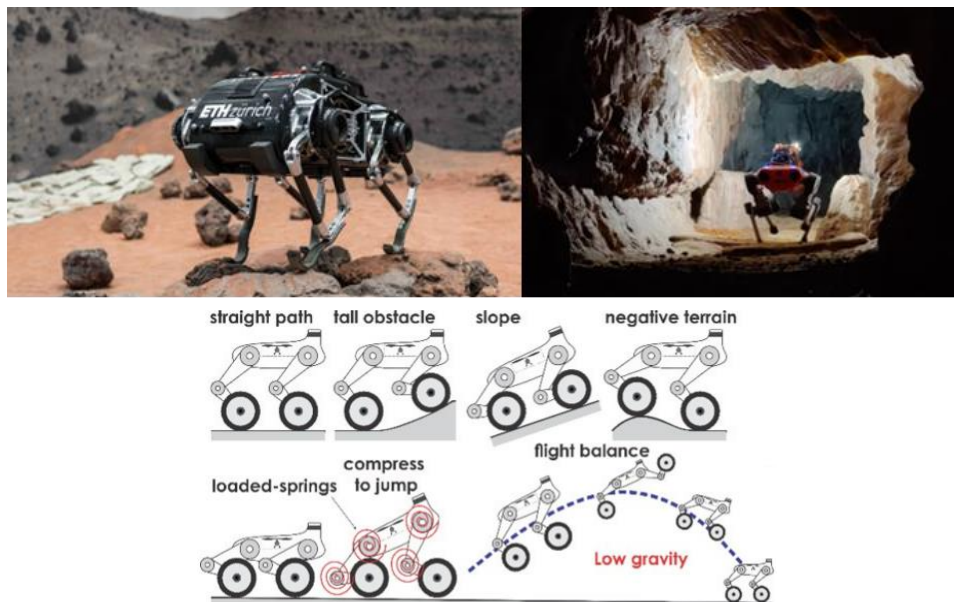


In-air-stabilization of a Jumping Quadruped in Mars Gravity Using Reinforcement Learning

Abstract: Over the last decade's satellites, telescopes, landers, and wheeled rovers have been the main form of space exploration. As the field of legged robotics has developed and matured significantly in recent years, we now see the opportunity to explore more diverse and interesting terrain in space using specialized quadruped robots optimized for challenging off-world planetary environments, such as craters, caves, and lava tubes. Legged robots, such as the Boston Dynamics Spot and the ANYbotics ANYmal, present a set of advantages in mobility and versatility in complex environments over traditional wheeled robots and rovers. Jumping legged robots may be able to traverse the geometrically complex subterranean voids of lava tubes on planets such as Mars. A jumping legged robot for Marian lava tube exploration will retain the key advantages of quadruped systems in overcoming rough terrain, while also being able to coordinate its actuators and exploit the low gravity environment of Mars and compliant leg designs to jump for significant height and thus overcome large obstacles. This project thesis aims to contribute to the modeling, control, and simulation of such a jumping legged robot that is currently being designed by our team at NTNU. The main goal of the project thesis is to study and develop reinforcement learning techniques to enable the robot to perform mid-air stabilization using its legs. The second objective is to incorporate jumping and landing safely into this control policy. If progress is sufficient, deployment of the developed control policy to an actual legged robot may be possible.



Tasks:

- Study and understand the basic Reinforcement Learning problem formulation, terminologies and common methods.
- Setup the simulation environment with simulated gravity and simplified robot.
- Use the existing robot design to create a simplified model and start setting up the learning pipeline.
- Train the control policy and evaluate/improve the performance in simulation environment.
- Implement the control policy on a real robot.

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