Distributed Learning of Decentralized Control Policies for Fast Legged Locomotion

Mert Kaan Yılmaz
Department of Computer Engineering,
Middle East Technical University,
06531 Ankara, Turkey
Email: kaan.yilmaz@ceng.metu.edu.tr

Abstract

Contemporary distributed reinforced learning algorithms requires autonomous multi agents that shares a common policy and decentralized systems locally distribute some part of a robot to manage higher level behaviors. In this project, I plan to take advantage of state-of-the-art asynchronous actor-critic(A3C) algorithm to achieve fast legged locomotion on RHex platform. My primary objective will be to accomplish fast locomotion on different terrains while conducting the stability of the body.

Keywords

Reinforcement Learning, Distributed Learning, Decentralized Control Policies, Legged Locomotion

I. Aim of the Project

Legged locomotion has been found to be a lot more robust to different environments as it does not require manipulation of the environment for mobility. Although many different method have been proposed, most of those are focused on either a fully centralized method which lacks fast reaction time, or either composed of fully reactive agents that misses the efficiency of reaching high level control. State-of-the-art learning studies also concentrate on centralized methods as a cooperation is required between limbs of the robot. My main motivation behind this project is to fully grasp and apply a distributed learning study along with a decentralized control policy on a RHex robot while aiming for a efficiency in terms of speed. If it were to give a better gait characterization than the traditional control behaviors, than it would definitely be interesting to study those results.

II. Related Work

The main work that my project depends on is done in [1]. They provided an offline decentralized controller on a snake-like robot for achieving forward movement and an online decentralized controller on a hexapod robot to accomplish body stability. Therefore, my work in the project will use both of their accomplishments to realize something different. Because carrying out legged locomotion with a decentralized controller is tough due to no agent has control over the other. Also, RHex [2], will be the robot platform I will be using. It's central pattern generators are known and accepted to be a cubic function. I plan to use them in comparison with my results.

III. Research Plan

My proposed plan is as follows:

- Further investigation on how authors in [1] achieved results

- Creation of simulation environment on raisim, raisimOgre & raisimGym [3]
- Deciding and constant update of parameters of learning process
- Accomplishing a simple task such as standing
- Testing fast locomotion
- Comparing results on past RHex platform results on locomotion

REFERENCES

[1] G. Sartoretti, Y. Shi, W. Paivine, M. Travers, and H. Choset, "Distributed learning for the decentralized control of articulated mobile robots," in *2018 IEEE International Conference on Robotics and Automation (ICRA)*, May 2018, pp. 3789–3794.

[2] U. Saranli, M. Buehler, and D. E. Koditschek, "Rhex: A simple and highly mobile hexapod robot," *The International Journal of Robotics Research*, vol. 20, no. 7, pp. 616–631, 2001. [Online]. Available: https://doi.org/10.1177/02783640122067570

[3] J. Hwangbo, J. Lee, and M. Hutter, "Per-contact iteration method for solving contact dynamics," *IEEE Robotics and Automation Letters*, vol. 3, no. 2, pp. 895–902, 2018.