SUPERball v2: A Deformable Tensegrity Rover for Planetary Exploration

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Motivations

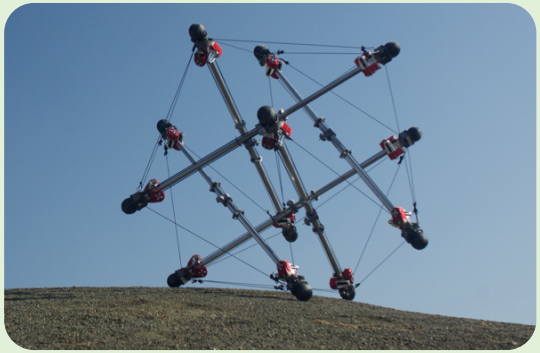
Interesting properties of tensegrity systems:

- Lightweight
- Robust against significant impacts and external forces
- Shape-shifting capabilities
- Variable stiffness based on cable pretension

Possible application: use as EDL (Entry, Descent, and Landing) and mobility system for planetary exploration

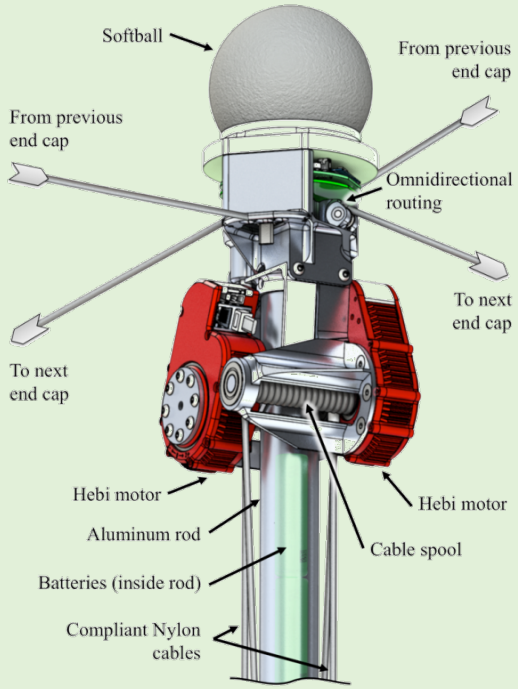
SUPERball v2 Specifications

- Icosahedron: 6 bars, 24 tensile elements
- 24 Hebi X8-3 actuators (fully actuated)
- Position, velocity, and torque-control enabled motors
- Compliant nylon cables (up to 15% stretch)
- Abrasion-resistant, shock-absorbing elements
- Designed for ground locomotion and high-speed landing (>7.5 m/s)
- Rod size: 1.95 m (6.4 ft)
- Robot weight: 38 kg (84 lbs)
- Scientific payload (max 5 kg) suspended in the center



SUPERball v2 in the NASA-ARC testing facility

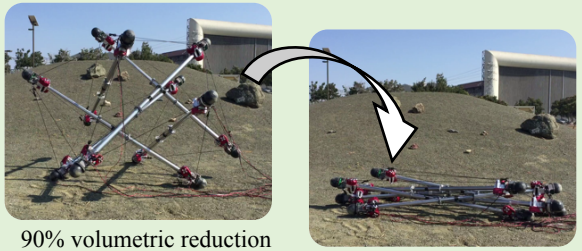
SUPERball v2 End Cap Assembly



The robot has a total of 12 end caps.

Shape-Shifting and Packing Capabilities

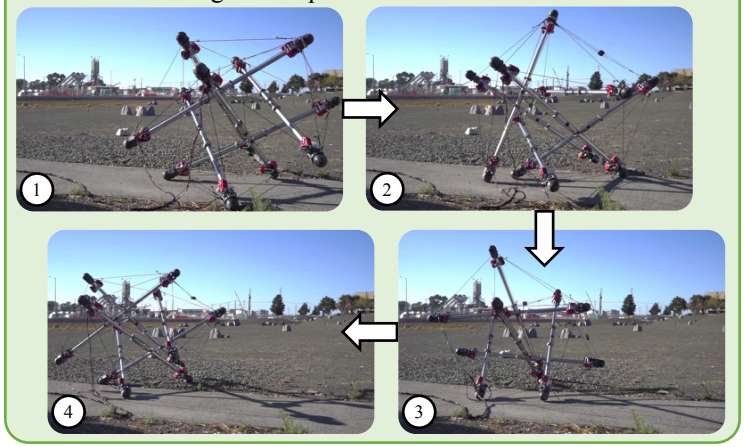
Each of the 24 cables can be reeled in or let out for a total length of almost 4 meters.
This allows for large shape deformation of the structure, used for mobility and storage packing.



90% volumetric reduction

Step-wise Locomotion Controller

By changing the cable rest lengths, it is possible to shift the center of mass projection outside of the support polygon. This makes the robot take a step (roll). Multiple steps can be combined to navigate complex terrains.



Contribution to the "Shape Changing Robotic Structures and Interfaces" Workshop at IROS 2018

Tensegrity robots share many properties and challenges typical of reconfigurable robots, soft robotics, and distributed systems. We seek to stimulate discussion by showing our progress, results, and open questions for this unconventional robotic platform.

We plan to show videos of the different tasks performed by SUPERball v2. We would also like to demonstrate some of these capabilities on a partially-actuated scaled model of the robot.

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