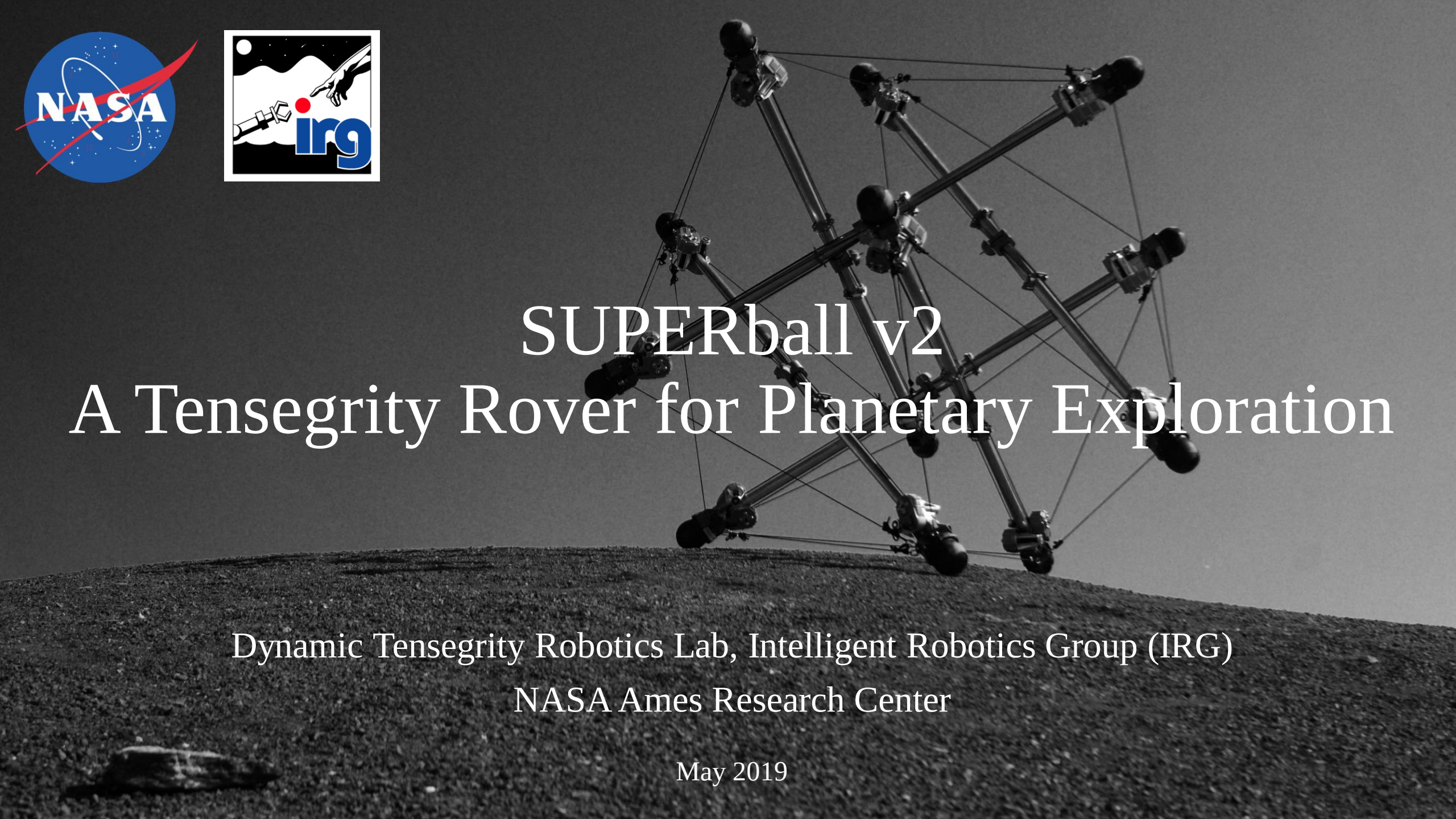
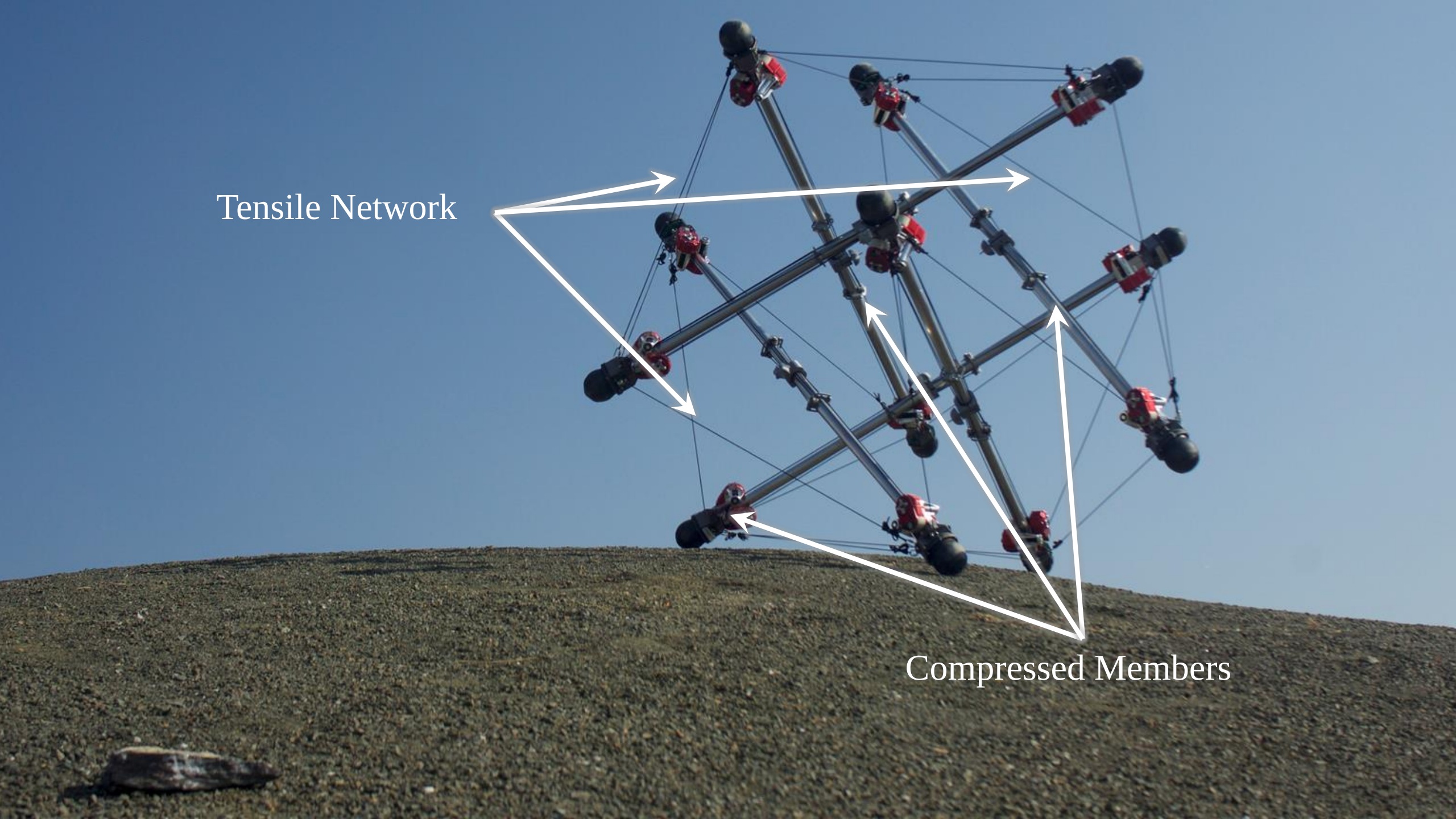


SUPERball v2
A Tensegrity Rover for Planetary Exploration

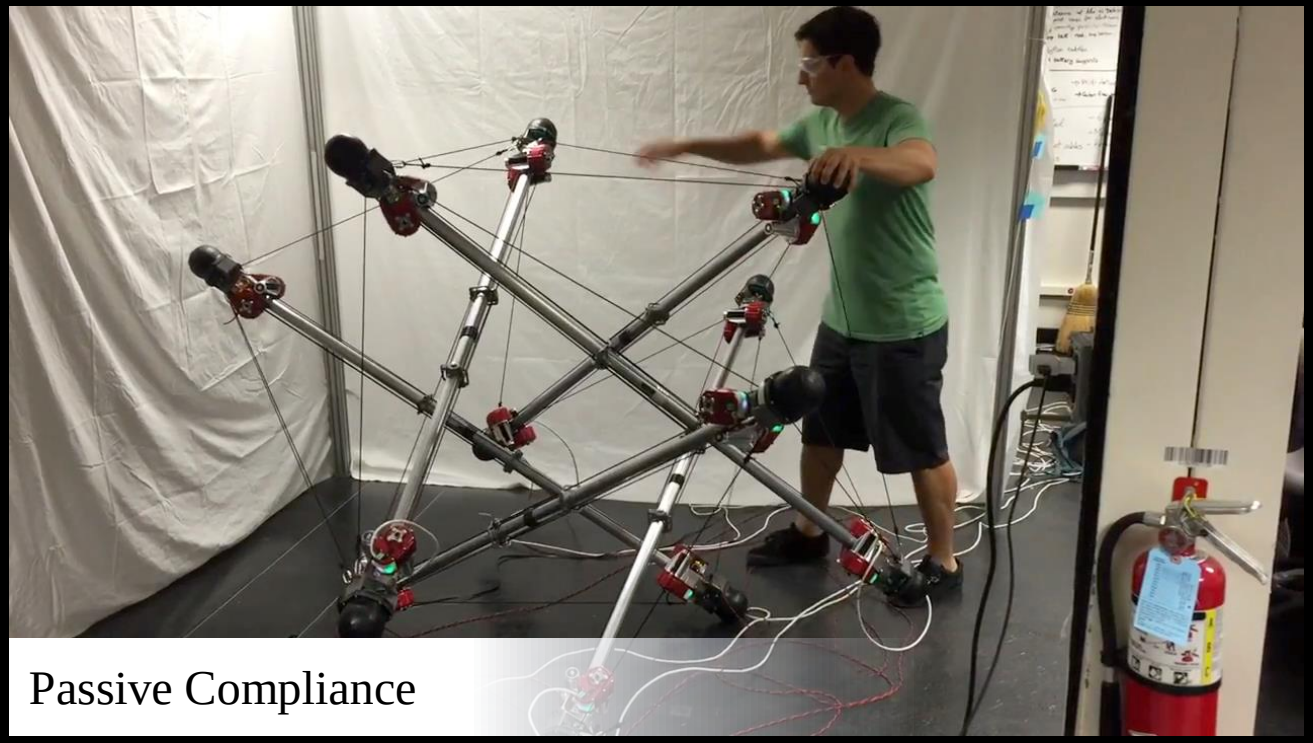
Dynamic Tensegrity Robotics Lab, Intelligent Robotics Group (IRG)

NASA Ames Research Center

May 2019


Tensile Network
Compressed Members

SUPERball v2

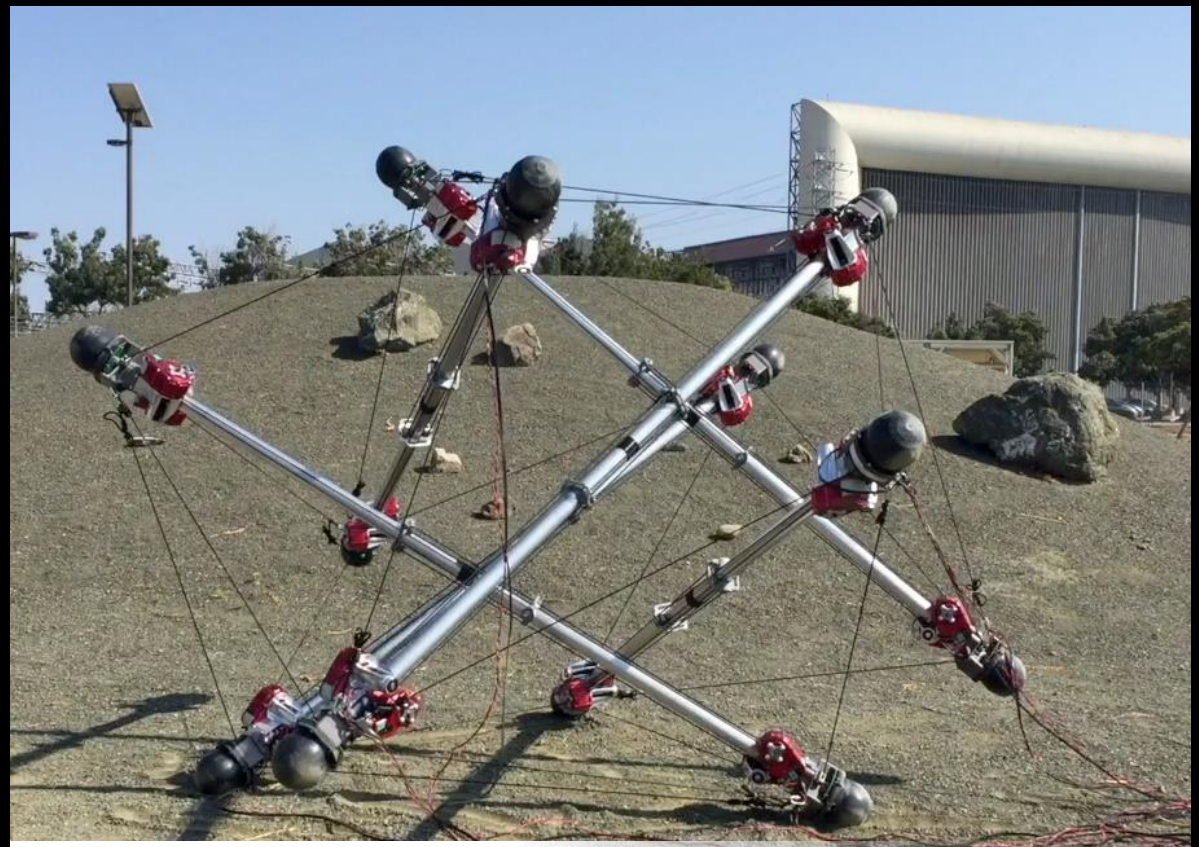


Passive Compliance

- 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
- 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)

Shape-Shifting SUPERball v2

Star Packing and Unpacking

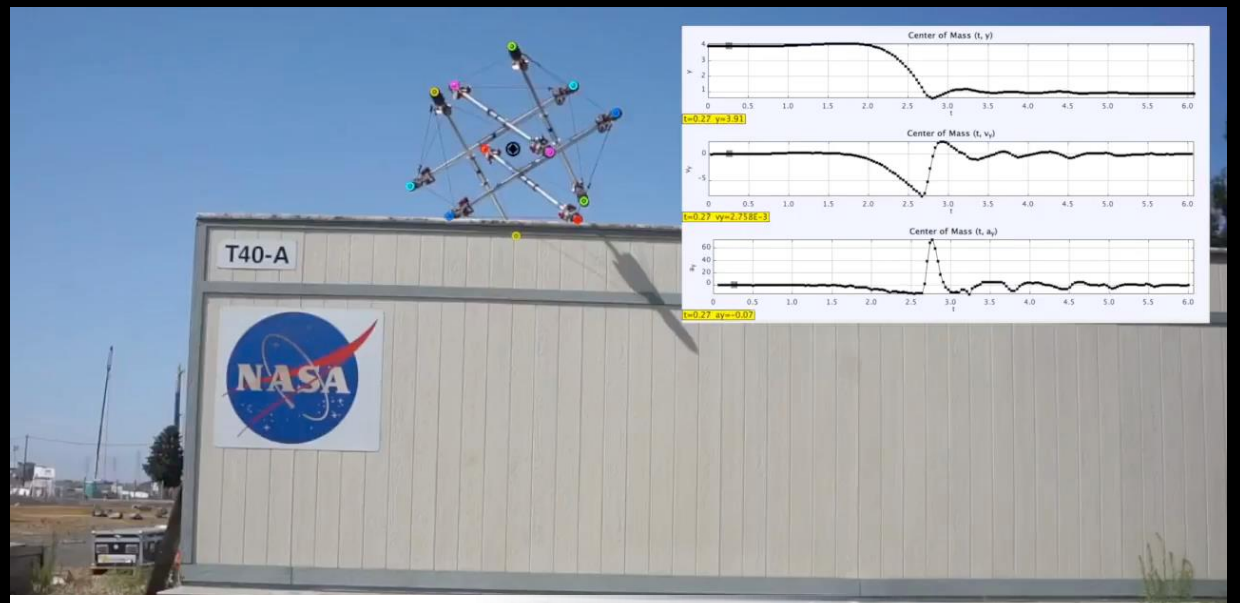


Horizontal Packing and Unpacking

Real-time speed

Mistreating SUPERball v2

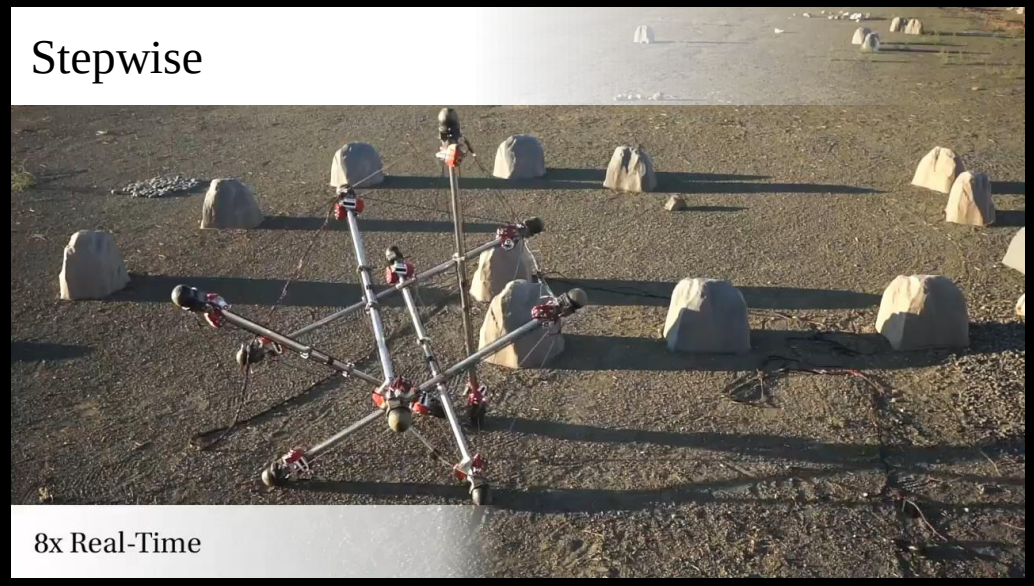
Durability Test



3.4 Meter Drop

Locomotion SUPERball v2

Stepwise



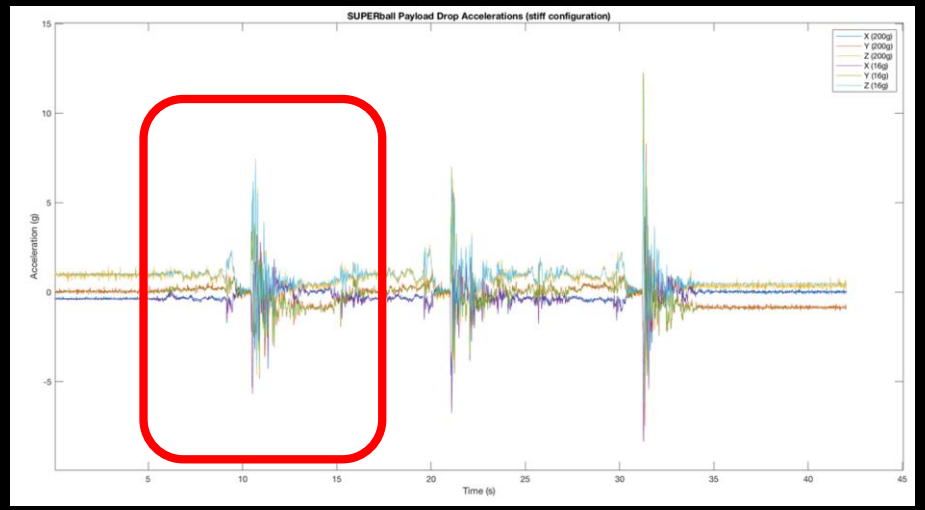
8x Real-Time

Trajectory Following

Trajectory Up Hill

Scientific payload

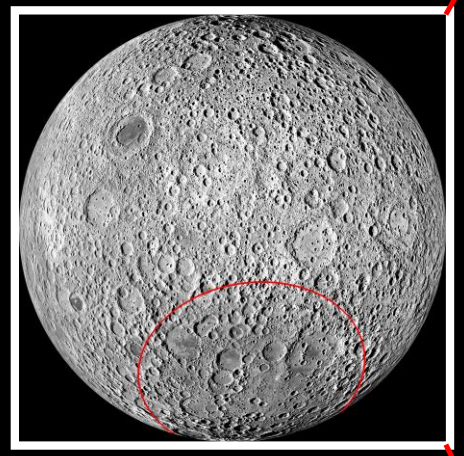
Quick Payload Drop

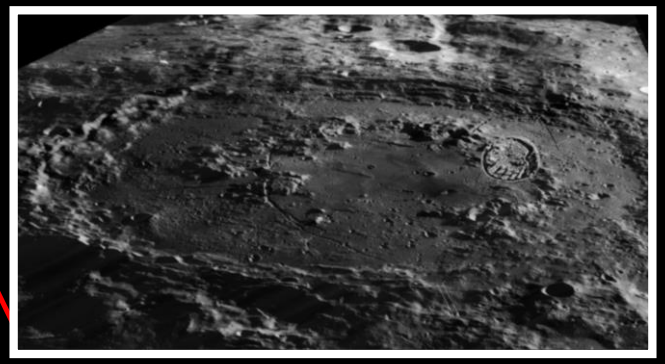


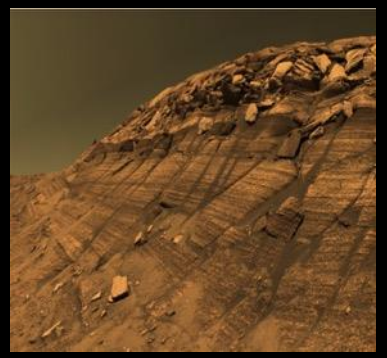
- Suspended payload bay, used to research mock science instrument placement and protection
- Evaluated both passive and active payload bays. (Actuation helps to achieve fine placement of a science sensor on a planetary surface.)
- Current prototype can host a 1U-CubeSat payload (10cm x 10cm x 11.35 cm)
- The science payload is protected from impacts.

Exploration Mission Need: Extreme Terrain Mobility

If your robot **IS** your landing system, there is a **significant reduction of risk during exploration,** which opens up new exploration strategies on the **Moon** and **Mars**







Safely explore high priority targets near cliff edges

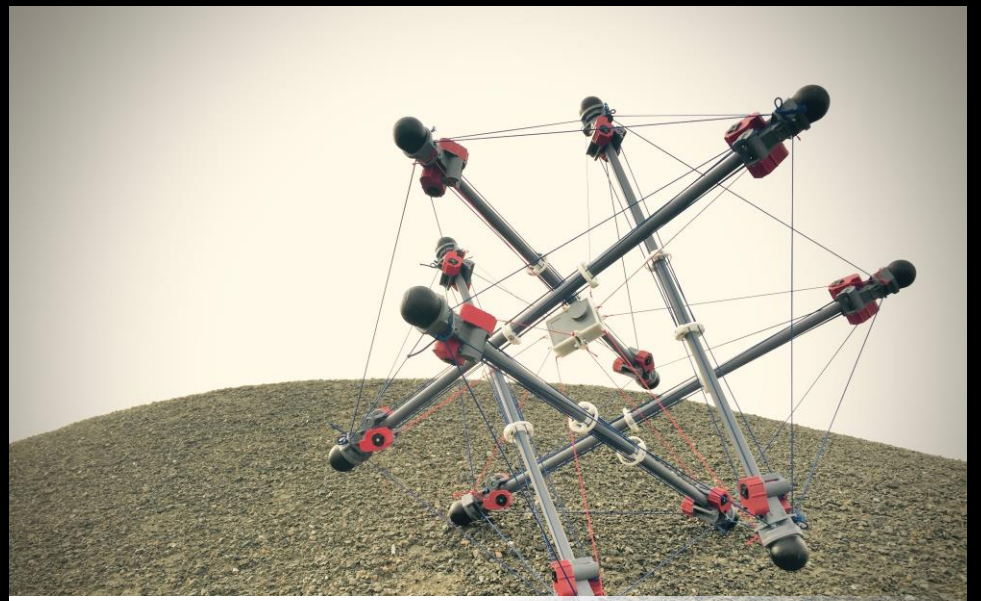
Traverse extremely rugged terrain with **broken jagged rock**, **ravines**, and **unstable crevices,** which are inaccessible to wheeled rovers.

When terrain is rugged and unstable, **falls may occur despite extreme caution and planning.**

NASA Cryosphere Program

Heavily crevassed glaciers are inaccessible to rovers and people.

- Cannot land a helicopter safely.
- Need to *drop* robot onto terrain
- Robot needs to be able to slide down crevasses (possibly 25-100 m deep).
- Science need to access bedrock below glacier and emplace seismometer.



Passive Mockup

Acknowledgement

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