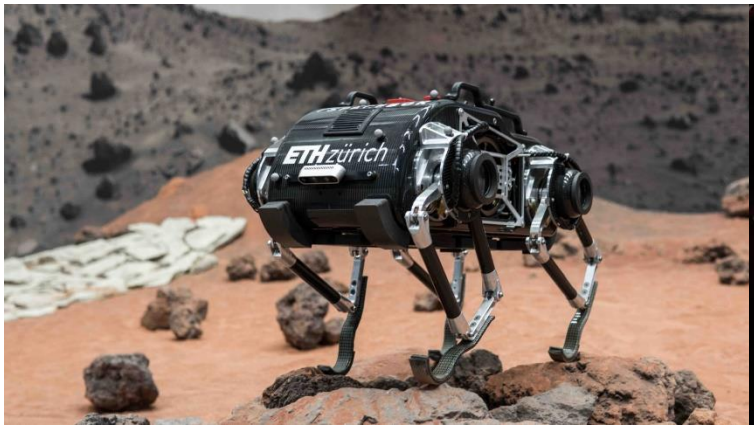
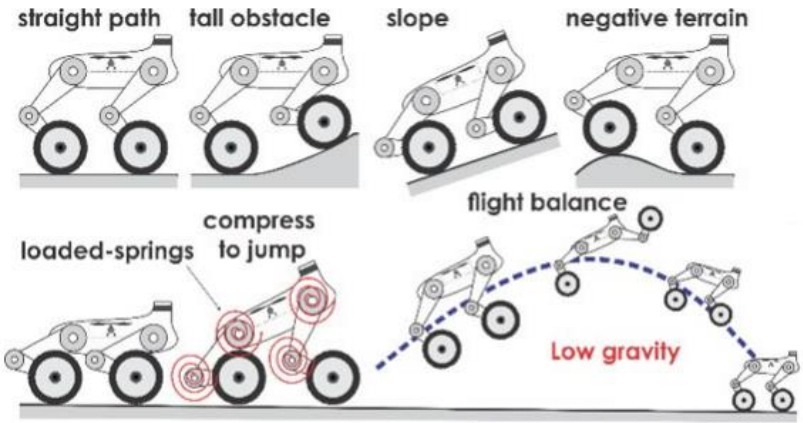
Modelling, simulation, and control of a jumping and walking quadruped robot for Martian Lava tube exploration

Abstract: Over the last decades 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 he 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 in 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. In this project your task is to contribute on the modeling, control and simulation of such as jumping legged robot that is currently being designed by our team at NTNU.





Tasks:

The work in this project starts by investigating the existing methods of control for legged robots. Subsequently, you will create a detailed model of a legged robot that can be used for simulation and control of both the jumping and walking phase of the robot by manipulating the actuatoros of the system and coordinating the motion of its legs and body while standing, crouching, walking, and jumping. The goal is to end up with a model and controller that can be implemented on a physical robotic being developed at NTNU.

- Model robot legs and quadruped robot
- Trajectory generation for robot feet
- Robust hierarchical controller for crouching, walking, jumping, and landing of quadruped robot
- Evaluation of model and controller in simulation.
- Possibility to implement a version of the developed controller on a robotic leg currently being developed at NTNU.

Literature (indicative):

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