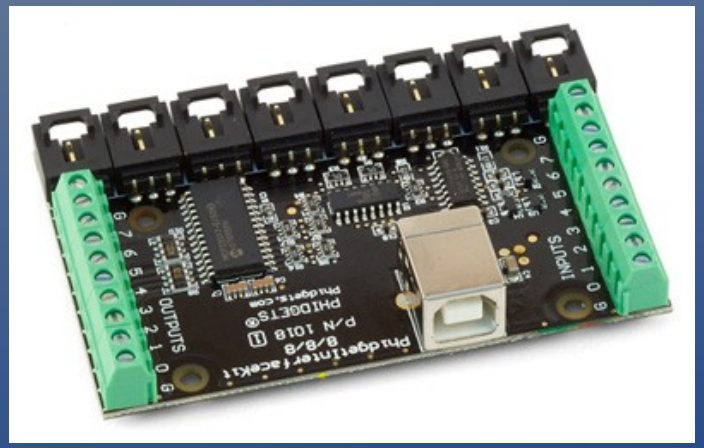
$$Cost = \frac{Power}{mgv}$$

P = IV

V = 7.4 V



Current = ???



Phidgets Interface Kit (I/O Board)

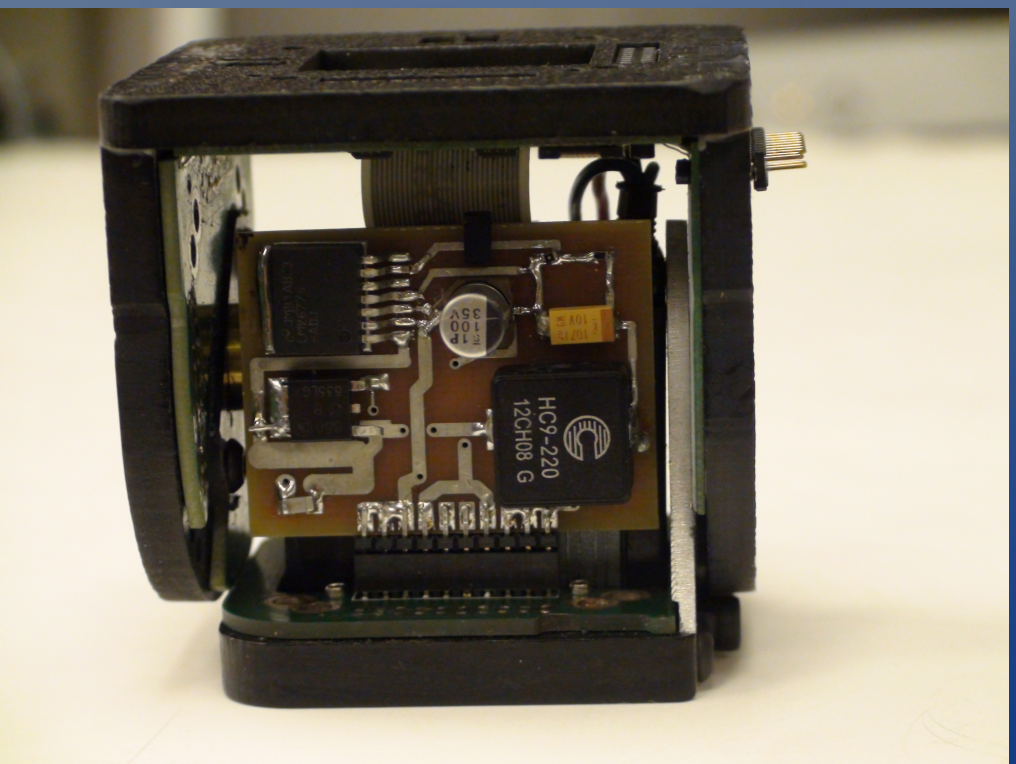
C Mex File

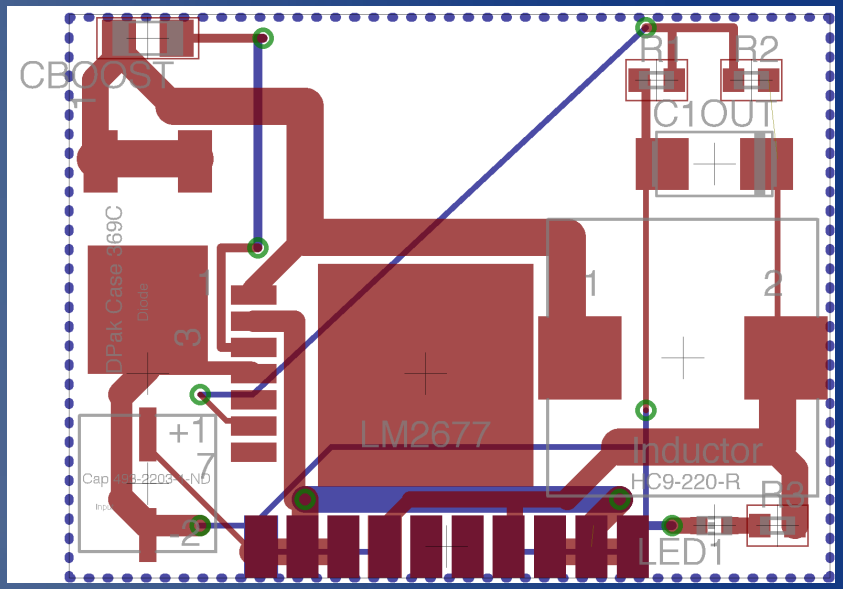
Matlab

Nelder Mead

Power Supply

- Voltage Regulators
  - IN: 24 V
  - OUT: 7.4 V
  - Current 5 A





Why not batteries?

- Ability to read Current
- Convenience

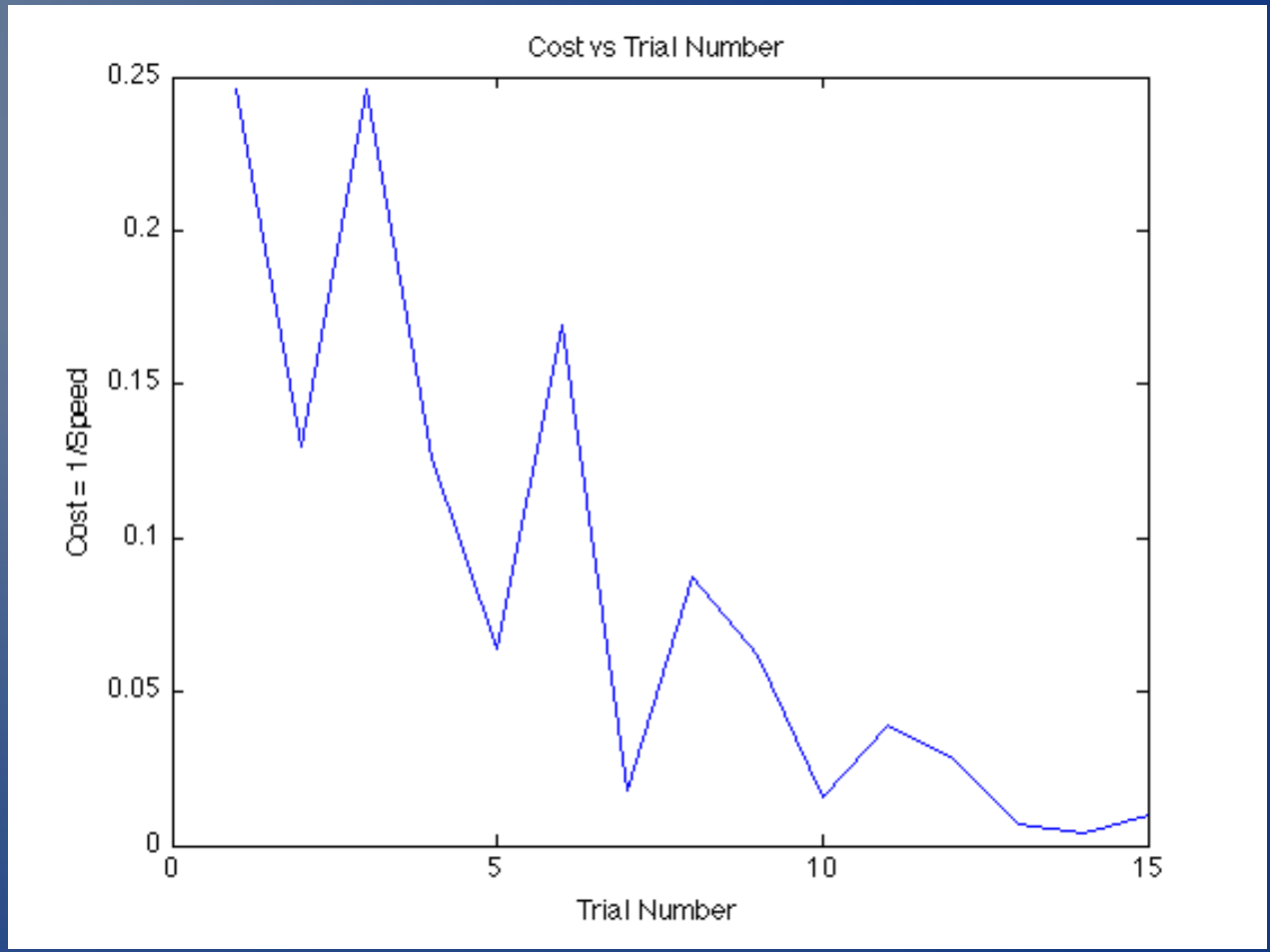
Conclusions

Short tests conducted

- Cost Function: 1/speed
- Battery Powered

Future work

- Voltage Regulators fine tuned



Acknowledgements

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Photo References

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Thank You!