Rethinking Multi-Legged Robots:
Passive Terrain Adaptability through Underactuated Mechanisms and Exactly-Constrained Kinematics

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This project seeks to thoroughly examine underactuated mechanisms in multi-legged robots for rough terrain, working towards drastic performance improvements by parting with over-constrained kinematics and complicated redundant control schemes in favor of designs that are **passively stabilized due to their large-scale mechanical adaptability and exactly constrained kinematics.**

Main research directions:

- Investigate the necessary degrees of freedom and actuation for passive adaptability to rough terrain
- Explore mechanisms that provide adaptability without compromising stability or performance
- Gait synthesis and control framework for continuous locomotion with limited intrinsic and extrinsic sensing

Current Approach:

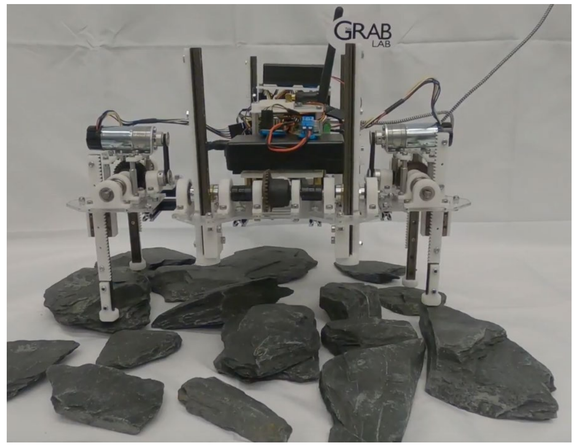
- Pairs of underactuated legs passively conform to terrain
- A compact body mechanism enables forward/yaw motions
- Simple body pose regulation with proprioceptive sensing

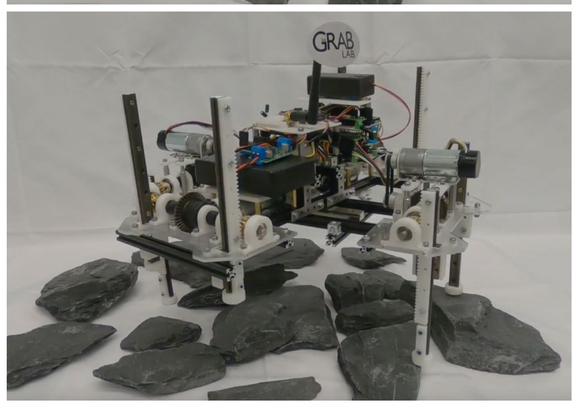
Broader Impacts:

- Robust, low cost, and low power deployment in unstructured environments
    - Search and rescue
    - Exploration in natural environments
- Additional applications in non-robotic vehicles

Main Progress since last year:

- Developed a full-mobility legged robot with passively adaptive legs
    - In favor of compact design and controllability, legs also perform pitch/roll motions
    - Bidirectional leg actuation improves stability on compliant terrains
    - Stable locomotion demonstrated in untethered outdoor testing





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