Body shape modulates obstacle attraction and repulsion during dynamic legged locomotion

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Han et al, *IJRR,* in revision

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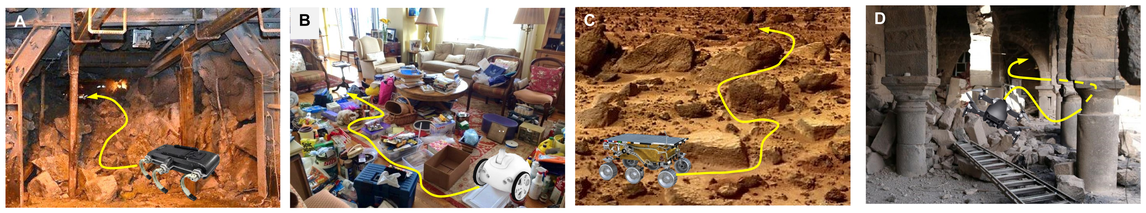
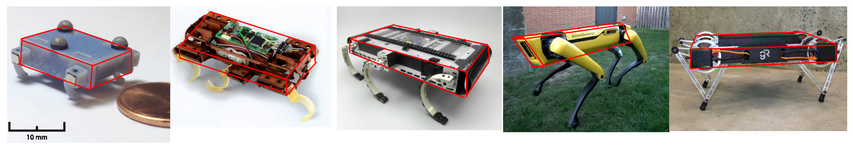
1. Background & Motivation

Need to use physical interaction to traverse complex terrain



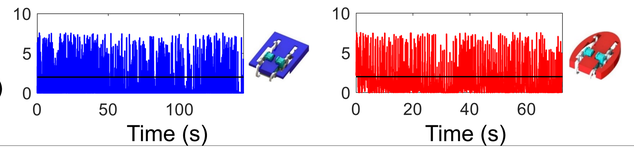
Can we use body shape to modulate interaction and thus locomotion?

Legged robots have angular body shape

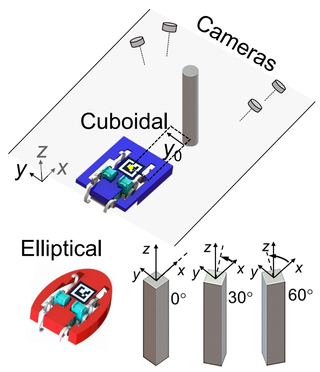


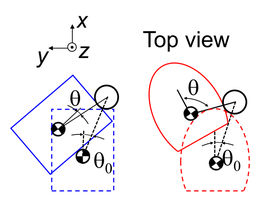
Frequent, intermittent contact challenges sensing & planning

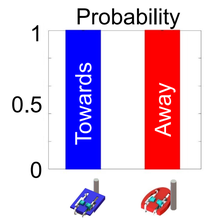
Body-obstacle distance (% body length)

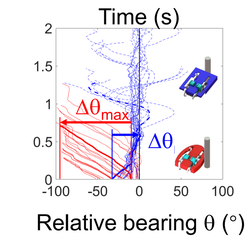


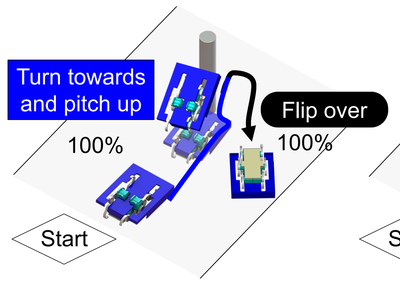
2. Methods & Results

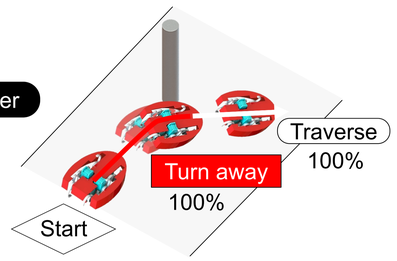


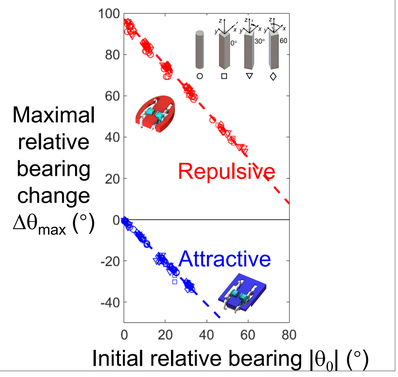




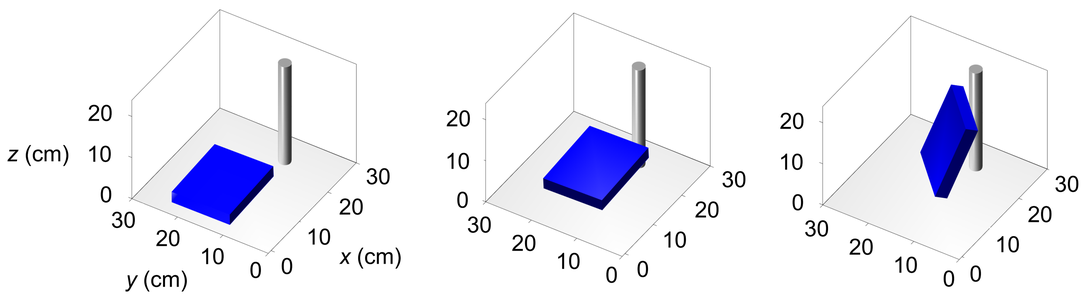




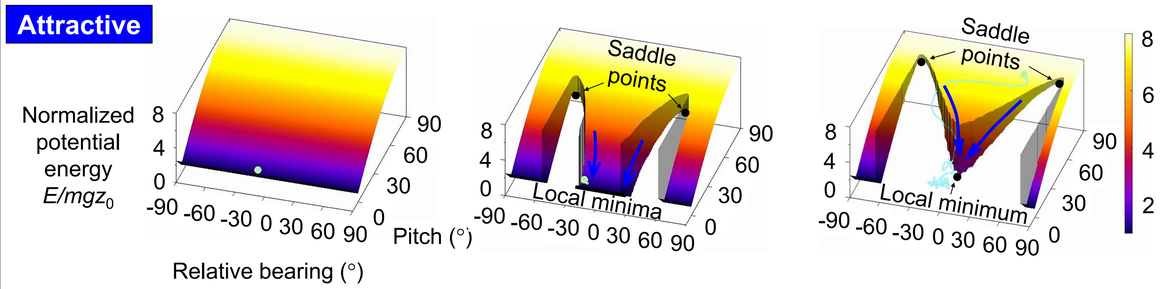


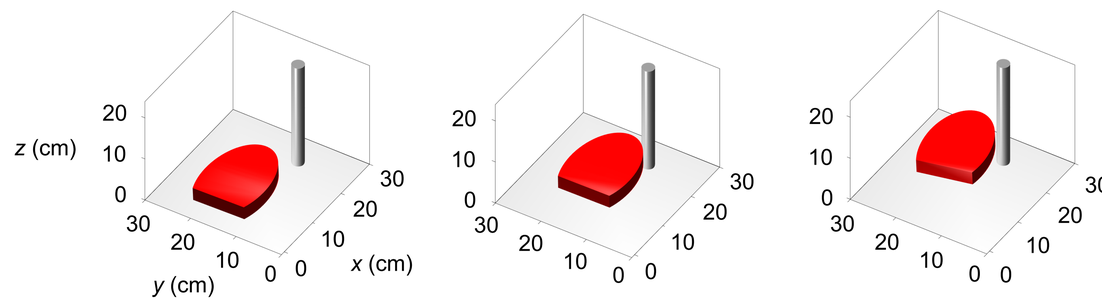


3. Energy Landscape Modeling

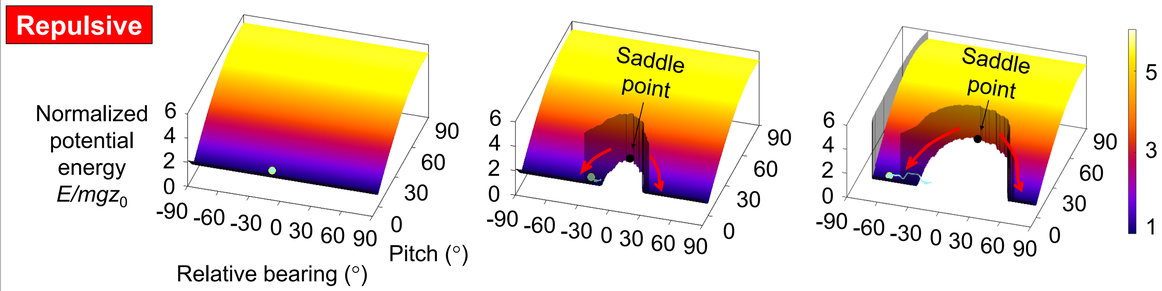


Attractive

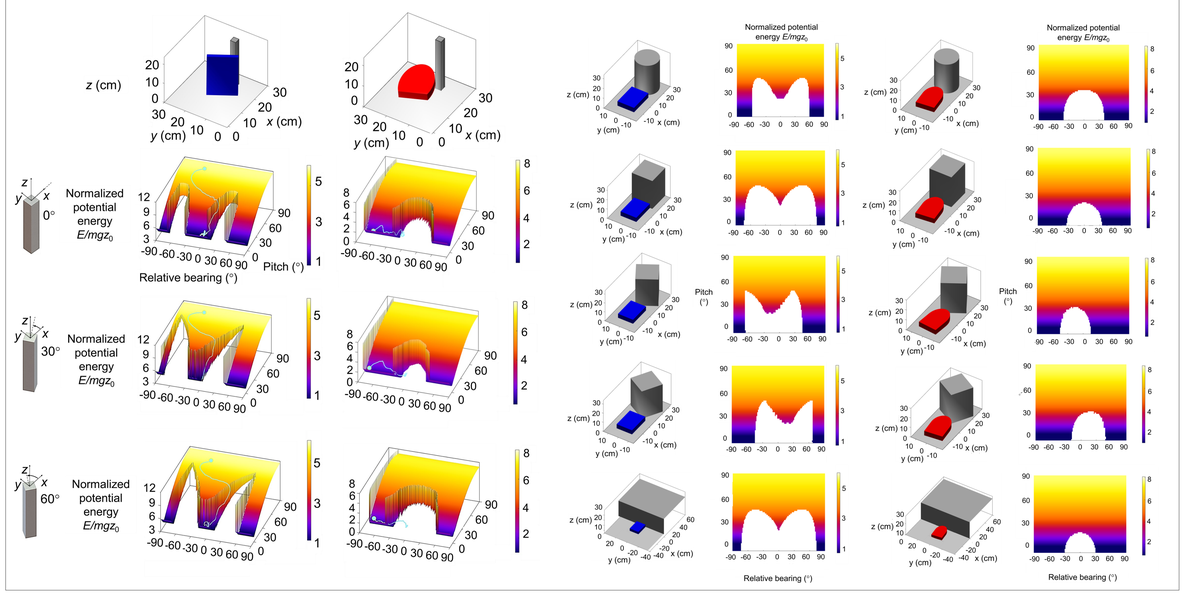




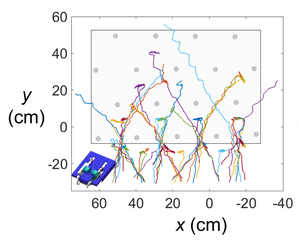
Repulsive

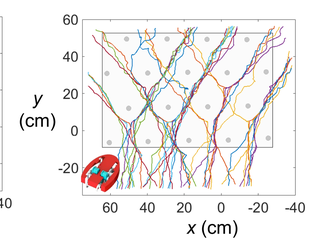


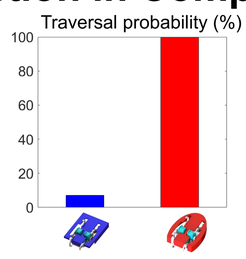
4. Interaction is Insensitive to Obstacle Property

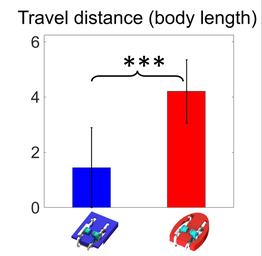


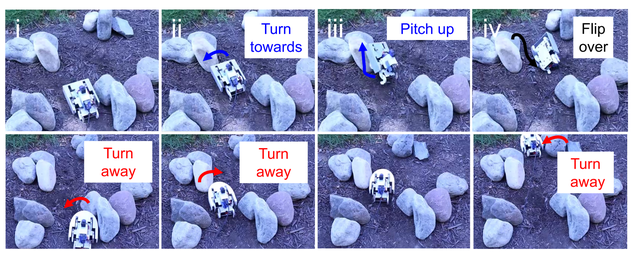
5. Shape Modulated Interaction in Complex Terrain











Broader implications

1. Body shape variation to alter landscape topology
2. Shape morphing strategies for desired interactions in complex terrain

Take-home messages

- During physical interaction, cuboidal body shapes are attracted to and elliptical body shapes are repelled away from obstacles.
- Obstacle attraction or repulsion is an inherent property of locomotor body shape and is robust to terrain variation.
- Terradynamic shapes are useful for passive control robot locomotion via obstacle interaction.
- Energy landscape approach helps understand locomotor-terrain interactions where equations of motion are too complex to solve.

Acknowledgements: We thank Dongkai Wang and Tim Greco for help with robot control system development; Yifu Luo and Xiao Yu for assistance during experimental setup and data collection; Tim Greco for help with natural terrain traversal demonstration; Zheliang Wang for preliminary modeling; Changxin Yan for 3-D reconstruction accuracy verification; Sean Gart, Yucheng Kang, Jean-Michel Mongeau, Dan Koditschek, Mark Cutkosky, Dan Goldman, Bob Full, and Ron Fearing for discussion.