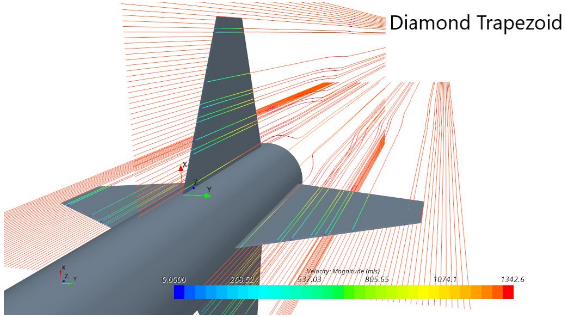
Supersonic Flow Around Rocket Fins at a High Altitude

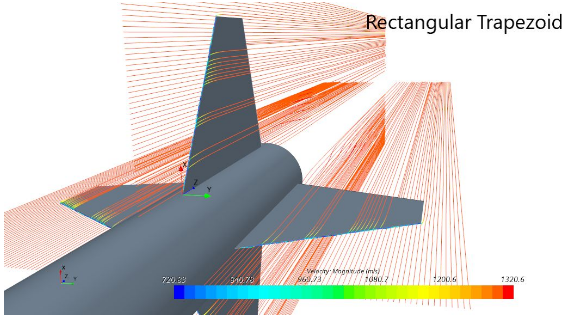
ME 548: STAR-CCM+ Final Project

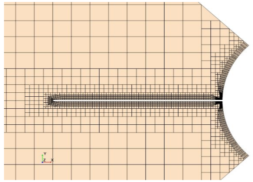
Catie Spivey

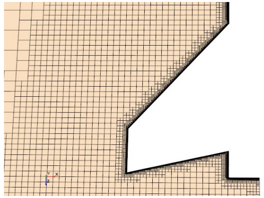
18 March 2021, Updated 13 April 2021

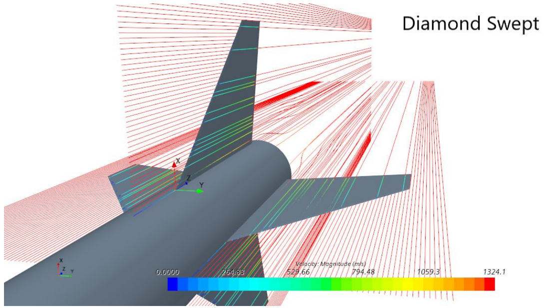
Property	Value
Static Temperature	219.59 K
Density	0.059612 kg/m^3
Dynamic Viscosity	1.4376 x 10^{-5} Pa-s
Absolute Pressure	3741 Pa
Thermal Conductivity	0.02003895 W/m-K
Speed of Sound	300 m/s
Mach number	4.33
Velocity	1300 m/s

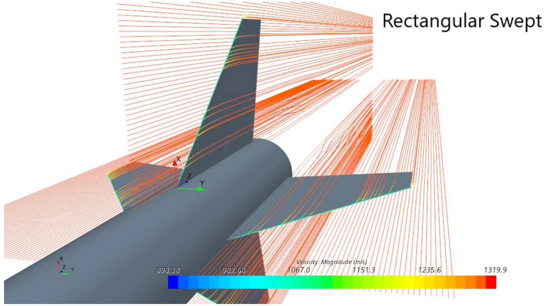


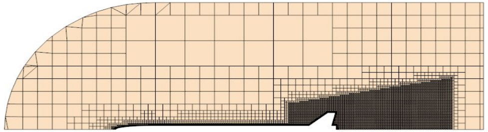


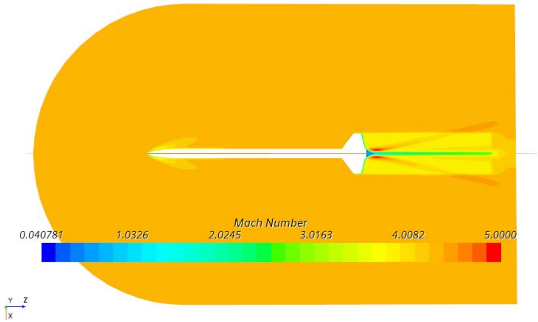


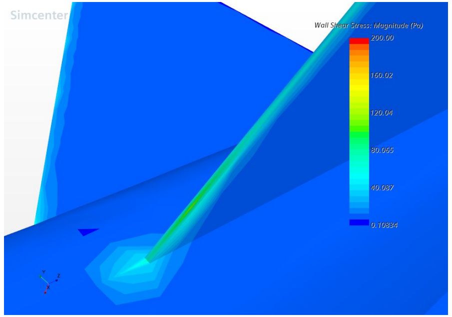








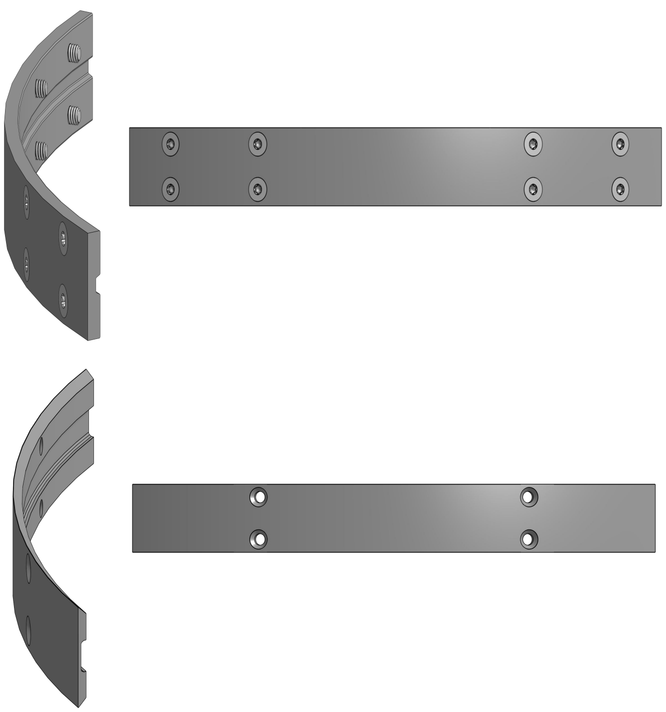




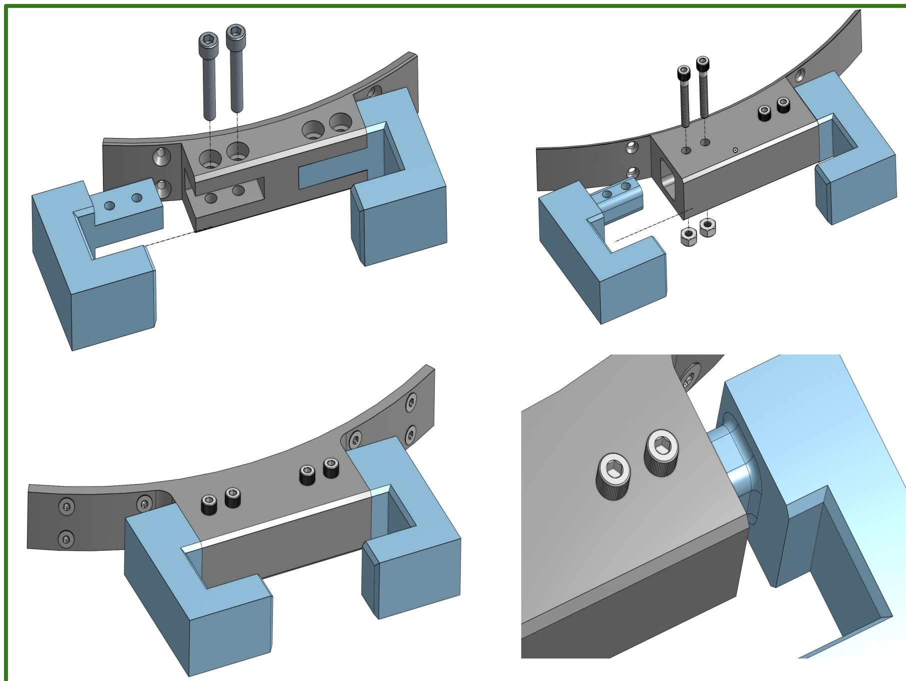
	FD (N)	P (psi)
RT	274.67	31
DT	45.89	5.8
RS	132.74	13.8
DS	93.05	6.05

Portland State Aerospace Society Launch Vehicle 4 Airframe Components CAD

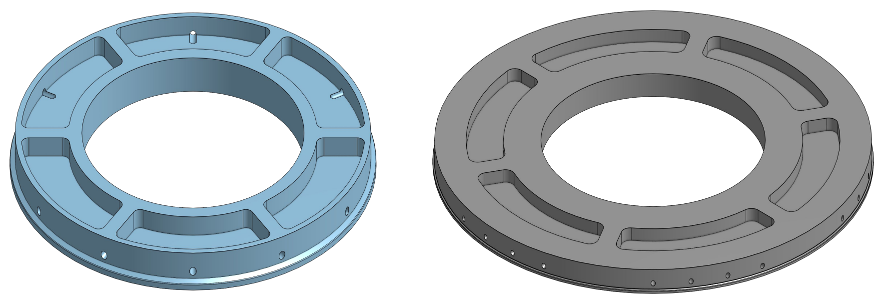
TOP: V1 coupling ring with arc clamp holes on top and bulkhead holes in the middle to allow for attachment of bulkheads. MIDDLE: V2 coupling ring with additional fastener holes added. BOTTOM: V3 coupling ring with unused fastener holes removed and arrow added for assembly alignment and placement of arc clamps.



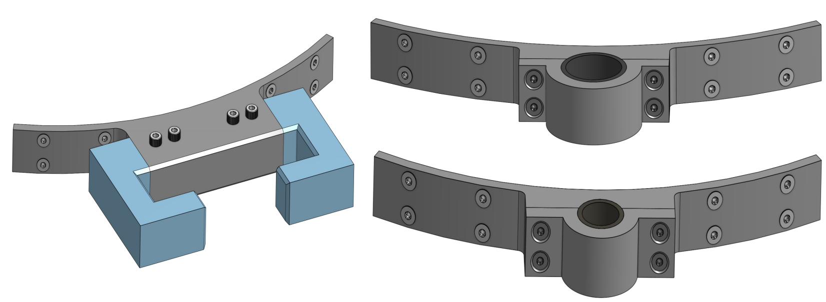
TOP: V1 standard arc clamps with holes to attach to the coupling rings. BOTTOM: V3 arc clamps with additional fastener holes, modified slot dimensions, and fasteners added.



TOP LEFT: Previous launch lug assembly built into an arc clamp with removable brackets shown in blue held in place with socket head fasteners. TOP RIGHT: V1 Launch Lugs assembly with removable brackets now inserted into a slot. BOTTOM LEFT: V3 Launch Lugs assembly with four more fasteners added. BOTTOM RIGHT: Close-up view of fillet added for V3 launch lug

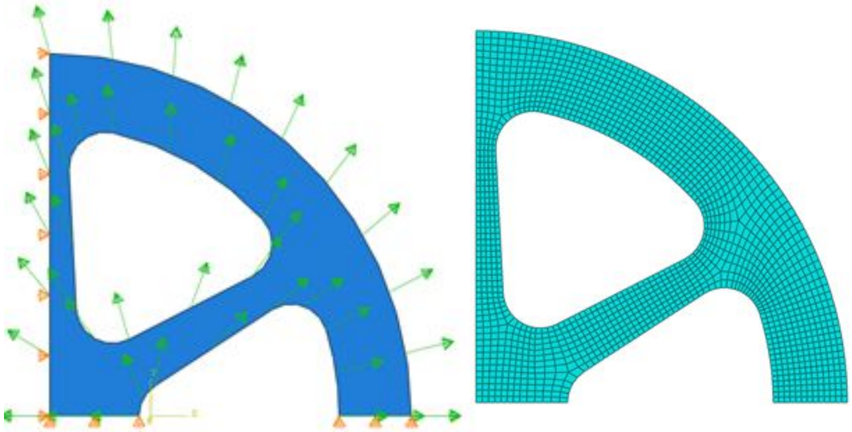


LEFT: LV3.1 thrust plate. RIGHT: LV4 thrust plate with extruded outer walls and fastener hole pattern matching that of a coupling ring.

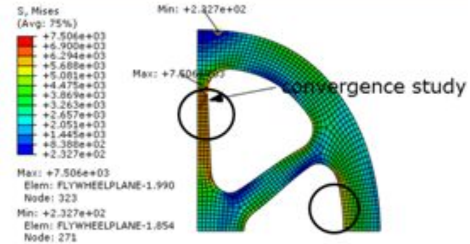


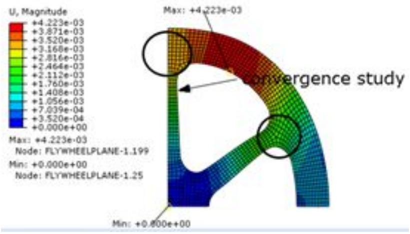
LEFT: Current Launch Lug assembly. RIGHT TOP: ¾ inch racepipe clamp. RIGHT BOTTOM: ½ inch racepipe clamp.

Abaqus FEA class final exam

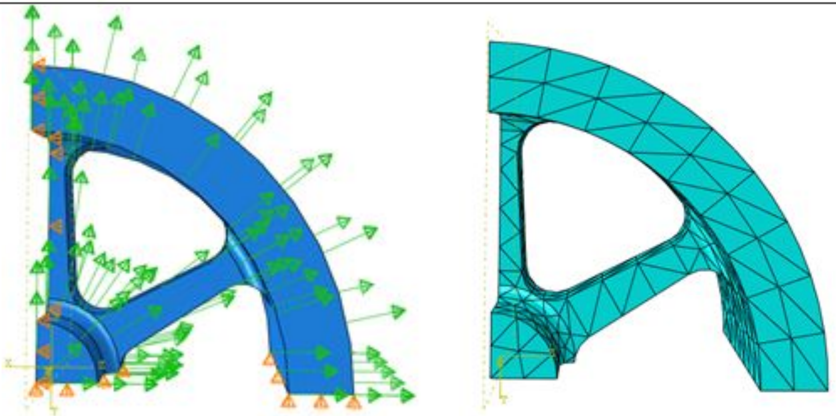


Plane stress section applied with thickness = 10. Symmetry BCs applied to left (U1 restrained) and bottom (U2 restrained) edges; rotational speed of 523.61 rad/s applied from (0,0,0) to (0,0,1). 4-node quad plane stress element assigned, maximum of 1686 elements used.

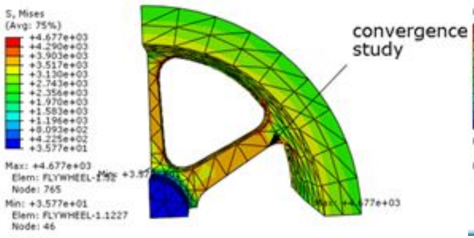


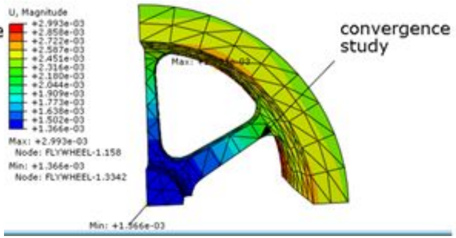


The location of the convergence study and critical locations (circled) of r = 7.63 are shown in the image above at 1037 elements. The part does not converge given the maximum allowed elements, so 1686 elements will be used as the maximum.



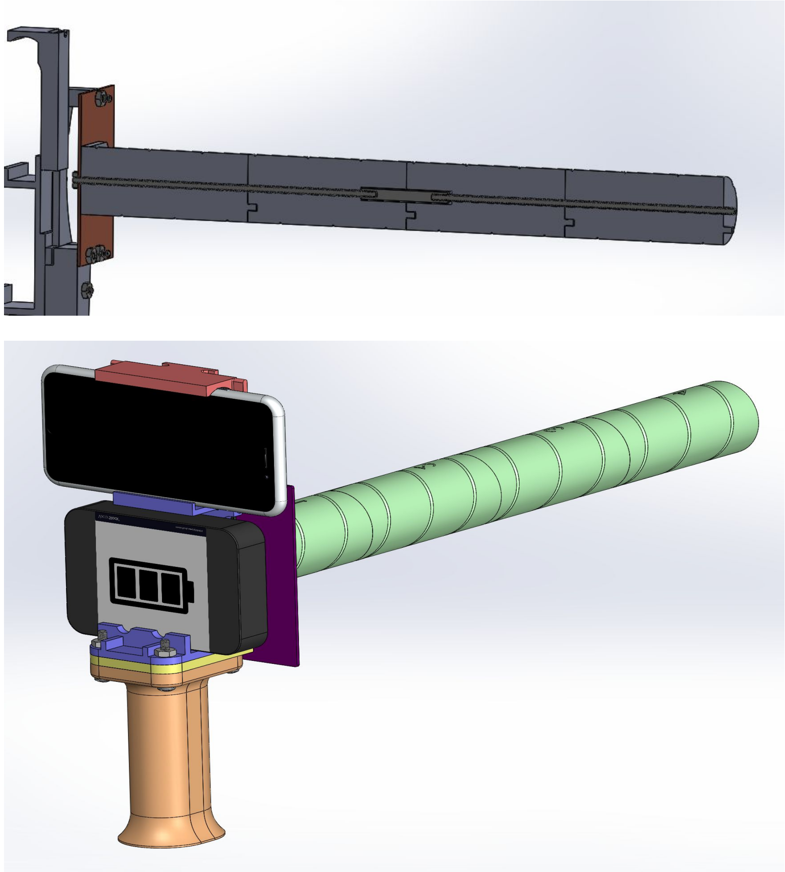
Solid section applied, NO plane/stress thickness selected. Symmetry BCs applied to left (U1 restrained) and bottom (U3 restrained) edges; rotational speed of 338.67 rad/s applied from (0,0,0) to (0,1,0). 10-node tet element assigned, maximum of 1867 elements used.



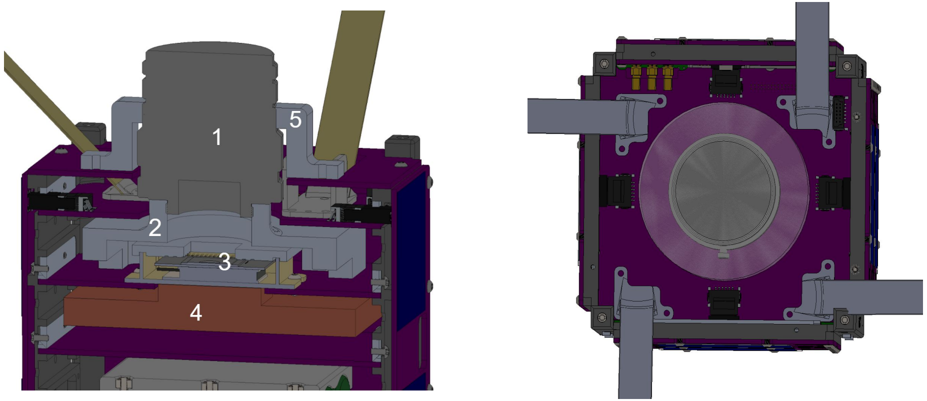


The location of the convergence study is shown in the image below at 1867 elements. The part converges before 1142 elements and thus this is taken to be a reasonable approximation.

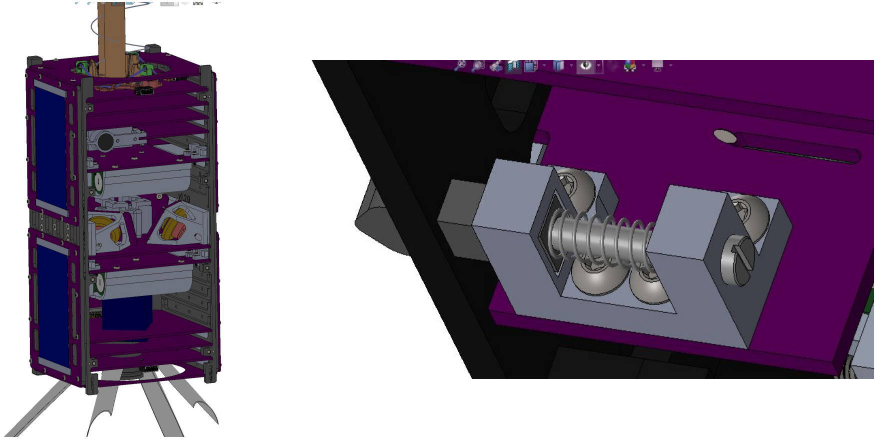
OreSat CAD



Handheld Ground Station. TOP: Cutaway.
BOTTOM: Full view



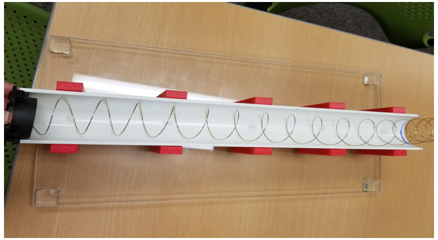
Cirrus Flux Camera Assembly and turnstile antennas

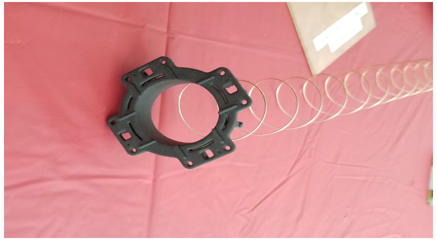


LEFT: OreSat full assembly. RIGHT: Inhibit switch

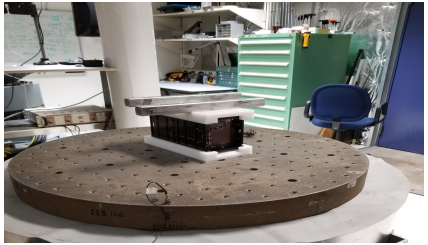
Some of my work on OreSat: Oregon's First Satellite

Left: Original Handheld Ground Station prototype created by previous team. Right: my modified Handheld Ground Station, eliminated the need for glue and improved parts for 3D printing and assembly.



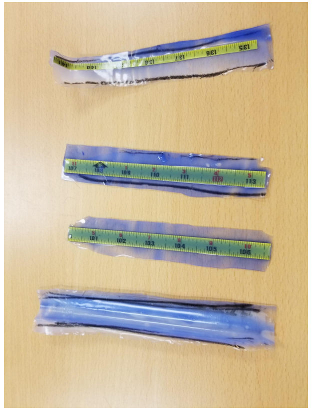


Left: I designed and assembled a PVC pipe and 3D printed helical antenna holder for use in the vacuum chamber. Right: testing the helical antenna deployment with a deployer I helped design.



Left: testing OreSat on the vibration table. Right: I worked with the machinist to refine the design of the frames for better manufacturability and reduced cost.

Left: I used the milling machine to make the base plate of the OreSat assembly jig that I designed, pictured Right fully assembled.



Left: vacuum bagging the deployable fiberglass antenna prototypes. Right: silicone, tape measure, and fiberglass combinations of deployable antenna prototypes.

Presenting OreSat structure and CAD at an Open House

Holding OreSat0 flight hardware

Speaking about my experiences at a Dean-Sponsored fundraiser

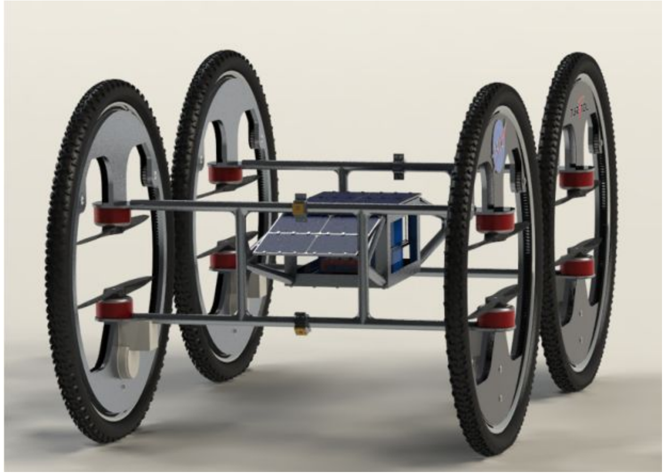
Presenting OreSat structure and CAD at TearDown 2019

NASA Academy Autonomous Vehicle Calculations and CAD

Property	description
bw	wheel width
dw	wheel diameter
M	rover mass
Ww	wheel loading
po	tire contact pressure*
v	velocity
Ph	housekeeping power
e	motor-gearbox-drivetain efficiency

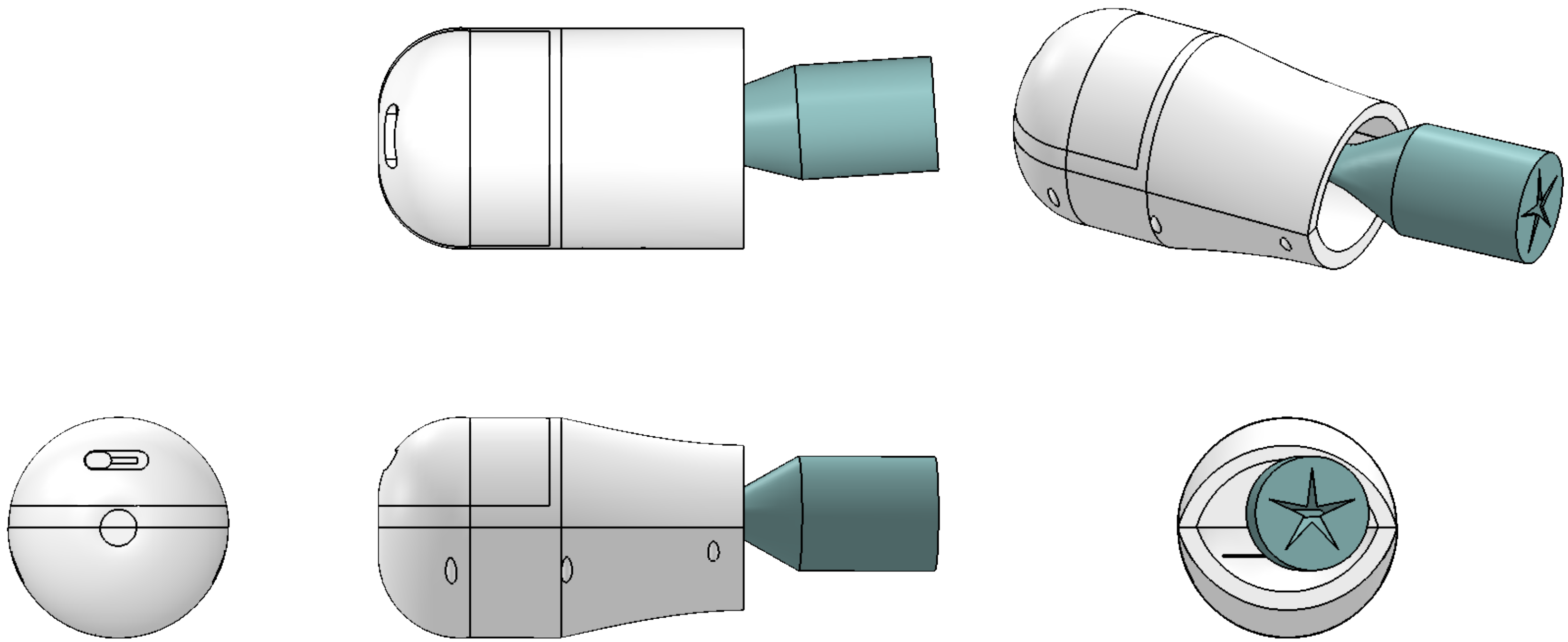
Property	description
m	moisture content
n	exponent of sinkage
kc	cohesive modulus of soil deformation
kf	frictional modulus of soil deformation
c	cohesion of soil
K	coefficient of slip
f	angle of internal friction
k	soil deformation modulus for tire

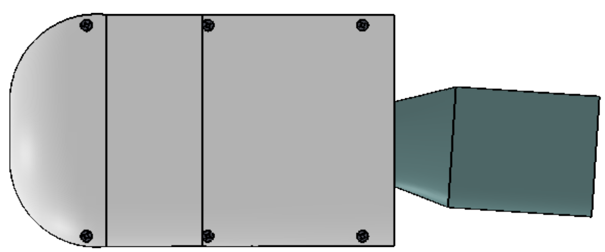
Bekker's Terramechanics: How much power and torque do we need to provide to the wheels to drive over a specific terrain? What size slope can we drive over in this terrain?



3D printed electronics mount and housing

REV.	TREMOR STABILIZING DEVICE	3/10/2018

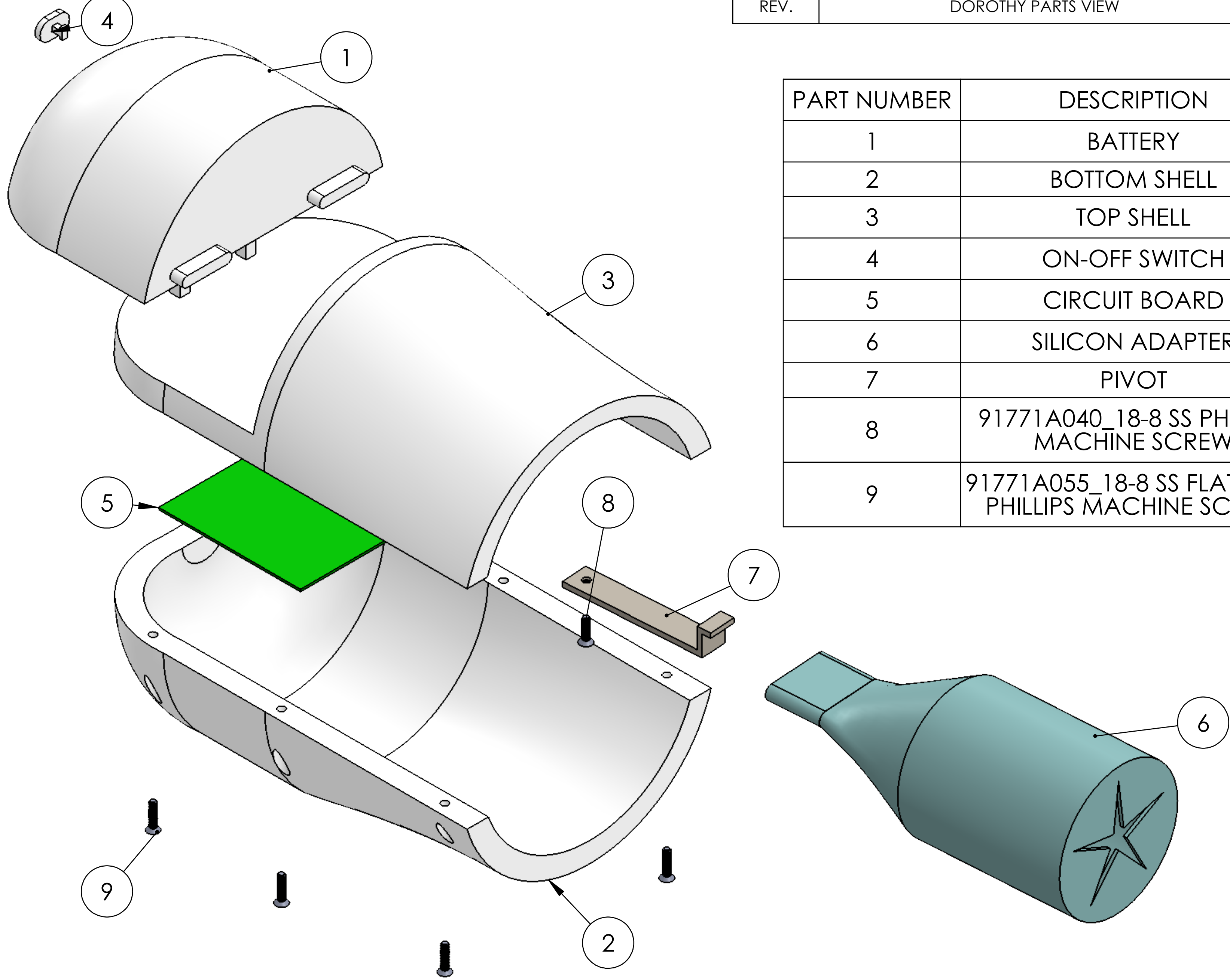




PROJECT DOROTHY:
HAND TREMOR STABILIZING DEVICE.
SILICON ADAPTOR HOLDS OBJECTS UP TO
ONE INCH DIAMETER.
IDEAL FOR MAKEUP APPLICATION

DRAWN BY CATIE SPIVEY	3/13/2018	INSTUCTOR SCHEIBLE	UNITS INCHES ANGLE ±1° XX ±.01 XXX ±.005 HOLES Ø ±.005	INTERPRET GEOMETRIC TOLERANCING PER ASME Y14.5M-2009	PROJECT DOROTHY	DWG. NO. DOROTHY DETAIL	REV -
PORTLAND COMMUNITY COLLEGE, ENGR-105				SCALE 1:2	SHEET 1 OF 10	DESCRIPTION DOROTHY ASSEMBLY VIEWS	

REV.	DOROTHY PARTS VIEW	3/11/2018



PART NUMBER	DESCRIPTION	QTY.
1	BATTERY	1
2	BOTTOM SHELL	1
3	TOP SHELL	1
4	ON-OFF SWITCH	1
5	CIRCUIT BOARD	1
6	SILICON ADAPTER	1
7	PIVOT	1
8	91771A040_18-8 SS PHILLIPS MACHINE SCREW	1
9	91771A055_18-8 SS FLATHEAD PHILLIPS MACHINE SCREW	6

DRAWN BY CATIE SPIVEY	3/13/2018	INSTUCTOR SCHEIBLE	UNITS INCHES ANGLE ±1° XX ±.01 XXX ±.005 HOLES Ø ±.005	INTERPRET GEOMETRIC TOLERANCING PER ASME Y14.5M-2009	PROJECT DOROTHY
PORTLAND COMMUNITY COLLEGE, ENGR-105				SCALE 1:1	SHEET 2 OF 10

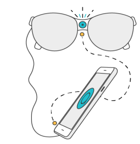
DWG. NO. DOROTHY DETAIL 2	REV -
DESCRIPTION DOROTHY PARTS VIEW	

Smart Glasses for the Blind and Visually Impaired

Catie Spivey Introduction to Product Design ITPD-S19-SPIVEYcatie-FN

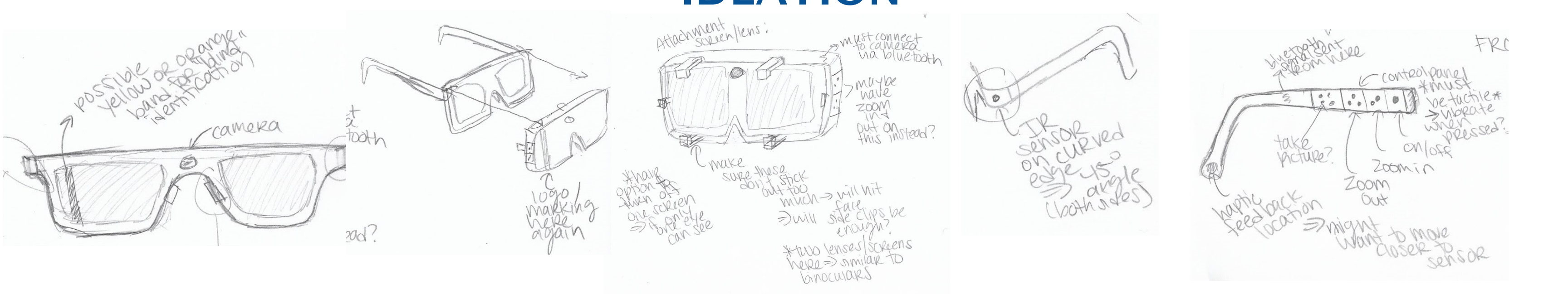
RESEARCH





Various “Smart Glasses” technologies exist on the market today, using integrated or attached cameras to record and use live images in different ways. A popular company called Aira uses Smart Glasses to connect with a trained assistant that then uses the camera to guide the visually impaired or blind user, allowing them more freedom in their daily lives, but they still must rely on another person.

IDEATION

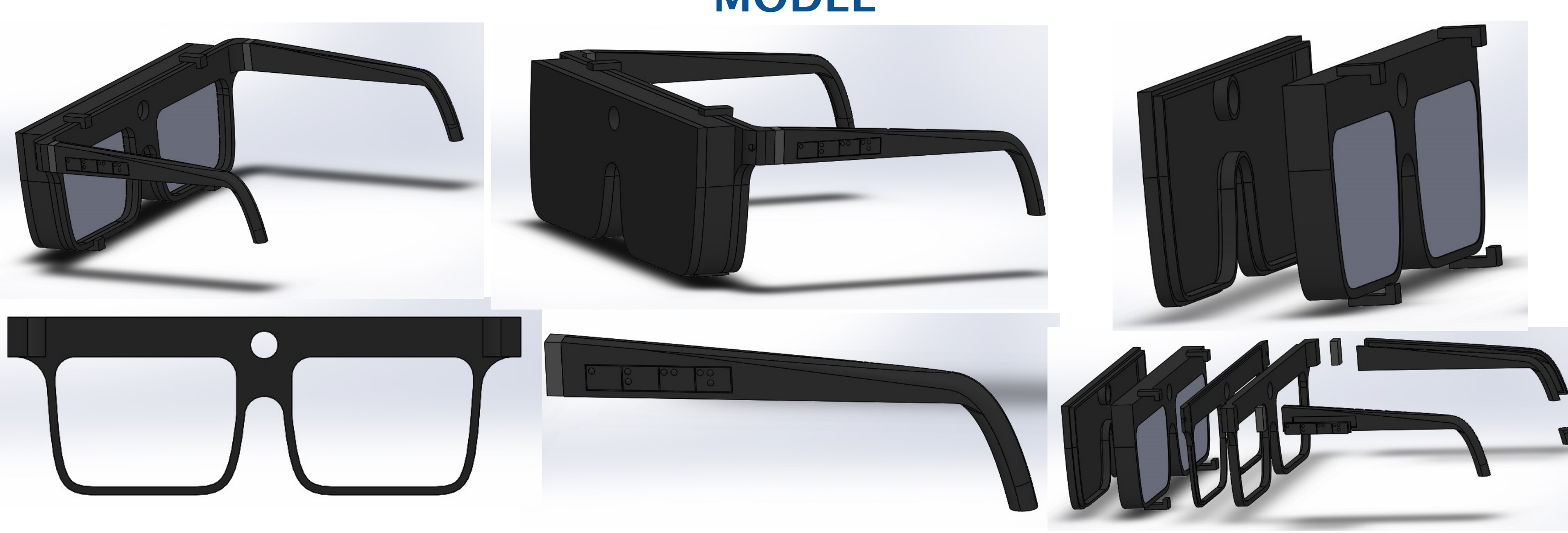


This prototype of Smart Glasses integrates the various existing smart glasses technologies with the current image recognition software into one set of glasses with an optional attachment. The glasses would include a camera between the lenses and connect to a smart phone via Bluetooth, while also including infrared obstacle detection technology to alert the user via haptic feedback of any approaching obstacles. The optional attachment would allow for visually impaired users to zoom/in out of images seen by camera.

MOCKUP

The mockups were made using clay and thin cardboard. The clay allowed for the creation of a more natural shape, as with the glasses lenses and arms, while the cereal box cardboard showed modular design and functionality.

MODEL



The design is modular to allow for 3D printing with a snap fit of the pieces, as well as insertion of electrical components. Future designs would need to account for tolerancing of various 3D printers and include nose pads, charging ports, and real clips on the attachment piece as well as real hinges. The hinges are based on existing hinges that allow for wires to pass through unharmed. The control panel on the arm includes four touch-sensitive buttons labeled with the braille letters “A” through “D”, following standard Braille conventions. The buttons allow for zooming in, out, capturing and image, and turning device on/off.