Mission Overview

- Mission Overview
- Theory and Concepts
- Concept of Operations
- Expected Results
Mission Overview

• **Goal statement:** The University of Nebraska - Lincoln looks to further develop and streamline the mechanism for a deployable boom and solar panel system started by NASA Langley Research Center.

• To verify success of the system video and sensor readings of the mechanical systems will be taken during deployment and retraction of the boom.

• To date, there is no easily integrated, functioning retractable boom system for suborbital platform experiments. The development of this mechanism will change such research capabilities by increasing the safety and ease of recovery of delicate hardware that needs to be deployed.
Mission Overview

• Multidiscipline Engineering Collaboration
  – NASA Langley Research Center
    • Research Basics and Mentorship
  – University of Nebraska–Lincoln Aerospace Club:
    • Experiment Operations/Structure/Subsystems
    • Data Acquisition
    • Power Distribution
    • Flight Operations
    • Structure
Mission Overview

- Program Objectives
  - Successfully deploy and retract a boom system in microgravity environment.
  - Successfully deploy and retract solar panel simulators.
  - Take measurements of stress and strain on the system as well as the acceleration of various points.

Mission Success: Fully deploy and retract booms and solar panel simulators with video and sensor data taken and stored.
Deployable and Retractable Booms

• Applications:
  – Suborbital and small satellite missions that need to get away from vehicle for data collection.
  • We are told that there are currently no “good” mechanisms for this application.
  – Increased hardware safety
    • Retractable booms would increase the safety of the hardware for re-entry and if any emergency should happen during flight
  – Ease of docking
    • A deployable and retractable arm would ease the docking process allowing experiments that need to get away from the launch vehicle while running.
Deployable Solar Panels

- Solar Panels can be on board power systems.
- A compact launch configuration that is able to transform into a fully functional panel would be of interest to many avenues of research.
- Current panels deploy so slowly some look like they are barely moving.
- There is no good way to refold a solar panel once it has been deployed.
Data Acquisition

- For verification of the mechanism, data acquisition is essential so there is feedback on the engineering design.
- Stress concentrations and accelerations on various parts of the system need to be monitored.
1. All systems powered
2. Power to actuator, systems deploy, collect data
3. Continue data collection/begin retracting systems
4. Finish retraction, power off actuators
Expected Results

- Full deployment of arm before deployment of sub payload.
- Full deployment of sub payload.
- Collect and store sensor and video data.
- Full retraction of sub payload.
- Full retraction of arm with sub payload.
Design Overview
Mechanical Design - Payload Layout
Mechanical Design - Payload Layout
Mechanical Design - Payload Layout
Mechanical Design - Arm

• Arm
  – Linkages unfolding
• Telescoping
  – Extension
• Scissor
  – Scissor Lift
• Track Based
  – Unfolding track and deploy payload
Mechanical Design - Sub Payload

- Snap Bracelet
  - Rolling mechanism
- Scissor Lift
  - Linkage Extension
- Pizza Fan
  - Fan out panels
- Tree (Langley)
  - Stem and leaf
- Folded
  - Accordion/Jacob’s ladder
Electrical Design: Primary System

Orchestrates both subsystems, takes camera and sensor data.

- Tell subsystem 1 to extend
- Get interrupt from subsystem 1 - full extension
- Tell subsystem 2 to deploy
- Get interrupt from subsystem 2 - full deployment
- Tell subsystem 2 to retract
- Get interrupt from subsystem 2 - full retraction
- Tell subsystem 1 to retract
- Get interrupt from subsystem 1 - full retraction
Electrical Design: Sub-System 1

Responsible for Arm extension/retraction

• Turned on by primary system
• Extends sub-system 2 out of payload
• Reports when fully extended
• Takes strain gauge data
• Primary system tells it to retract
• Retracts sub-system 2 into payload
• Reports when fully retracted
Electrical Design: Sub-System 2

Responsible for solar panel extension/retraction
- Primary system tells it to deploy
- Deploys solar panels
- Takes strain gauge data
- Retracts solar panels
- Repeat Deploy/Retraction if possible
- Tells primary system it is fully retracted
Electrical Design: Software Overview

- Written in C/C++
- Points of Emphasis
  - Collection and storage of sensor data
    - ADC’s for strain gauges
  - Taking a successful video
  - Communication between systems
    - Non-custom protocol
      - Most likely SPI
  - Successful Extension/Retraction (servos, actuators)
    - PWM
User’s Guide Compliance

- No weight estimates yet
- Will fit in payload space
- **Deployables**
- Not using provided ADC lines
- Asynchronous: retrieve data from payload
- Parallel: provide status information
- CG will be accounted for
- High voltage: Using 28V provided. Most likely not, depending on mechanism.
User’s Guide Compliance

• Hazardous procedures:
  – No anticipated hazardous materials/chemicals
  – Deployable boom

• No RF transmissions

• Bolt heads will be flush mount

• Team is all U.S. citizens and residents
Organization Chart

Faculty Advisor: Karen Stelling

NASA Mentorship: Matthew Mahlin & Justin Green

Team Leads: Chris Volle & Taylor Kerl

Mechanical
- Charlie Sullivan
- Jordan McElligott
- Nathan Villiard
- Joe Schenk

Electrical
- Derek Stapleton
- Michael Fay
- Amy Price
- Thomas Lassek
- Kevin Svobda

Systems
- Taylor Kerl
- Chris Volle
- Charlie Sullivan
- Derek Stapleton
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<th>Month</th>
<th>Event</th>
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# Team Contact Matrix

University of Nebraska - Lincoln

## Fall 2015 RS-X Contact Matrix

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<tr>
<th>Role</th>
<th>Name</th>
<th>Day Phone</th>
<th>Cell Phone</th>
<th>Receive Texts?</th>
<th>Email</th>
<th>Citizenship</th>
<th>OK to Add to Mailing List?</th>
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<tbody>
<tr>
<td>Faculty Mentor</td>
<td>Karen Stelling</td>
<td>(402) 472-5253</td>
<td></td>
<td>No</td>
<td>Karen Stelling <a href="mailto:kstelling2@unl.edu">kstelling2@unl.edu</a></td>
<td>YES</td>
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<tr>
<td>Research Sponsor</td>
<td>Matthew Mahlin</td>
<td>(402) 419-1806</td>
<td></td>
<td>Yes</td>
<td><a href="mailto:mattmahlin@gmail.com">mattmahlin@gmail.com</a></td>
<td>Yes</td>
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<tr>
<td>Team Lead</td>
<td>Taylor Kerl</td>
<td>(952) 465-8449</td>
<td>***</td>
<td>Yes</td>
<td><a href="mailto:tkerl@huskers.unl.edu">tkerl@huskers.unl.edu</a></td>
<td>Yes</td>
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<tr>
<td>Team Lead</td>
<td>Christopher Volle</td>
<td>(217) 412-8187</td>
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<td>Yes</td>
<td><a href="mailto:volle593@gmail.com">volle593@gmail.com</a></td>
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<tr>
<td>Mechanical Lead</td>
<td>Jordan McElligott</td>
<td>(308) 380-8086</td>
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<td>Yes</td>
<td><a href="mailto:jlmcessligott@gmail.com">jlmcessligott@gmail.com</a></td>
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<tr>
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<tr>
<td>Electrical Lead</td>
<td>Derek Stapleton</td>
<td>(308) 380-1043</td>
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<td>Yes</td>
<td><a href="mailto:derek.stapleton42@gmail.com">derek.stapleton42@gmail.com</a></td>
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<tr>
<td>Mech Member</td>
<td>Amy Price</td>
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<td><a href="mailto:amyjo_95@hotmail.com">amyjo_95@hotmail.com</a></td>
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<td>Mech Mentor</td>
<td>Charlie Sullivan</td>
<td>(913) 908-9272</td>
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