Highly mobile, self-anchoring robots for coordinated, high-force environmental interaction

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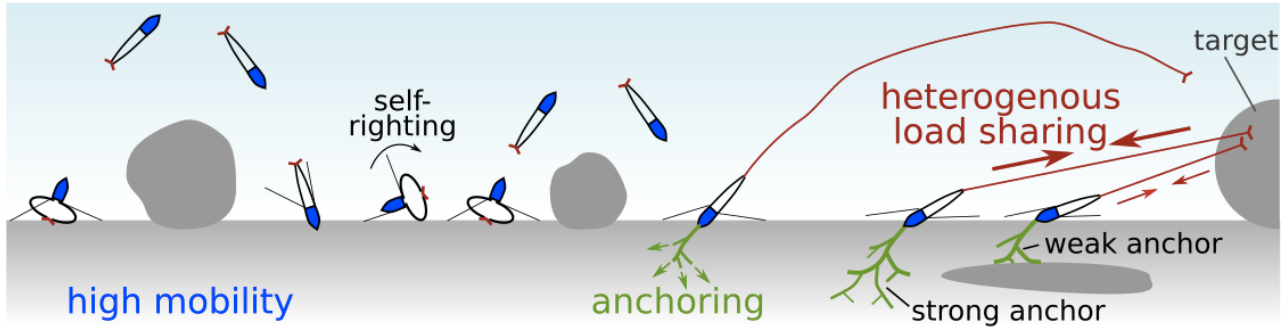
Research Objectives

I. Advance state of knowledge in (TRL 1-2):
   1. Mechanics of jumping
   2. Root-like anchoring and burrowing in low gravity
   3. Load-sharing for heterogenous anchoring strength

II. Develop new hardware (TRL 3):
   1. Jumper
   2. Burrowing and anchoring device for low gravity soils
   3. Load-sharing mechanism

III. Integrate and evaluate (TRL 4)
   1. Integrate subcomponents into working robot team



We propose to develop a team of highly mobile robots that are capable of jumping across extreme terrains, self-anchoring using root-like structures, and applying significant forces in a coordinated manner, despite heterogeneity in anchor strength.

Approach

Phase I: Test hypotheses and models via controlled experiments, including using regolith-like soils

Phase II: Design, prototype, test, analyze and iterate to create sub-component hardware

Phase III: Integrate sub-components to create functional robots; demonstrate and evaluate team of coordinated robots performing representative task (rolling a boulder)

Potential Impact

- Will enable robots capable of both:
  - high mobility to traverse extreme terrain, and
  - high force environmental interactions to move heavy objects.
- Will advance space science and exploration:
  - mobility opening access to new locations,
  - burrowing enabling sampling of subsurface soils,
  - force-application enabling tasks that involve heavy objects.
- Fundamental knowledge created during this work will enable future space applications that involve jumping, anchoring/burrowing, and load sharing.