Robotics and Embedded Systems

Human Brain Project

Master/Bachelor Thesis - Semester Project

Energy-Efficient Gait Exploration for Snake-like Robots Based on Adversarial Reinforcement Learning

Background

Deep reinforcement learning has been demonstrated as a powerful framework for robotics to design sophisticated and hard-to-engineer behaviors. However, defining a proper and efficient reward is usually challenging for complicated tasks involving multiple factors and engineering labors. Inverse reinforcement learning, refers to the problem of inferring an expert's reward function from demonstrations, which holds the promise of automatic reward acquisition.

Recently, Generative Adversarial Networks (GANs) have proven to be efficient systems for data generation. Their success is achieved by exploiting a minimax learning concept, which has proved to be an effective paradigm in many fields. On the basis of GANs, several promising IRL algorithms have been proposed, such as MaxEnt [1], GAIL[2], and AIRL[3].

Your Tasks

In this thesis, your task will be using state-of-the-art IRL algorithms to explore energy-efficient gait for a snake-like robot on the basis of our existing results (published on IJCAI'19) [4]. To be specific:

1. You will first grasp our existing work, which acquired energy-efficient gaits based on the PPO algorithm. Our demo is at https://videoviewsite.wixsite.com/rlsnake.
2. You will then take it as an expert experience to explore more efficient gaits for our snake-like robot based on adversarial reinforcement learning.
3. You will have the opportunity to run your gaits on prototype experiments.

Requirement

- High self-motivation;
- Six month working time;
- Interested in reinforcement learning and robotics motion control.

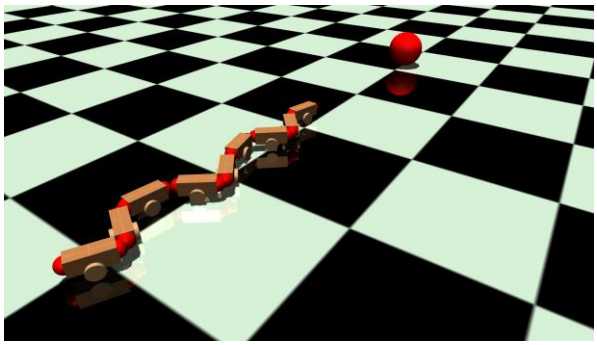

Figure 1 Snake Robot in MuJoCo

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[1] *Maximum entropy inverse reinforcement learning*. AAAI, 2008

[2] *Generative adversarial imitation learning*. NIPS, 2016.

[3] *Learning Robust Rewards with Adversarial Inverse Reinforcement Learning*. ICML, 2017

[4] *Energy-Efficient Slithering Gait Exploration for a Snake-Like Robot Based on Reinforcement Learning*. IJCAI, 2019