MA/SA/BA

Learning Advanced Skills for Complex and Discrete Terrain

Background

While modern quadruped robots have mastered basic locomotion like walking and trotting, their capabilities lag significantly behind the dynamic agility seen in animals. Our goal is to bridge this gap by developing advanced skills, such as agile jumping for quadruped robots. The ability to perform more advanced locomotion skills is a fundamental requirement for traversing the complex, discrete terrains found in the real world (Fig. 1), enabling a robot to clear gaps or overcome obstacles that would otherwise render it immobile.

Tackling this challenge provides an exciting opportunity to explore some of the most interesting questions in robot learning and control. It's a chance to design a system that connects what the robot sees (an obstacle) to what it does (a precise jump), elegantly tying together perception and control. The core of the project involves answering questions like: How can we teach a robot to generate powerful, athletic motions efficiently? And how can it learn to intelligently plan its actions before a jump, where it must commit to a trajectory and manage its body while briefly airborne?

By leveraging deep reinforcement learning, this thesis aims to develop creative solutions to these questions.

Your Tasks

Through this project, you will gain hands-on expertise in state-of-the-art reinforcement learning (RL) and quadruped control. The research progresses from a foundational literature review and simulation setup, to designing reward functions and training the jumping policy, culminating in transferring the learned policy to the **Unitree Go2** robot available in our lab for real-world validation.

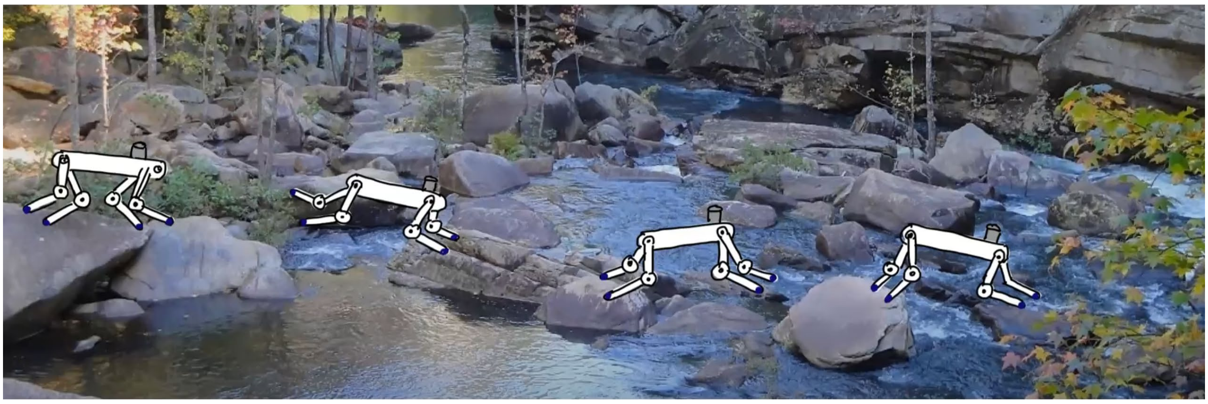

Fig.1 Learning advanced locomotion skills for complex and discrete terrain [1]

Requirements

- High self-motivation and passion for research.
- Six months working time.
- Existing knowledge about robotic control, RL is an advantage

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[1] Kim, Hyeongjun, Hyunsik Oh, Jeongsoo Park, Yunho Kim, Donghoon Youm, Moonkyu Jung, Minho Lee, and Jemin Hwangbo. "High-Speed Control and Navigation for Quadrupedal Robots on Complex and Discrete Terrain." Science Robotics, 2025.

*Unitree Go2 picture from https://www.unitree.com