ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

CRL
Computational
Robotics Lab

Master Thesis / Semester Thesis

Development of RL-enabled pipeline for Humanoid Robot Locomotion

Introduction

The development of humanoid robots capable of efficient and dynamic locomotion has been a long-standing challenge in robotics. Achieving this requires integrating advanced hardware systems with intelligent control algorithms that can adapt to complex and dynamic environments. Reinforcement Learning (RL) has emerged as a powerful tool in this domain, enabling robots to learn locomotion over challenging terrains [1, 2] and showing human like motions.

The goal of this project is to design and develop a pipeline for deploying RL policies on the pndbotics humanoid robot [3].

Task Description

The student will:

- Conduct a thorough study of the software stack of the robot and prior literature on RL[4] and state estimation [5].
- Design and develop a pipeline for deploying RL policies on the hardware.
- Explore sim2real gap and how to overcome it.
- Possibly use our in-house infrastructure to train RL policies for imitating human motion data and deploy on the robot.
- Write a report and give an oral presentation at the end of the project.

Skills

- Very good programming skills in C++, Python, and familiarity with ROS.
- Experience in working with software stack of robots.
- Experience with RL or state estimation is a plus.
- Willingness to work on hardware and cutting edge APIs.

Remarks

This thesis is overseen by Prof. Dr. Stelian Coros.

Contact

For further information or application for the thesis project, please contact Fatemeh Zargarbashi (fatemeh.zargarbashi@inf.ethz.ch) and submit a copy of your CV and your transcripts.

References

[1] I. Radosavovic, S. Kamat, T. Darrell, and J. Malik, "Learning humanoid locomotion over challenging terrain," *arXiv preprint arXiv:2410.03654*, 2024.

[2] J. Lee, J. Hwangbo, L. Wellhausen, V. Koltun, and M. Hutter, "Learning quadrupedal locomotion over challenging terrain," *Science robotics*, vol. 5, no. 47, p. eabc5986, 2020.

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[4] A. Escontrela, X. B. Peng, W. Yu, T. Zhang, A. Iscen, K. Goldberg, and P. Abbeel, "Adversarial motion priors make good substitutes for complex reward functions. 2022 ieee," in *International Conference on Intelligent Robots and Systems (IROS)*, vol. 2, 2022.

[5] M. Bloesch, M. Hutter, M. A. Hoepflinger, S. Leutenegger, C. Gehring, C. D. Remy, and R. Siegwart, "State estimation for legged robots: Consistent fusion of leg kinematics and imu," 2013.