QuadraTot Bot

CS 4701: Practicum in A.I.
Pre-Proposal

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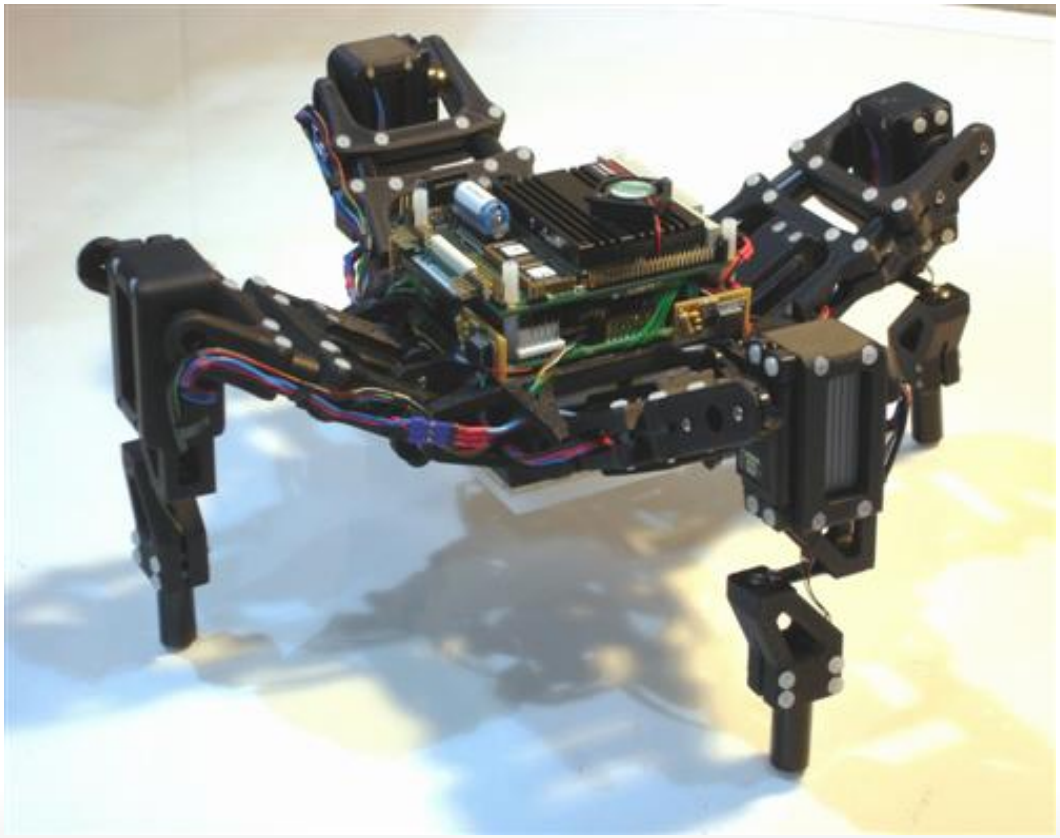
Problem Statement and Motivation

- **Goal** – teach a quadruped robot how to walk using learning algorithms
- **Competition** – beat current preprogrammed gait



http://www.botjunkie.com/2007/08/17/starfish-self-modeling-robot-has-imagination/

General Approach

Where's the AI?

- Optimization (gradient descent, Levenberg-Marquardt, ...)
- Evolutionary algorithm / Genetic algorithm
- Reinforcement learning
- Supervised learning?

Domain specific hints

- Reduced dimensionality of parameter space (periodic, symmetric, ...)
- Parametrized gait vs. non-parametrized gait (?)
- Geometric constraints

Background Reading

- An Evolutionary Approach to Gait Learning for Four-Legged Robot
  by Sonia Chernova, Manuela Veloso
- Policy Gradient Reinforcement Learning for Fast Quadrupedal Locomotion
  by Nate Kohl, Peter Stone
- Evolving Dynamic Gaits on a Physical Robo
  by Viktor Zykov, Josh Bongard, Hod Lipson

Evaluation Plans

- AI will be evaluated on the following, compared to its initial hard-coded walking, and compared to other quadraped robots in the lab
  - Speed taken to walk a certain distance
  - Number of failures (falling down, getting stuck) over a certain number of attempts
  - Efficiency and power consumption

I/O Specification

Input:

- Motor encoder position (optional, likely)
- Motor force feedback (optional, likely)
- Robot position estimate via external pose estimation system (optional, less likely)

Output:

- Motor position commands over time

System Architecture and Work Plan

- Robot with on-board computer running Linux
- Lower level drivers are in C and we hope to implement the system in Python

- Once we begin working with the robot and have an idea of the algorithm we will use, we will divide the work

Schedule

	Milestones	**Deadlines**
Week 1 (9/13-9/19)	Read papers, get lab access, talk to relevant other researchers	9/17 Final proposals due
Week 2 (9/20-9/26)	Continue reading, get robot to move	
Week 3 (9/27-10/03)	Implement parametrized gait and determine proposed coding schedule for more advanced algorithms in time for Code Review #1.	
Week 4 (10/04-10/10)	Begin main algorithm dev/testing effort	10/5 Code Review #1
Week 5 (10/11-10/17)	Algorithm dev/testing	
Week 6 (10/18-10/24)	Algorithm dev/testing	
Week 7 (10/25-10/31)	Algorithm dev/testing, quantify/solidify current results for Code Review #2	
Week 8 (11/1-11/7)	Finish collecting results, begin writing	11/2 Code RReview #2
Week 9 (11/8-11/14)	Finish collecting results, writing	
Week 10 (11/15-11/21)	Finish collecting results, writing, get final demo ready	
Week 11 (11/22-11/28)	Finish collecting results, writing, get final demo ready	
Week 12 (11/29-11/30)	Final demo	11/30 Final presentation