TEAM: 21Spr01-GA

Due Date: Friday, November 5, 2021 at 11:59pm

Provide several pics of the current state of your completed system thus far here:

Figure 1: Base plate with installed Y-axis rail brackets and inner bearing

Figure 2: Bottom view of base plate showing inner bearing

Figure 3: Detail view of inner bearing resting on outer bearing

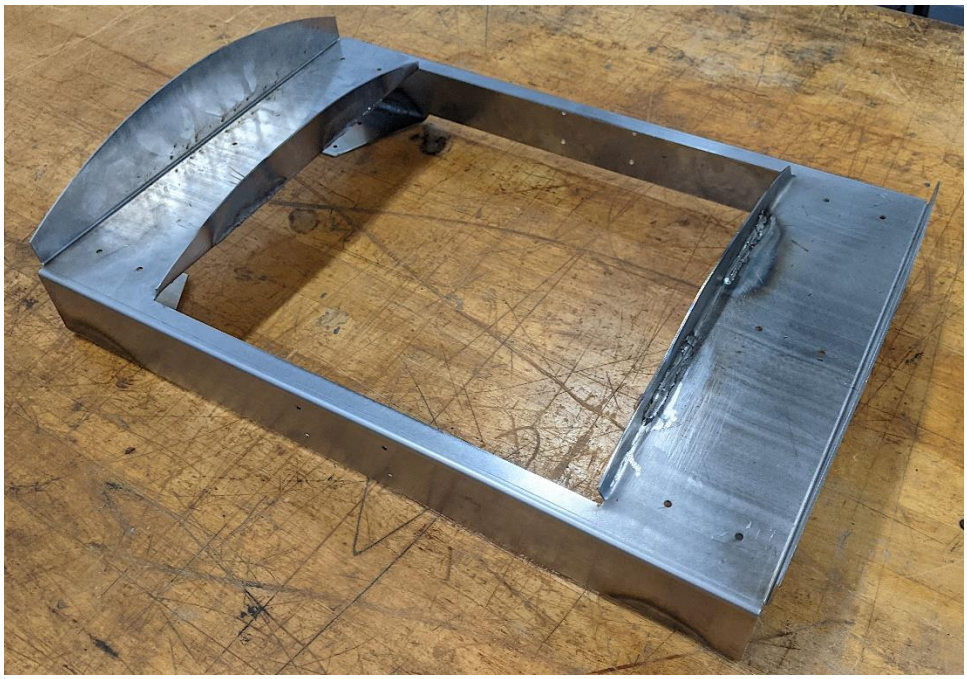


Figure 4: Z-axis carriage with stitch cuts reinforced by weld beads

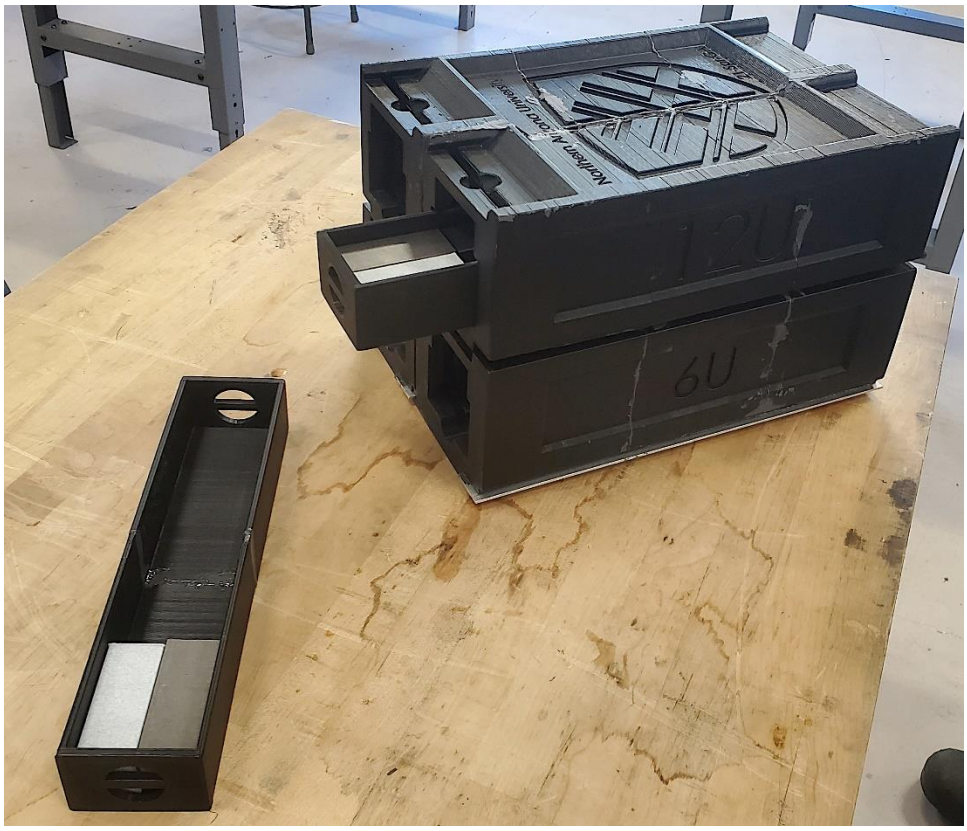


Figure 5: 3D printed test satellite in 12U configuration with weight drawers

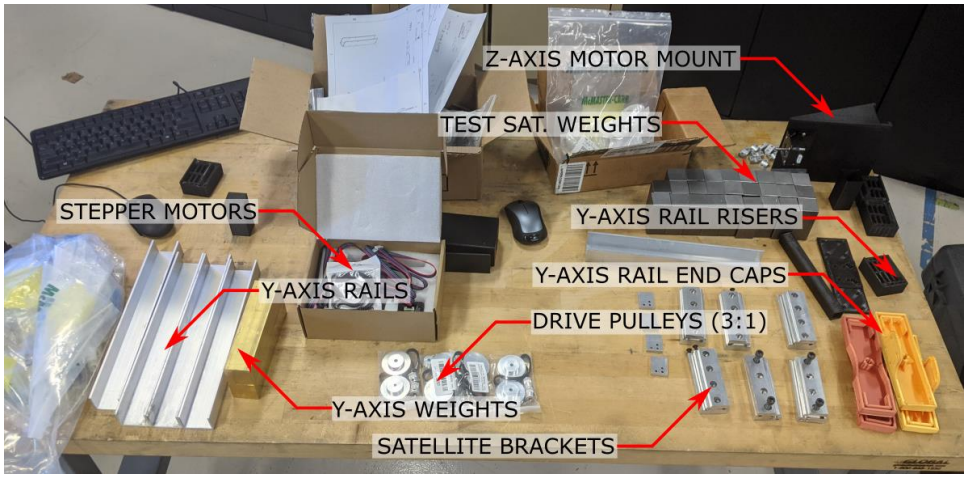


Figure 6: Parts which are completed or nearing completion to be installed soon

Figure 7: System with Z Carriage and Y Axis Rails Subsystems Installed

Figure 8: Side View of System with Subsystems Installed

Figure 9: Side View to Show Y Axis Rails Subsystem

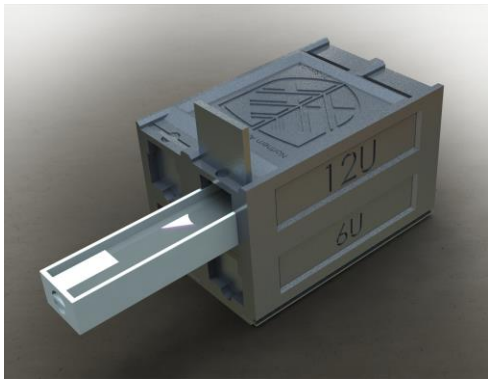
	Name/Description	Parts	Category	Quantity	Price
1	Male and female pin connectors	Motor Control	Motor Assembly	1	$15.16
2	Junction boxes	Motor Control	Motor Assembly	1	$8.72
3	Toggle switch	Motor Control	Motor Assembly	1	$10.91
4	Pulley assembly	Stepper motor drivetrain	Motor Assembly	4	$61.09
5	Stepper motor bracket	Stepper motor drivetrain	Motor Assembly	1	$16.36
6	12V power supply	Motor Control	Motor Assembly	1	$21.82
7	distribution board	Motor Control	Motor Assembly	2	$18.54
8	Terminal block kit	Motor Control	Motor Assembly	1	$13.53
9	Stepper motor driver	Motor Control	Motor Assembly	1	$10.14
10	Stepper motors	Stepper motor drivetrain	Motor Assembly	1	$42.56
11	Lead screws	Stepper motor drivetrain	Control Assembly	2	$26.18
12	Snap ring kit	Stepper motor drivetrain	Motor Assembly	1	$11.84
13	pulley belts	Stepper motor drivetrain	Motor Assembly	2	$24.23
14	3D print filament	Replica Satellite	Manufacturing	2	$45.98
15	Lead Screws	Stepper motor drivetrain	Control Assembly	4	$17.40
16	Linear bearing sleeve	Stepper motor drivetrain	Control Assembly	10	$9.10
17	Hex nuts	Lead screws	Control Assembly	4	$8.84
18	Linear bearing sleeve	Drive Train	Control Assembly	10	$9.60
19	linear bearing sleeve	Drive Train	Control Assembly	10	$9.40
20	Aluminum	Lead screws Mounts	Manufacturing	3	$27.36
21	Retaining rings		Control Assembly	1	$11.02
22	retaining rings	Drive Train	Control Assembly	1	$8.71
23	Linear rods	Drive Train	Control Assembly	10	$55.30
24	Lead screw clamps	Drive Train	Control Assembly	4	$29.80
25	Aluminum		Manufacturing	1	$16.00
26	Retaining rings		Control Assembly	1	$9.50
27	Set Screws		Control Assembly	1	$9.38
28	Aluminum Plate	Base Plate	Manufacturing	1	$170.48
29	Aluminum bars	Lead screws	Manufacturing	2	$127.38
30	3D Filament	Replica Sate	Manufacturing	3	$68.97
31	3D Filament	Replica Sate	Manufacturing	2	$45.98
32	Steel stock	Weights in Replica sate	Manufacturing	2	$173.76
33	JB Weld	Replica Sate	Manufacturing	3	$43.17
34	Steel Disc	Outer bearing plate	Manufacturing	1	$54.92
35	Steel Sheet	Sate plate	Manufacturing	1	$97.24
36	Steel Rod	Brackets	Manufacturing	1	$13.00
37	Brass Stock	Vertical Weights	Manufacturing	2	$151.44
38	Aluminum C channel	Vertical Weights	Manufacturing	2	$74.20
39	Brass Stock		Manufacturing	1	$26.22
40	Aluminum plate	Replica Sate	Manufacturing	2	$19.72
41	Net	Safety system	Testing	1	$23.99
42	Aluminum	Replica air bearing	Manufacturing	1	$117.69
43	Z carriage			1	$71.44
44	Vertical Brackets			5	$79.20
45	setup			1	$81.60

Figure 10: Bill of Materials

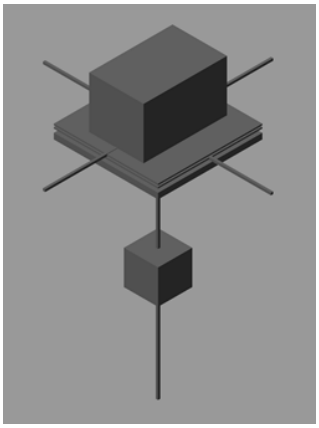
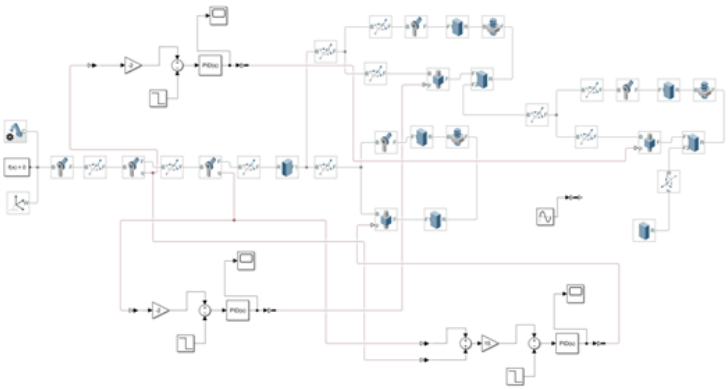
The following are the Action Items each person completed between Hardware Review 1 and Hardware Review 2:

Team Member: Travis Harrison

Action Item	Date Completed	Result/Proof of Completion
Machining and Manufacturing **Parts Completed** Angled Plates for Transfer Bearings x 3 Satellite Bracket Lower x 6 Satellite Bracket Upper x 6 Outer Bearing Plate Stand Assisting with Base Plate Assisting with Inner Bearing Bending and welds on Z Carriage Y Axis Weight x1 Aluminum Rails for CubeSat x6 Covers for C Channel Drawers x 4 Bottom Bracket x 20 Top Bracket x 18 Bearing Bracket x 6 Z Nut Bracket Main Z Nut Bracket Brass Holster	9/24 10/8 10/15 10/6 10/20 10/11 10/8 10/29 11/3 10/26 11/5 10/29 10/15 11/4 11/5 11/5	*[See figures 1-9]*
3D Printed Parts **Parts Completed** 3UL 3UM 3UR 6UL 6UM 6UR 12UL1 12UM1 12UR1 12UL2 12UM2 12UR2 C Channel Drawers x 8 Top Caps x 4 Bottom Caps x 4 X Motor Mount Spacers x 20+ Z Motor Riser Mounting Risers x 4	9/23 9/24 9/22 9/25 9/26 9/25 10/2 10/7 10/6 9/30 10/1 9/29 10/20 11/1 10/29 10/21 10/30 11/1 10/28	*[See figures 5,6]*

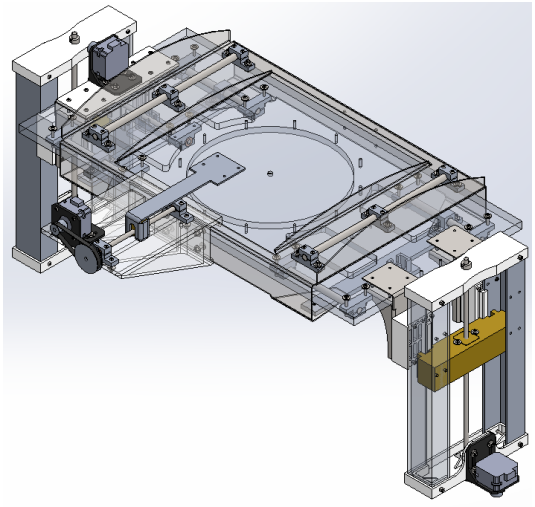
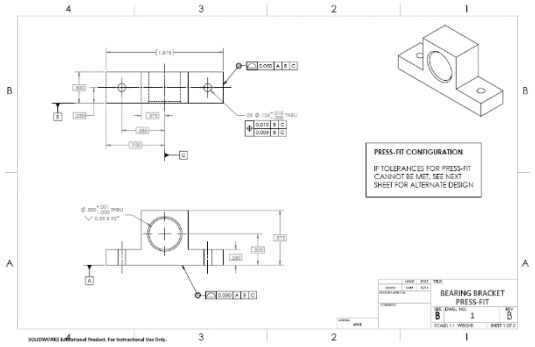
Various CAD for Replica CubeSat Assembly of system Submitting work orders x 4 Assisting machine shop staff for our work orders (particularly in writing gcode) Various redesigns of parts to make manufacturable and creating engineering drawings for parts	9/23 11/2 10/1 11/5 11/5	 *Replica CubeSat CAD*

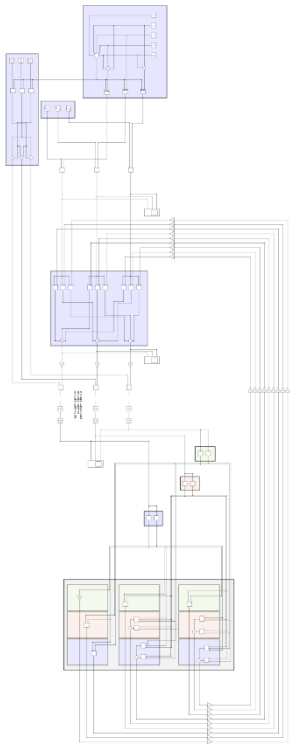
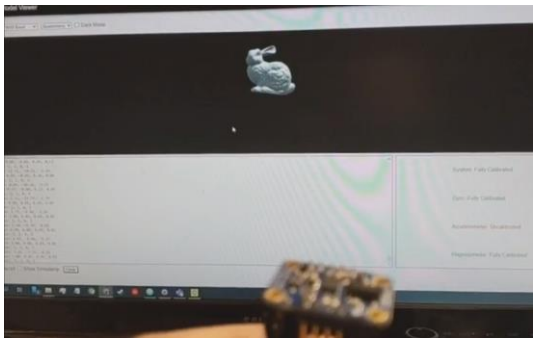
Team Member: Connor Hoffmann

Action Item	Date Completed	Result/Proof of Completion
Create Simulation for Balancing Fixture **Features** Self-balancing in z axis Self-balancing in x axis PID controls optimized for situation Visual representation of CubeSat Visual Representation of Fixture Vertical weight implementation Lead screws simulated IMU Simulated with Joints	10/27	 *Solid Model*  *Simulink Simulation Tree*
Assembled Fixture Subassemblies **Subassemblies** Vertical weight bracket Z-Carriage bracket Linear rod bracket Lead Screw Bracket	11/2	See Figure 9.
Website Updating **Updates** Optimized sections for mobile Updated documents Updated photo gallery Added new Photos Updated documents	11/5	https://www.ceias.nau.edu/capstone/projects/ME/2021/21Spr01_GA/
Manufacturing Parts **Parts** Replica CubeSat weights	10/20	See Figure 5.

Purchasing Parts **Parts** *See Bill of Materials	10/15	See Figure 10.

Team Member: Sean McGee

Action Item	Date Completed	Result/Proof of Completion
Design and refine SOLIDWORKS part models **Parts Completed — Iterations since HWR1** Base plate — 4 Linear rod, lead screw brackets — 2 Linear bearing brackets — 2 X-axis motor mount — 3 Y-axis rail brackets — 2 Y-axis rails — 3 Y-axis rail caps — 3 Y-axis rail risers — 2 Y-axis weights — 2 Y-axis weight threaded inserts — 2 Z-axis carriage — 2 Z-axis motor mount — 2 Z-axis lead screw nut bracket — 1	10/05 10/10 10/14 10/19 10/08 10/27 10/19 10/27 11/04 10/27 10/19 10/19 11/04	 *SOLIDWORKS assembly*
Create mechanical drawings for manufacturing **Part Drawings** Base plate Lead screw Linear bearing bracket Y-axis rail Linear rod, lead screw brackets Y-axis weights Y-axis weight inserts Z-axis carriage Z-axis lead screw nut bracket	10/05 11/05 10/14 10/27 10/10 11/04 10/27 10/08 11/05	 *Linear bearing bracket drawing*
Order components **Components — Vendor** Hardware — McMaster-Carr Z-axis carriage — OSH Cut Y-axis rail brackets — OSH Cut M3x0.5 tap — Amazon	10/22 10/08 10/08 10/29	 *McMaster-Carr order invoice*

Assist in design assembly **Tasks** Assemble test satellite Refine, install Y-axis subassm. Install Z-axis carriage	 10/25 11/02 11/02	*[See figures 1-9]*
Simulate fixture operation **Tasks** Rot. reference frame Simulink model Fixed reference frame Simulink model Motor control analysis	 10/14 10/25 10/27	 *Rot. Reference frame Simulink model*
Prep control system components **Tasks** Set up Raspberry Pi Soldering drivers, load cell amps, IMU Testing motors, drivers, IMU	 09/30 09/24 09/30	 *Testing IMU with provided code*

Team Member: Scott Mesoyedz

Action Item	Date Completed	Result/Proof of Completion
Machine and Manufacturing Components Tasks: Angled Plate for Transfer Bearing Aided x3 Satellite Bracket Lower Aided x6 Satellite Bracket Upper Aided x6 Replica CubeSat Weight x24 Covers for C Channel Drawers x4 Satellite Bracket Side x4 Y Axis Rails x4 Bottom Bracket Aided x13 Y Axis Weights Aided x1 Brass Weight Inserts x2 Covers for C Channel Drawers Aided x4	 9/24 10/8 10/15 10/15 10/20 10/22 10/26 10/28 11/3 11/3 11/5	*[See Figures 1-9]*
Assembled Fixture Subassembly Tasks: Mount Transfer Bearings to Angular Brackets Mount Spherical Bearing Attach Y Axis Rail Mounts Attach Y Axis Rails Attach Y Motor Mounts Attach Y Motors Attach X Axis Motor Mounts	 10/20 10/28 11/1 11/1 11/1 11/1 11/2	*[See Figures 7,8 and 9]*

The following are the Action Items for each team member between HR 2 and the Final Product presentation:

Team Member	Action Items	Date Due
Travis Harrison	1. Machining and Manufacturing Components 2. 3D Printing Parts 3. Various Additional Contributions	1. 9/24-11/5 2. 9/23-11/1 3. 9/32-11/5
Connor Hoffmann	1. Create Simulation for Balancing Fixture 2. Assembled Fixture Subassemblies 3. Website Updating 4. Manufacturing Parts 5. Purchasing Parts	1. 10/27 2. 11/2 3. 11/5 4. 10/20 5. 10/15
Sean McGee	1. Design and refine SOLIDWORKS part models 2. Create mechanical drawings for manufacturing 3. Order components 4. Assist in design assembly 5. Simulate fixture operation 6. Prep control system components	1. 10/05–11/04 2. 10/05–11/05 3. 10/08–10/29 4. 10/25–11/02 5. 10/14–10/27 6. 09/24–09/30
Scott Mesoyedz	1. Machining and Manufacturing Components 2. Assembled Fixture Subassemblies	1. 9/24-11/5 2. 10/20-11/2