Aerially-Deployed Jetpack-Launched Mars Helicopter Chassis

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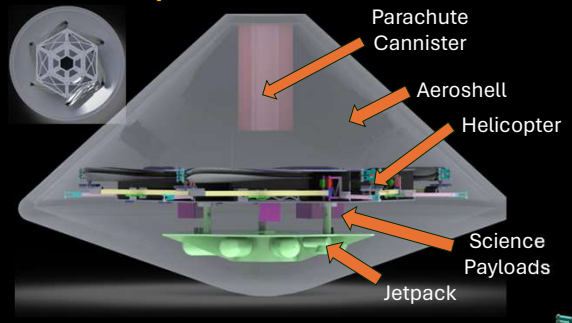
Major Requirements

- Design and Build Functional Prototype Helicopter ✓
- Total Helicopter Mass ~44 kg < 50 kg ✓
- Survive Falcon-9 Launch Loads ✓
- Stow Within Aeroshell Geometry ✓

-Helicopter Stowed in Aeroshell-



Leg

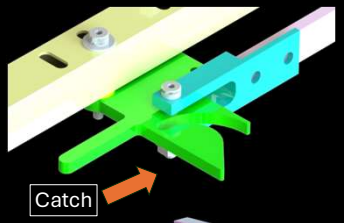
Can the leg survive a 2 m/s vertical and 0.5 m/s horizontal landing velocity?

Load Requirement	Yield Strength	Pass/Fail
365 N	1046 N (235 lb)	✓
96.6 N	134 N (30.2 lb)	✓
96.6 N	68 N (15.4 lb)	✗

Arm

Can the arm reliably deploy during landing?

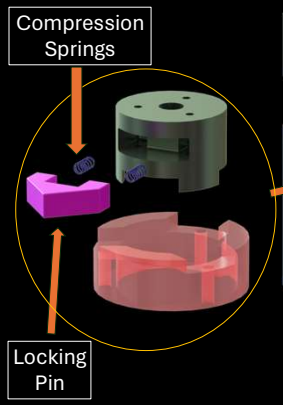
- Deploy time = 4.83 s < 5.0 s ✓
- Start/Stop Deployment ✓
- Off-Angled Deployment ✗

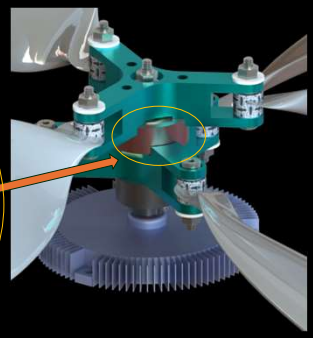


Rotor

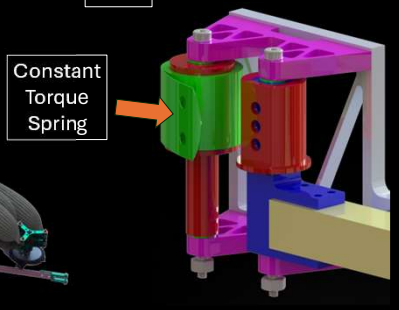
Can the rotor transition from the stowed to deployed configuration and consistently lock into place?

- Rotor Deployment ✓
- Locking Pin Actuation ✓





-Stowed Helicopter Assembly-



Launch Loads Testing

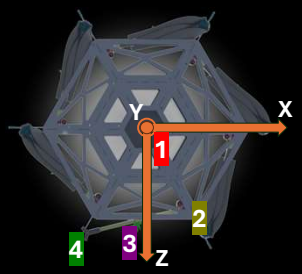
Test Procedure (Z & Y axes)

1. Pre Sine Survey
   - Learn Baseline Response
   - Compare to FEA
2. Random Vibration
   - PSD input
3. Mid Sine Survey
   - Compare to previous survey
4. Sine Burst
   - Static Loading
   - 8.5G Axial, 3G Lateral
5. Post Sine Survey
   - Compare to previous survey

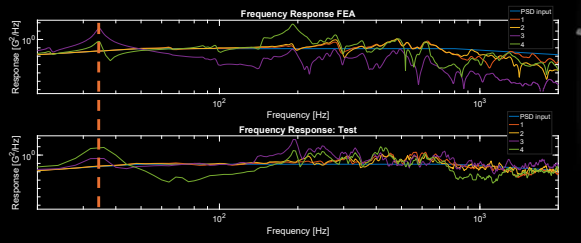
Structure Requirements

1. 8.5G Static Axial (Y) Load ✓
2. 3G Static Lateral (Z) Load ✓
3. Random Vibrations (PSD Input) ✓
4. Primary Axial Frequency > 25 Hz ✗
5. Primary Lateral Frequency > 10 Hz ✓

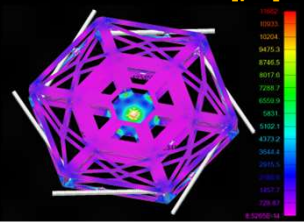
Accelerometer Locations



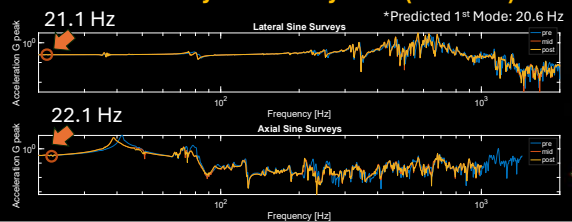
Lateral Random Vibration Response



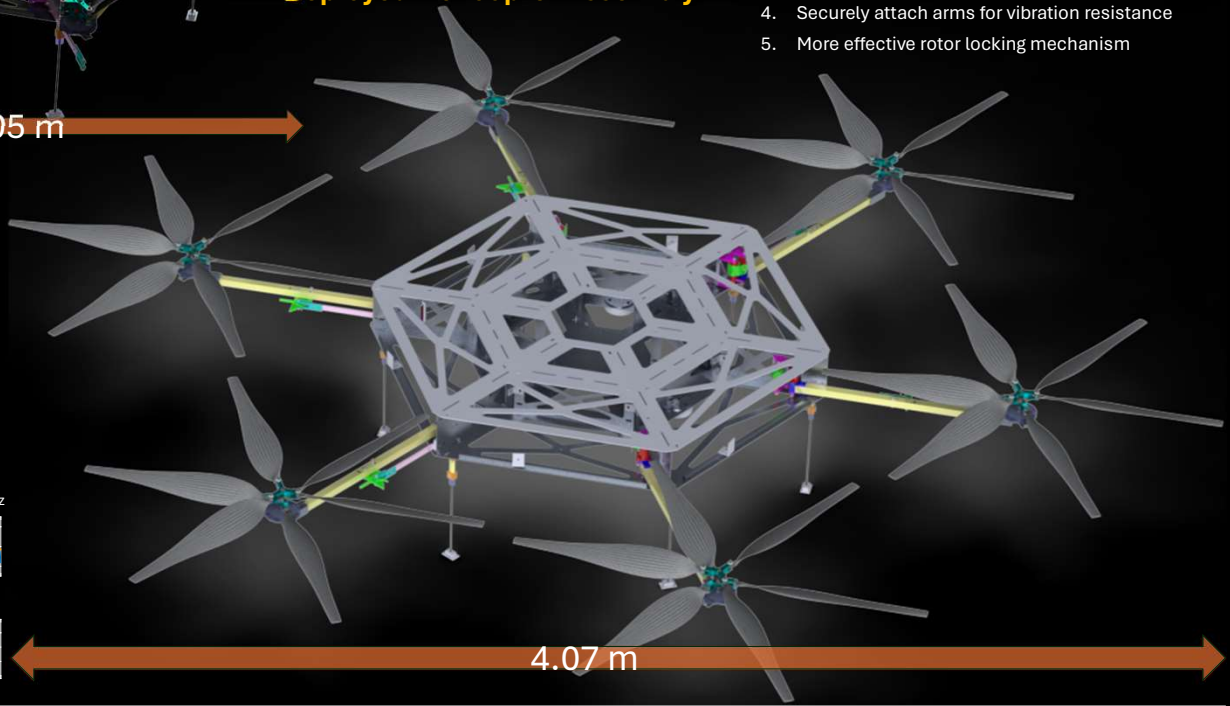
Static Axial Stress [psi]



Sine Surveys at Battery Pack (Sensor 1)



-Deployed Helicopter Assembly-



Flight Recommendations

1. Carbon fiber composite structure
2. Modular arm, leg, and rotor systems capable of independent test
3. Stiffer arm deployment hinge spring
4. Securely attach arms for vibration resistance
5. More effective rotor locking mechanism

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