Assemblers Internship Exit Presentation

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Mechanical & Electrical Subteam

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Agenda

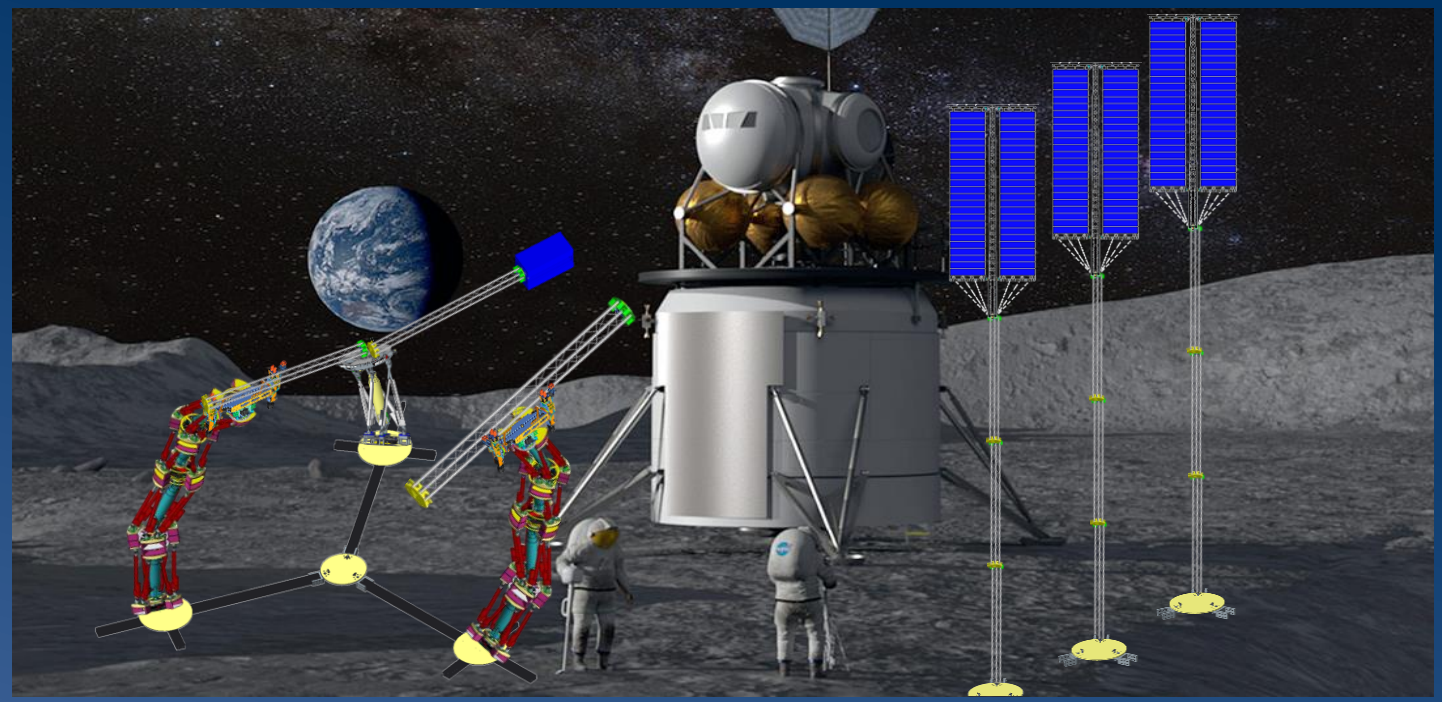
- About Me
- Assemblers Project Overview
- Camera and SAS Mount
- End-Effector Force Calculations
- Gripper Finger Design
- Jigging End-Effector Mechanism
- Questions

About Me

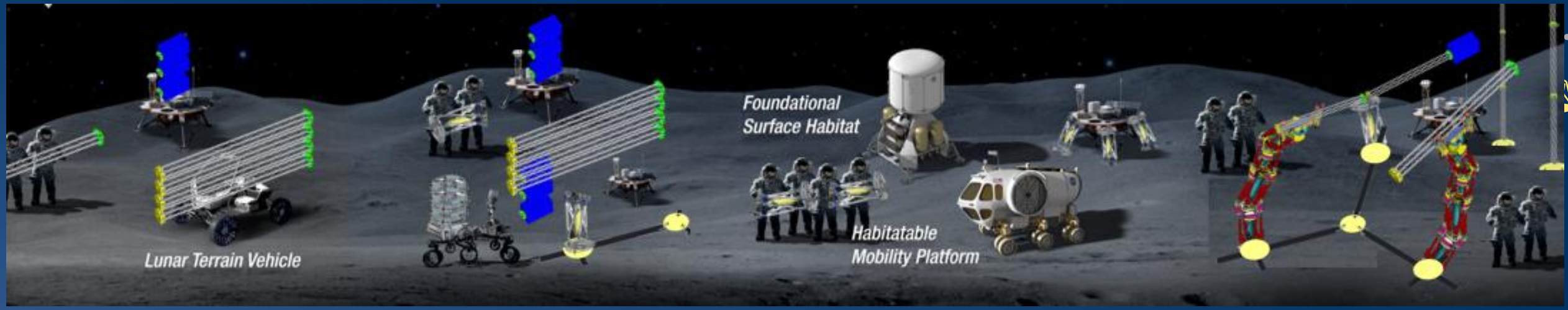
- Senior at Georgia Tech
- Mechanical Engineering Major
  - Concentration in Automation & Robotics
- From Rochester, NY
- Hobbies are basketball and cooking

Assemblers Overview

- Autonomous, modular, robotic in-space assembly
- System based on multiple stacked Stewart Platforms
  - 6 degrees of freedom
- Components
  - Stewart Platform
  - End-Effectors
  - Base and Foundation
  - Test Articles



Project Storyboard



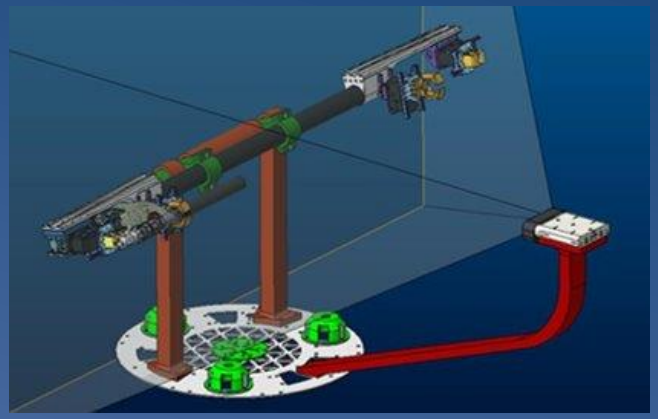
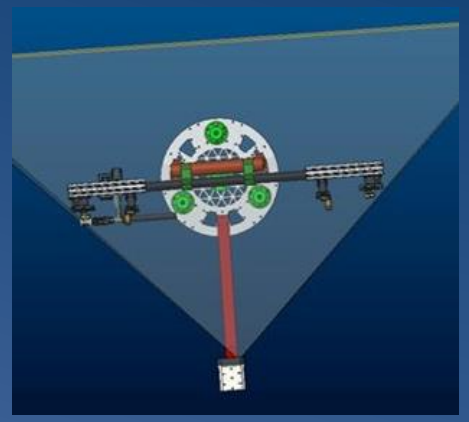
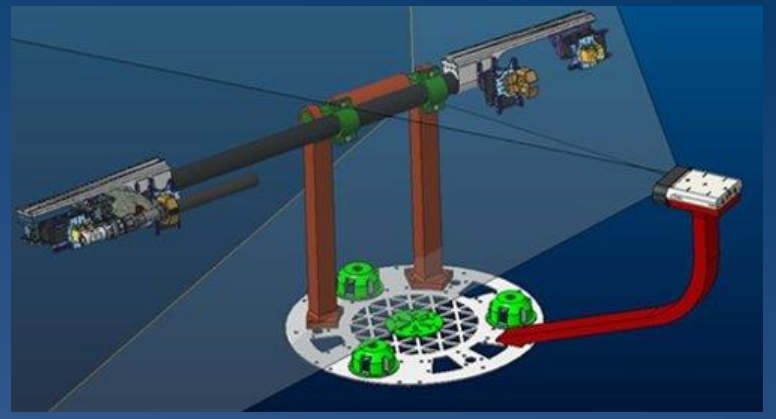
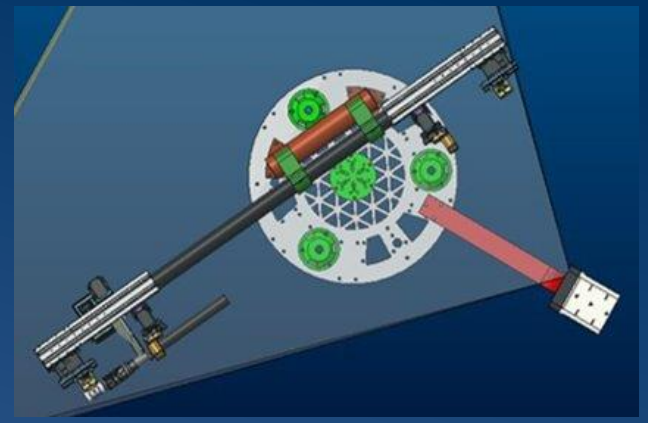
ACT – I: Work Site Preparation	ACT – II: Foundation Preparation	ACT – III: Structure Assembly	ACT – IV: Error Detection and Correction	ACT – V: Task Switching	ACT – VI: Assembly Completion and Post Assembly Activities
• Work site preparation tasks allocated • Material offloading • Site inspection and preparation • General Staging	• Foundation preparation tasks allocated • Assembler Configuration • Transport Material to site • Foundation Setup • Foundation inspection	• Structure Assembly tasks allocated • Component Jigging • Component Joining • Assembly inspection	• Error detection • Error correction • Situation reports • Resume planned assembly queue	• Next task allocated • Next task execution • Complete assembly inspection	• Validation Reports • Agent switch to maintain and support mode • Other post assembly task execution

Abbreviations

- COTS: Commercial Off-The-Shelf
- EE: End-Effector
- SAS: Strut Attachment System

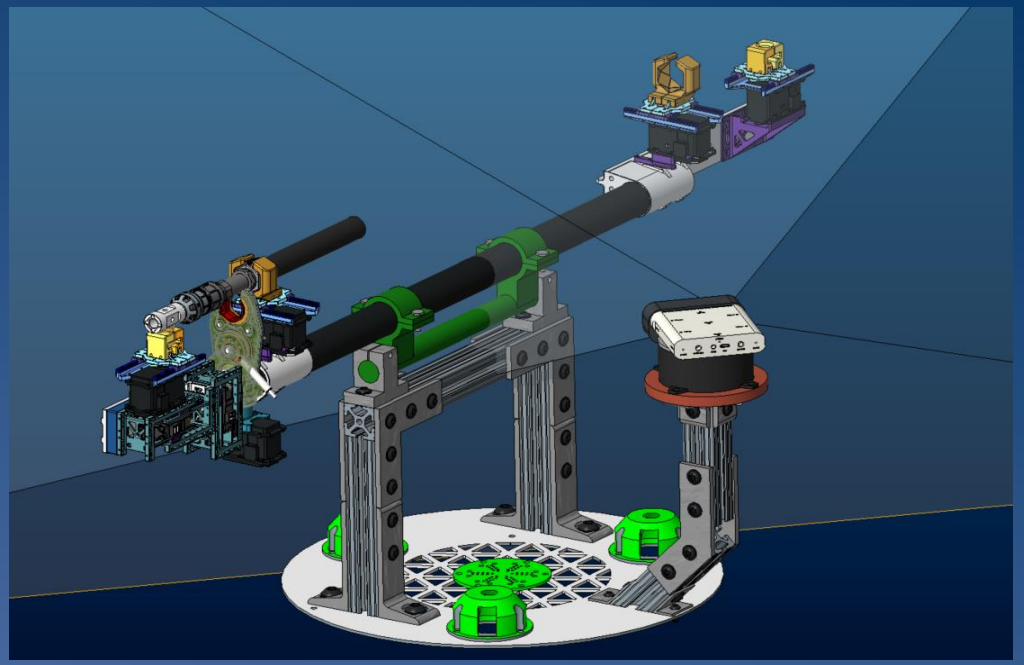
Camera/SAS Mounts

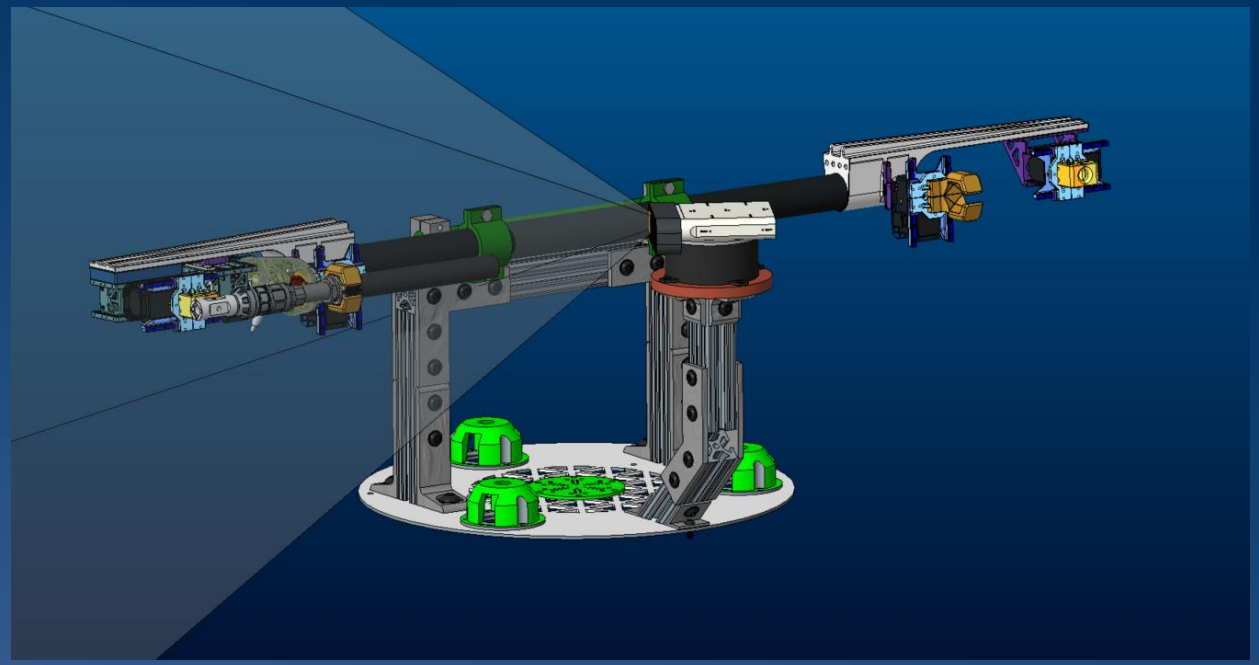
- Initial concept designs
- Issue with distance required for camera field of vision
- Multiple angles/positions tested

Camera/SAS Mounts

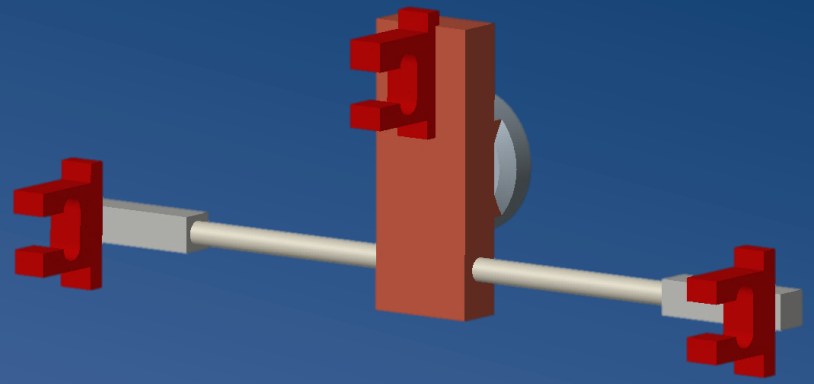
- Mainly 80/20 framing with COTS components
- Added turntable to camera base

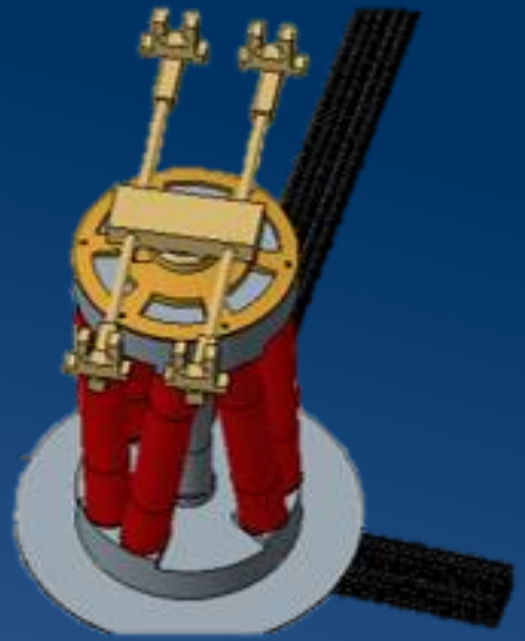




End Effector Concepts

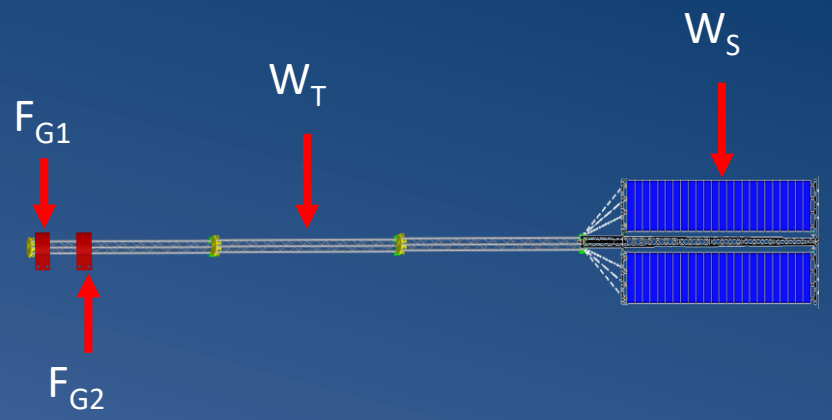
- Truss Manipulator
  - Grab and move truss segments
- Truss Jigging
  - Aid and jig the truss segment during assembly





Jigging EE Forces

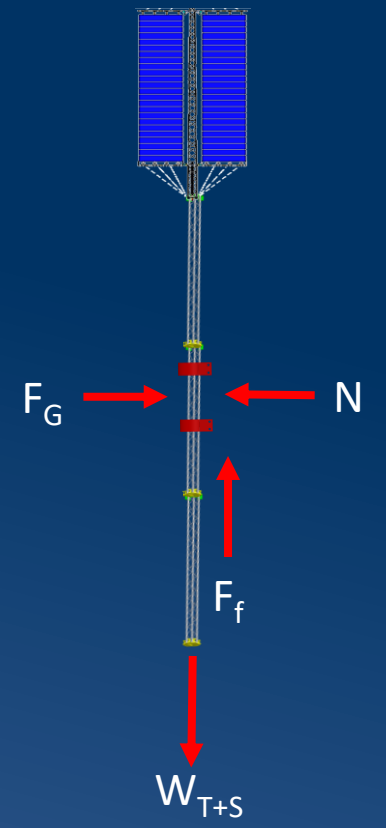
- Jigging gripper in various holding positions
- Forces measured in lbs.



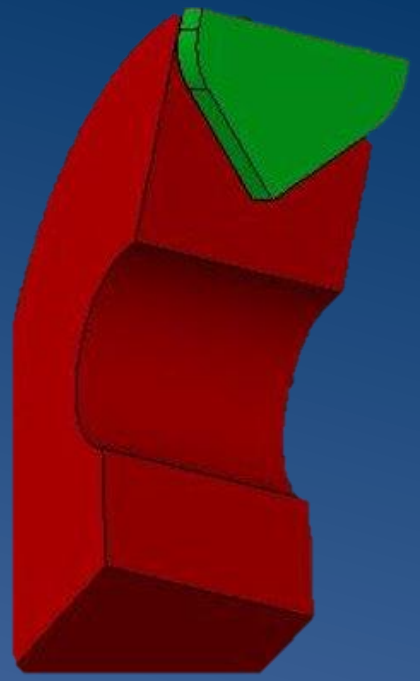
Grip Location	G1 Total	G2 Total	G1 Split	G2 Split
End	159.3	229.3	79.7	114.7
1/3	73.8	143.8	36.9	71.9
Middle	22.5	92.5	11.3	46.3
2/3	28.8	23.8	14.4	11.9

Manipulator EE Forces

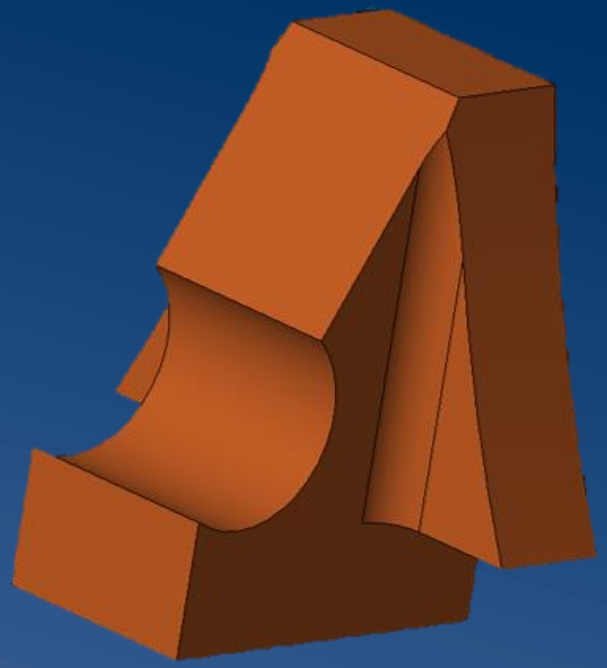
- Force on manipulator gripper in vertical position
- Verifications with motor specifications
- Gripper force needed for worst case ~32.9 lb.
- Force provided from lead screw ~60 lb.
  - $F = \frac{2T}{d}\left(\frac{\pi d - fl}{l + \pi f d}\right)$



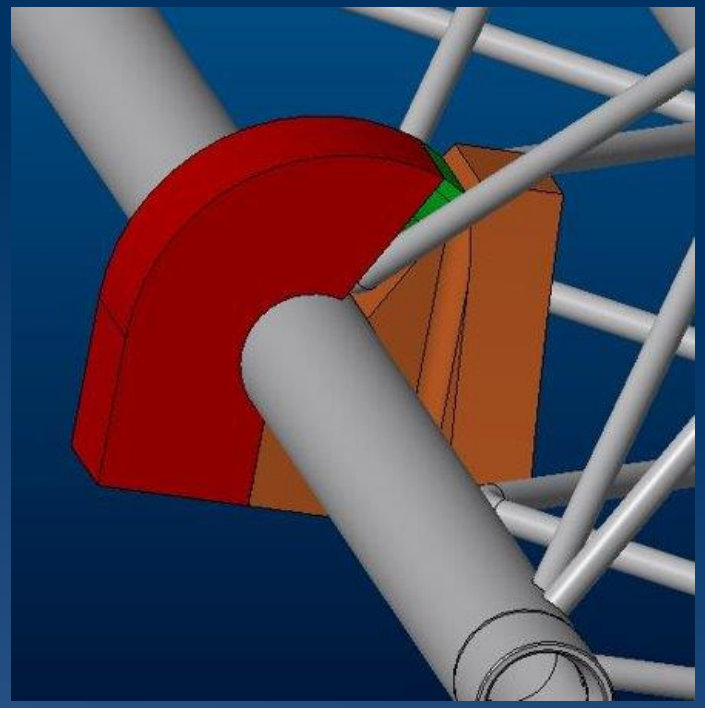
Initial Gripper Fingers



Moving Finger

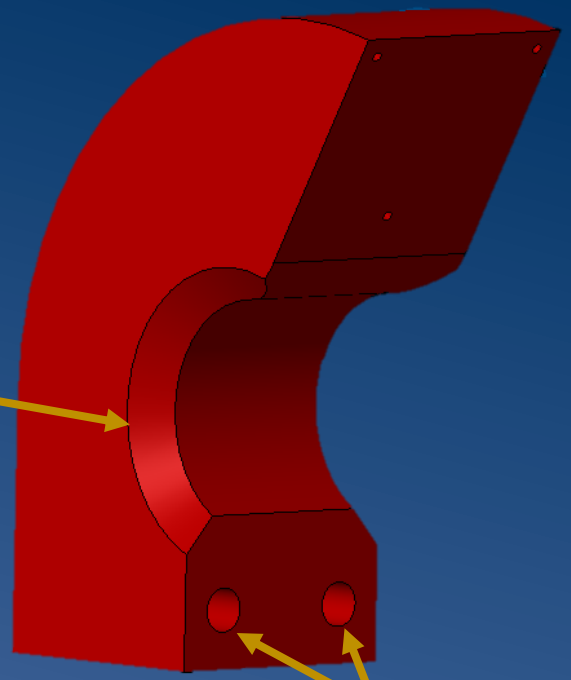


Stationary Finger



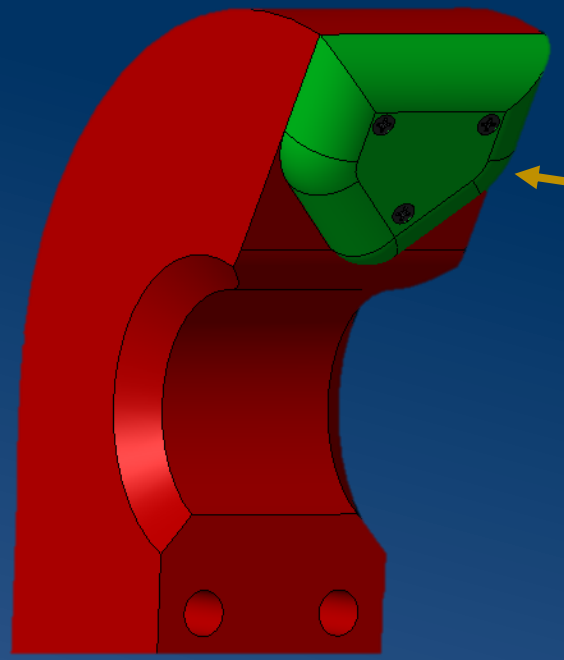
Fingers with Truss

Moving Gripper



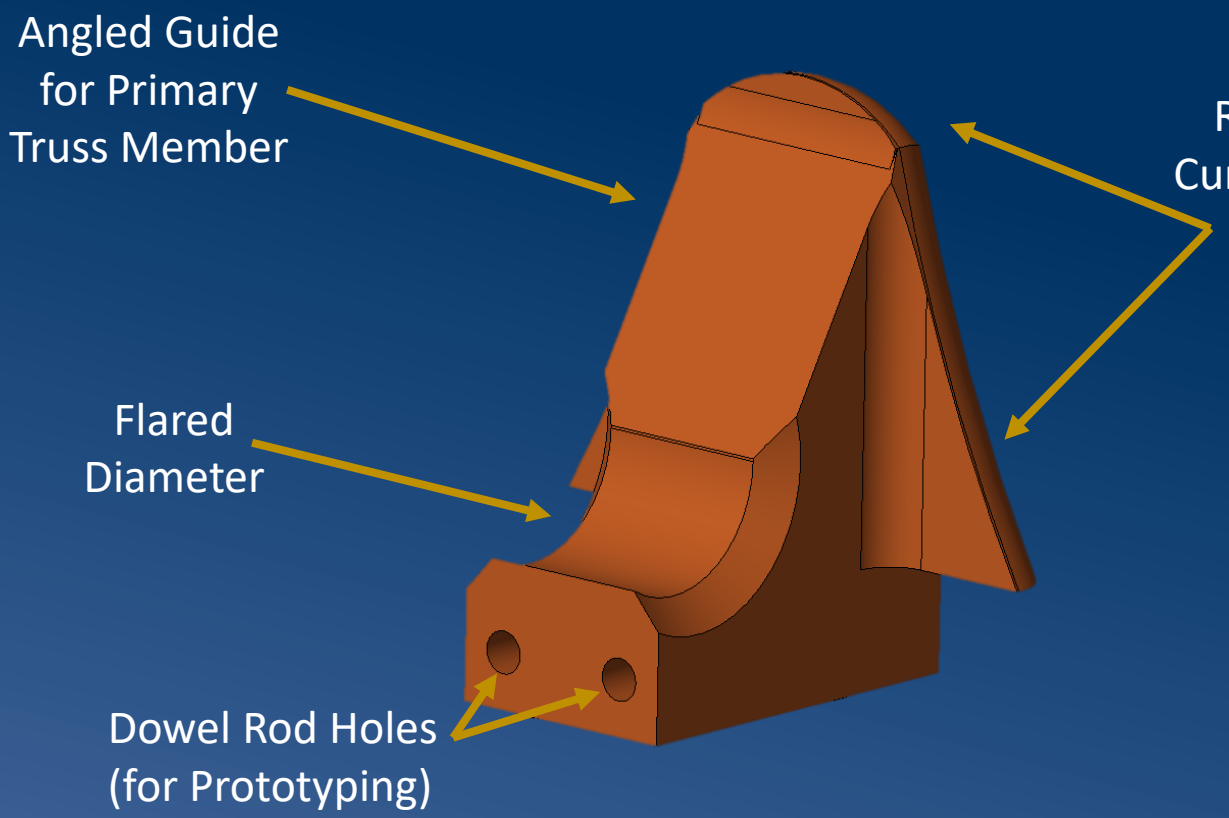
Flared Diameter

Dowel Rod Holes (for Prototyping)



Swappable add-on with 3 fasteners

Stationary Gripper



Jigging EE Inch Worming

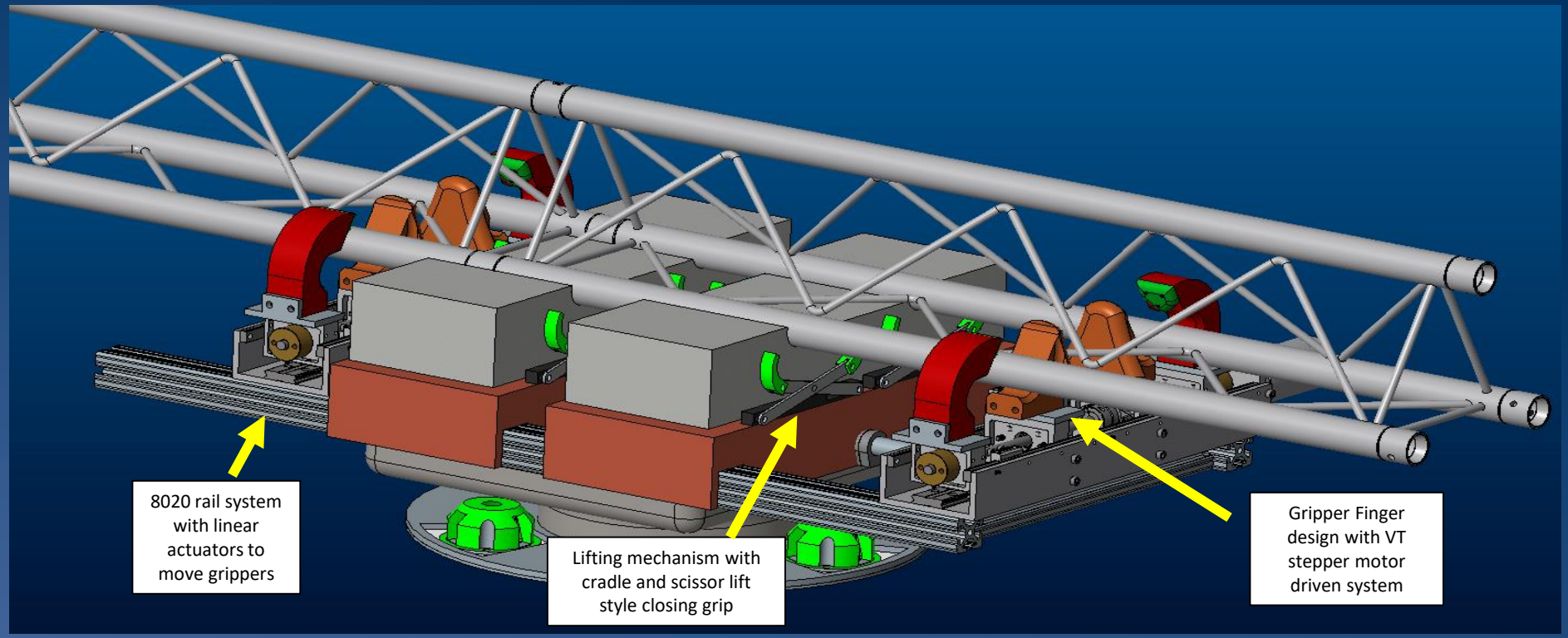
- Gripper fingers (intended for manipulator EE) would cause issues with inch worming movement
- Need modified EE design for jigging end effector with mechanism for truss translation

= Interference Point

~1.5” movement before interference

Movement Idea #1

- Move truss using to allow grippers to reset

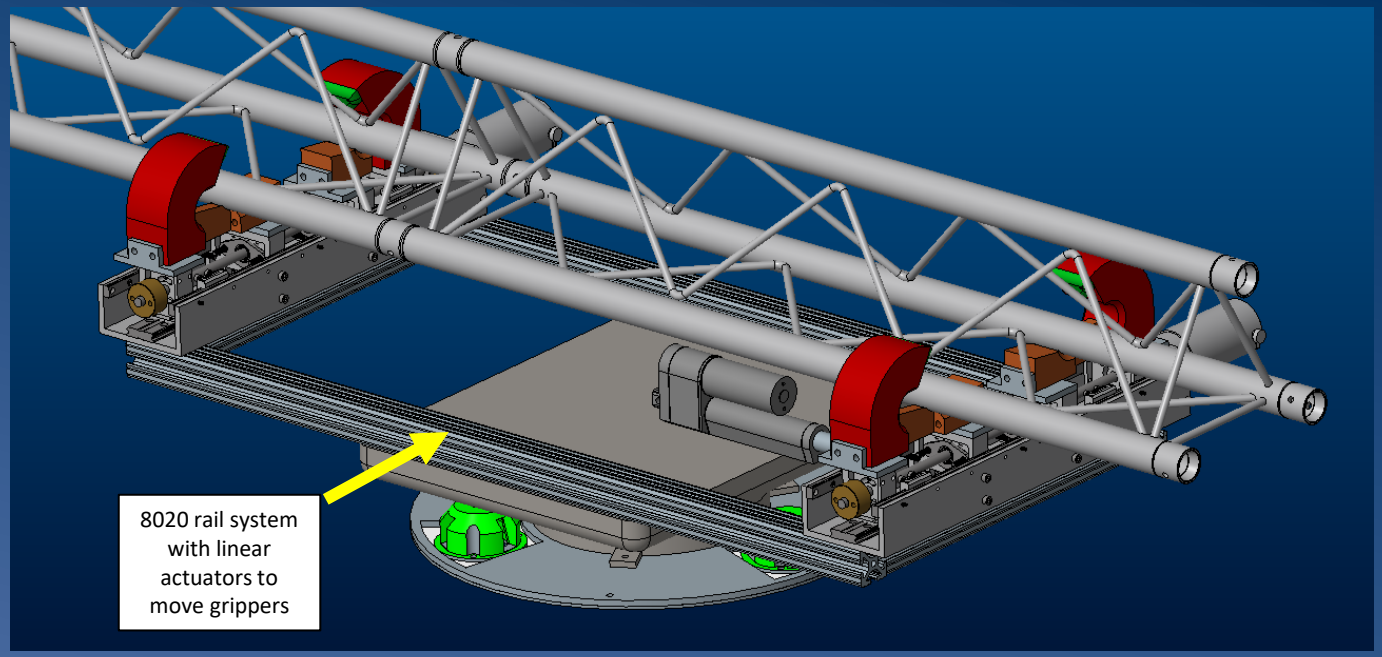


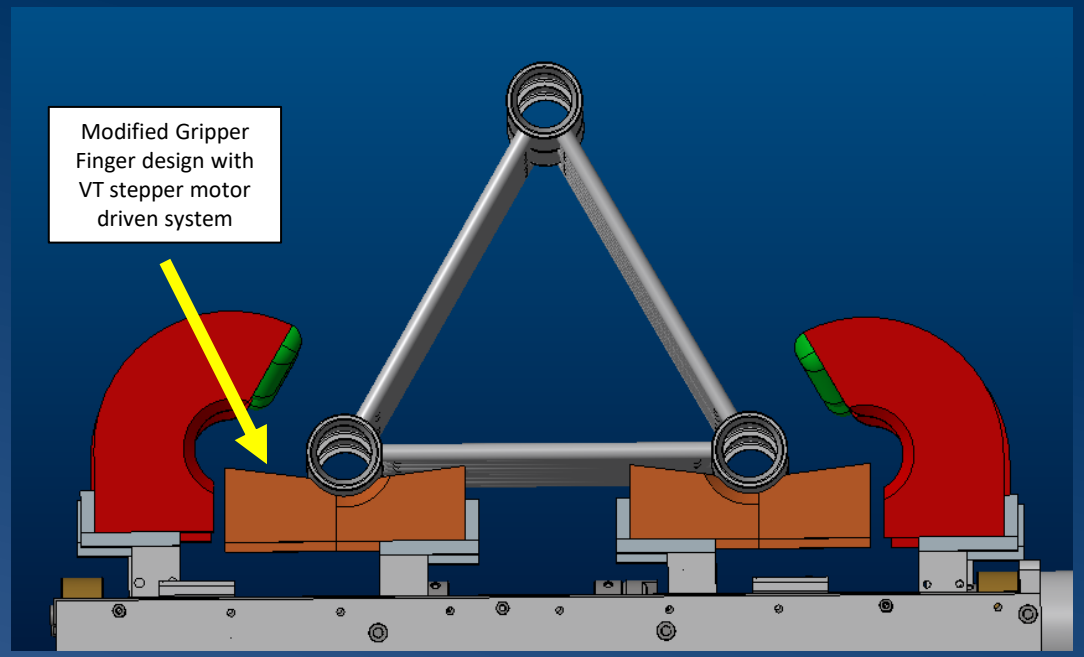
Movement Idea #1 Animation

Click to Play Animation

Movement Idea #2

- Modified gripper from truss manipulator EE fingers
- Lowered height to avoid interference with secondary truss members



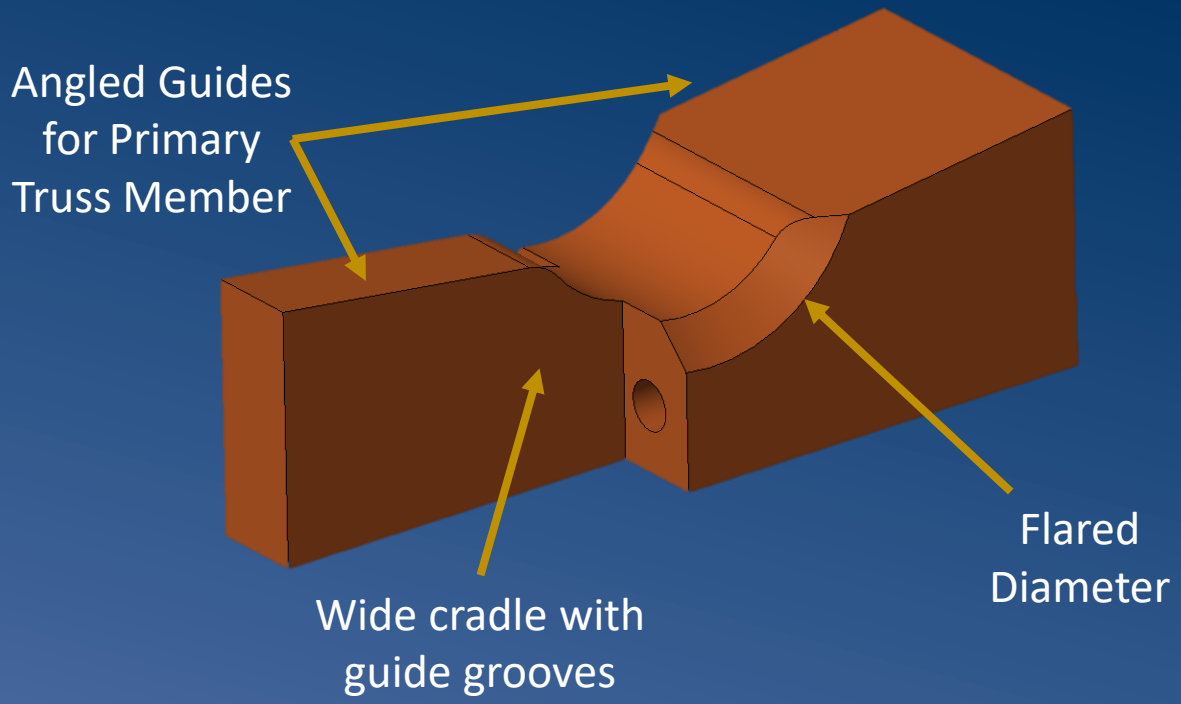


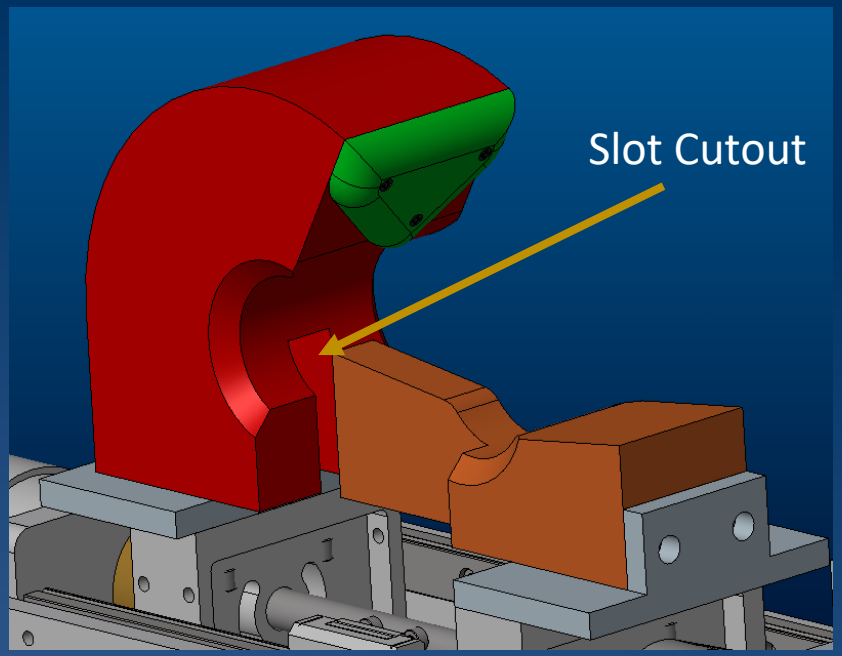
Movement Idea #2 Animation

Click to Play Animation

Gripper for Jigging End Effector

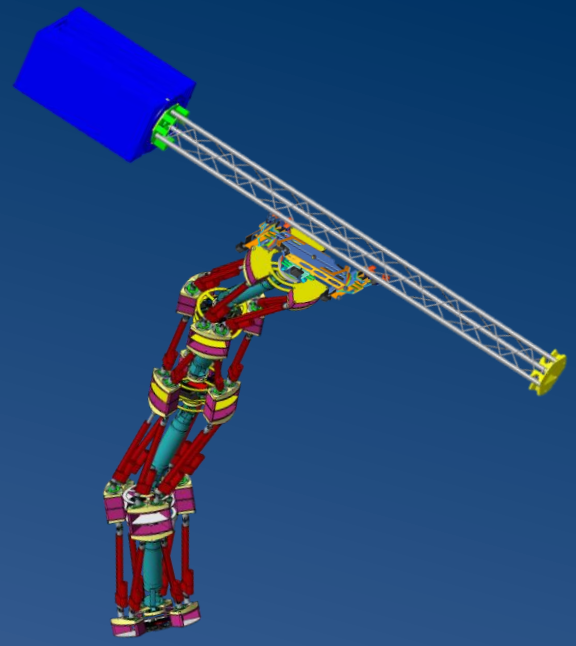
- Lowered height eliminates need for side guide grooves
- Wider stationary gripper allows for more stable cradle





Takeaways

- In-Space Assembly and Robotics
- Learned a lot about Creo and conceptual design
- First time teleworking
  - M&E Standups
  - Sprint Reviews
- Future Plans
  - Classes at Georgia Tech
  - Career in robotics



Acknowledgements

- Thank You
  - Jim Neilan
  - Matthew Mahlin
  - John Mulvaney
  - Iok Wong
  - John Cooper
- Intern Coordinators
- Fall Interns
- NASA & USRA