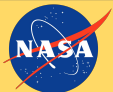


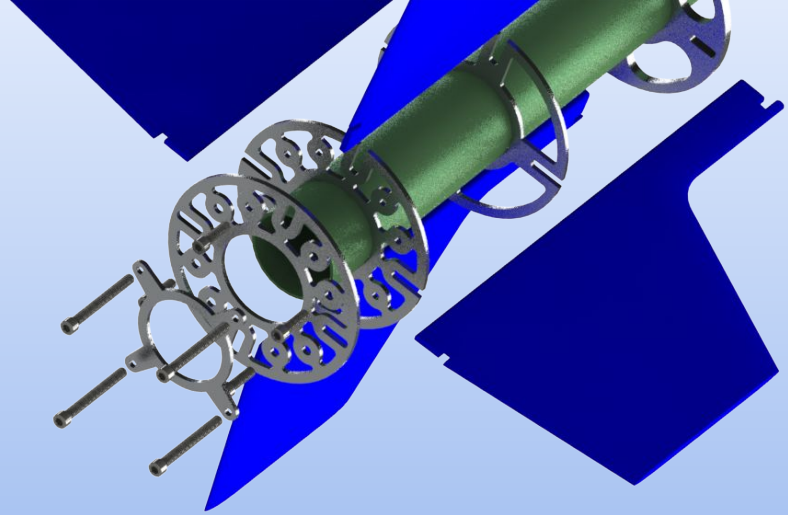
NASA Student Launch 2018 - 2019
Critical Design Review -- Presentation
January 22, 2019



UC SANTA CRUZ

Key Design Features

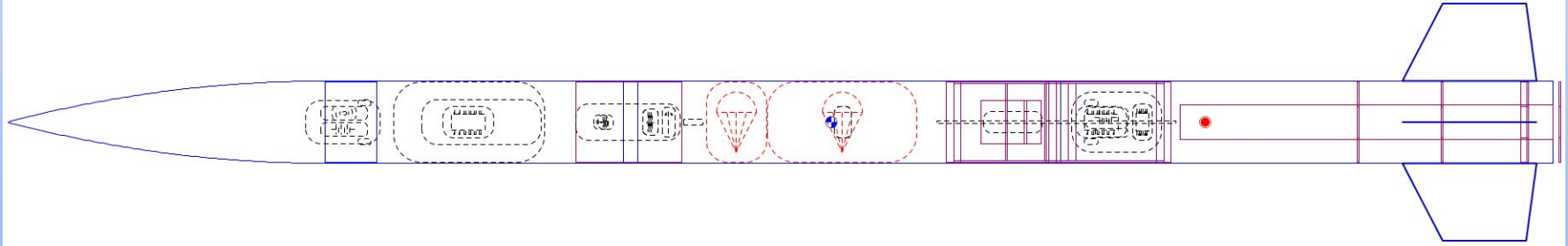
- Carbon Fiber Airframe
 - Rolled in house
- Removable Fins
 - As Built CP adjustment
- ADAS (ADaptive Aerobraking System)
 - Adaptive deployment of drag fins
 - Guides vehicle to predetermined altitude via apogee reduction from drag
- Rover Payload
 - Compact rover
 - Object detection system
 - Actuated Landing Correction



Vehicle Dimensions

Rocket
Length 104 in, max. diameter 5.52 in
Mass with no motors 17.7 lb

Stability: 4.54 cal
• CG 55.235 in
• CP 80.305 in
at M=0.30



Apogee: N/A
Max. velocity: N/A
Max. acceleration: N/A

Height: 104in

Weight: 17.7lbs (no motor)

Diameter: 5.46in

CG: 62.99in from nose

Motor Choice and Vehicle Characteristics

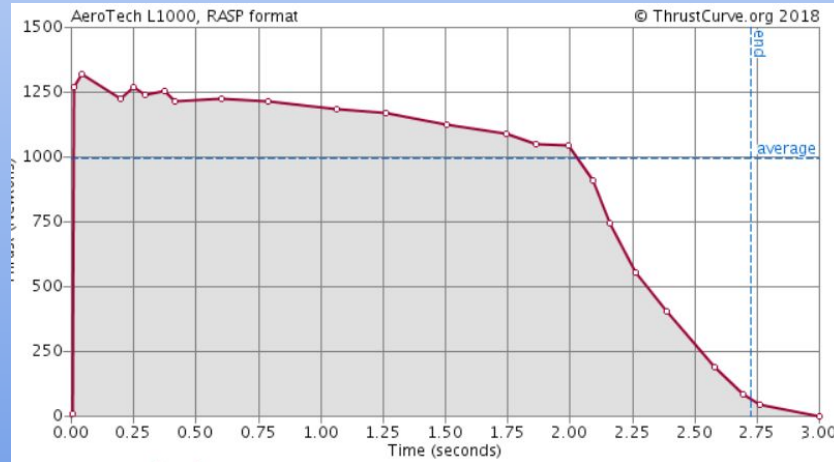
Length (inches)	Diameter (inches)		Mass (lbs)	Final Motor Selection	Recovery System (inches)		Predicted Altitude (feet)	Vehicle Material	CG (in, nose)	CP (in, nose)
	Outer	Inner			Drogue	Main				
104	5.46	5.36	17.7	L1000	18	60	5280	Carbon Fiber	62.99	80.3 05

Motor Choice: AeroTech L1000

Motor Weight: 4.84lbs

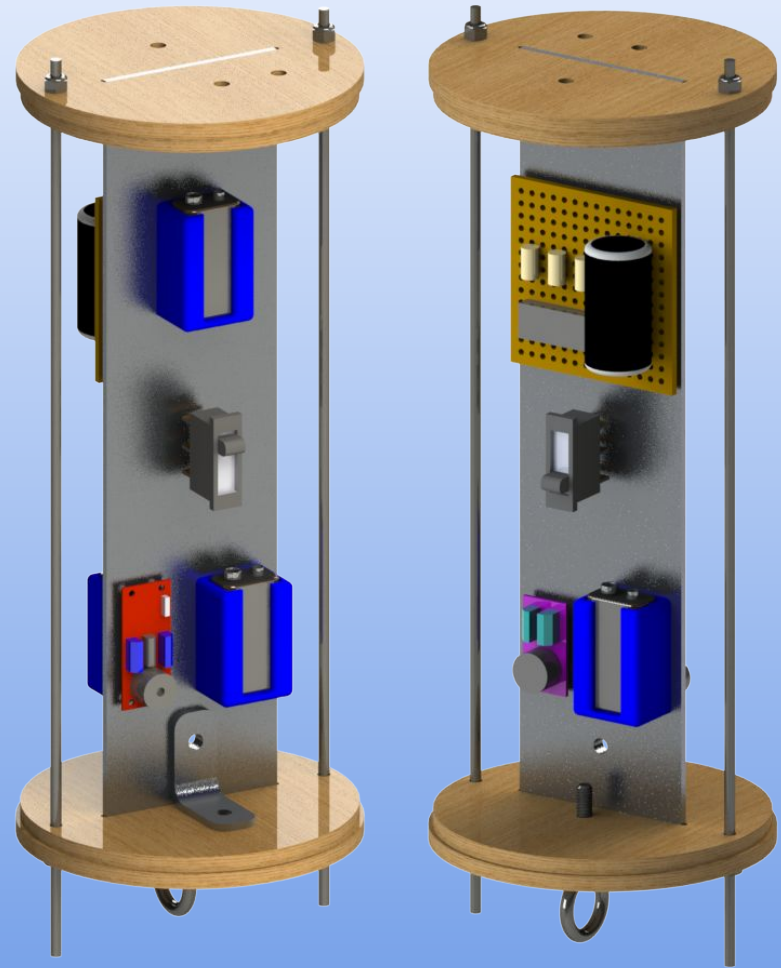
Rail Exit Velocity: 80.1ft/s

Thrust to Weight: 12.8



Recovery Details

- Two stage deployment system
- Drogue 18"
- Main 60"
- StratoLoggerCF altimeter
- EasyMini altimeter
- Jolly Logic Chute Release
- Eggfinder RX and TX



Kinetic Energy and Drift

$$KE = \frac{1}{2} mv^2 = 88.19 \text{ Joules}$$

mass = 5.154kg

Landing velocity = 5.85m/s

Wind Velocity (in mph)	Drift Radius by Hand (ft)	Drift Radius by OpenRocket (ft)	Percent Difference
0	0	0	-
5	159	129	23%
10	380	295	29%
15	566	485	17%
20	767	683	12%

Landing Kinetic Energy will be below the 100J KE requirement

Predicted Drift radius will satisfy the maximum 2,500 foot drift requirement

Testing

Each component of the rocket will be tested thoroughly to ensure performance meets team and NASA standards:

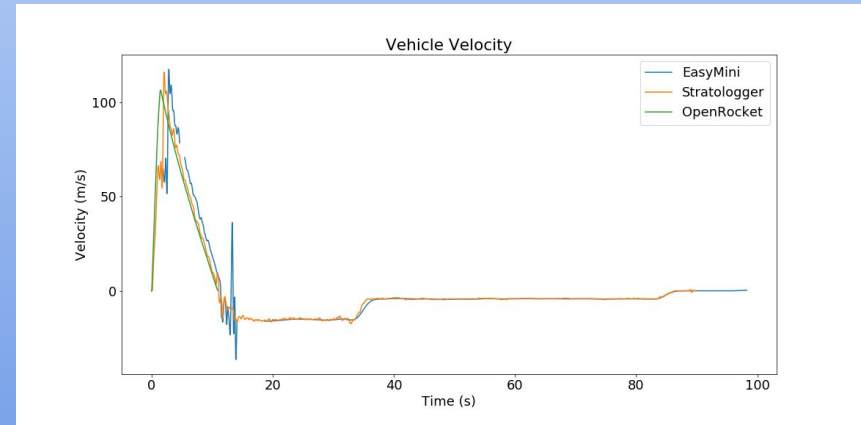
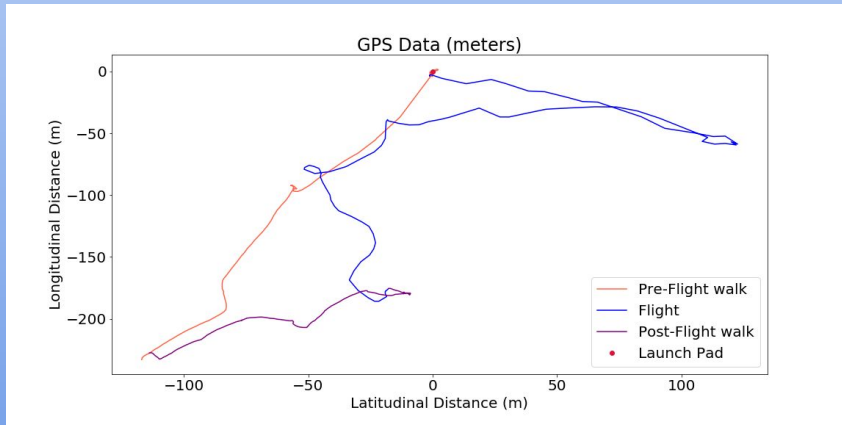
- Software tests for ADAS and Payload: unit and integration tests for deployment, performance, and sensors
- Ground tests for Payload separation
- Airframe stress tests to ensure structural integrity
- Make sure sensors are functioning correctly in recovery module
- Visual inspections of batteries and sensitive electronics to check for potential hazards

Subscale Flight

Take Me Home Specifications: OD=3.15" weight=4.75kg length=85.5" Aerotech J420 motor

Lack of sufficient pressure holes in recovery bay led to noisy/unreasonable data gathered by the internal altimeters (will attempt to fix in future flights)

Data that was physically sound agreed very well with our predictions

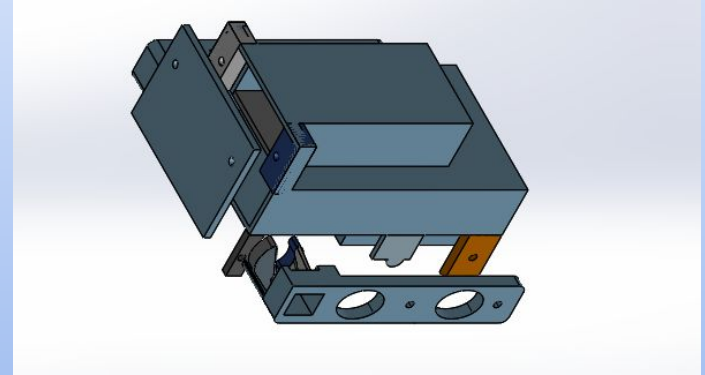


Subscale Flight

Device	EasyMini-v1.0	version 1.6.8	serial 3318
Flight	4		
Maximum height	609.2 m	1999 ft	
Maximum speed	91.7 m/s	301 fps	Mach 0.3
Maximum boost acceleration	54.9 m/s ²	180 ft/s ²	5.60 G
Average boost acceleration	11.5 m/s ²	38 ft/s ²	1.18 G
Ascent time	3.2 s boost	9.5 s coast	
Drogue descent rate	11.0 m/s	36 ft/s	
Main descent rate	4.3 m/s	14 ft/s	
Descent time	33.7 s drogue	36.1 s main	
Flight time	82.5 s		

Payload: Design Overview

- Systems:
 - Soil Collection (Bulldozer design)
 - Drive
 - ODAS (Object Detection and Avoidance)
 - ALC (Actuated Landing Correction)
- Dimensions
 - Depth: 4.33 inches
 - Width: 2.35 inches
 - Length: 2.6 inches
 - Weight: 15 oz
 - Material: PLA

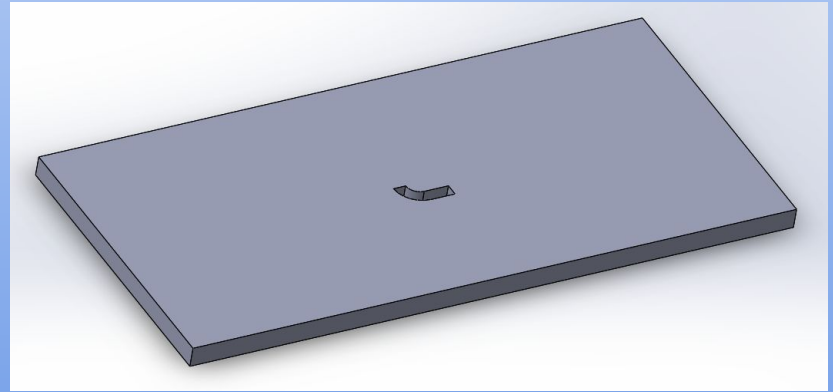
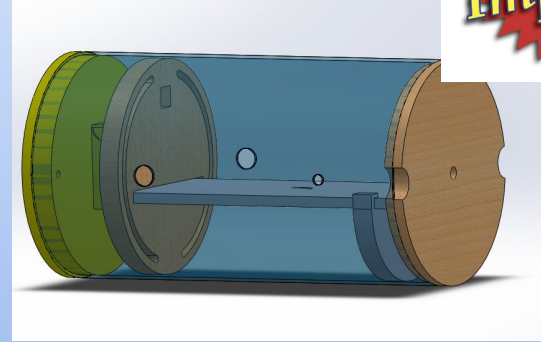


Rover chassis design

Payload: Integration with Vehicle

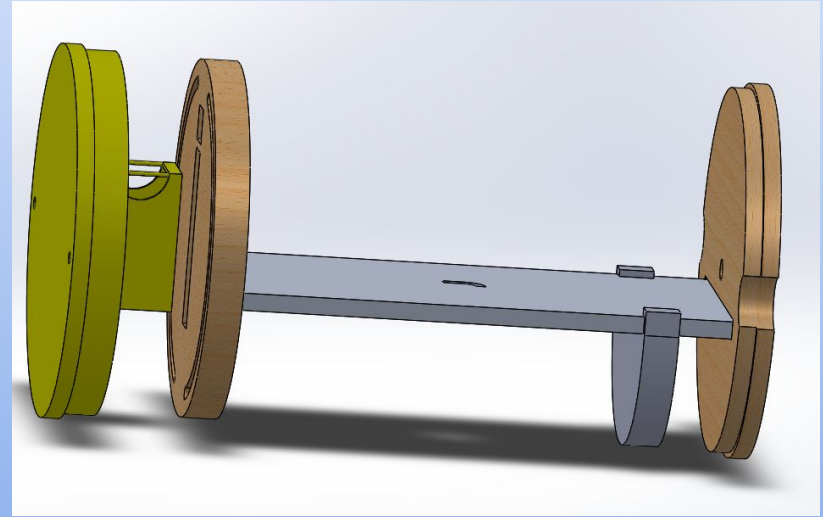
New!
Improved!

- In-Flight Securement
- Shear Pins
- Safety Tether
- Key + lock design



Payload: Deployment

- Black powder charge
- Reverse kill switch
- Actuated Landing Correction (ALC)



Payload: In Action

ODAS

- Computer vision
- Ultrasonic sensor

Drive System

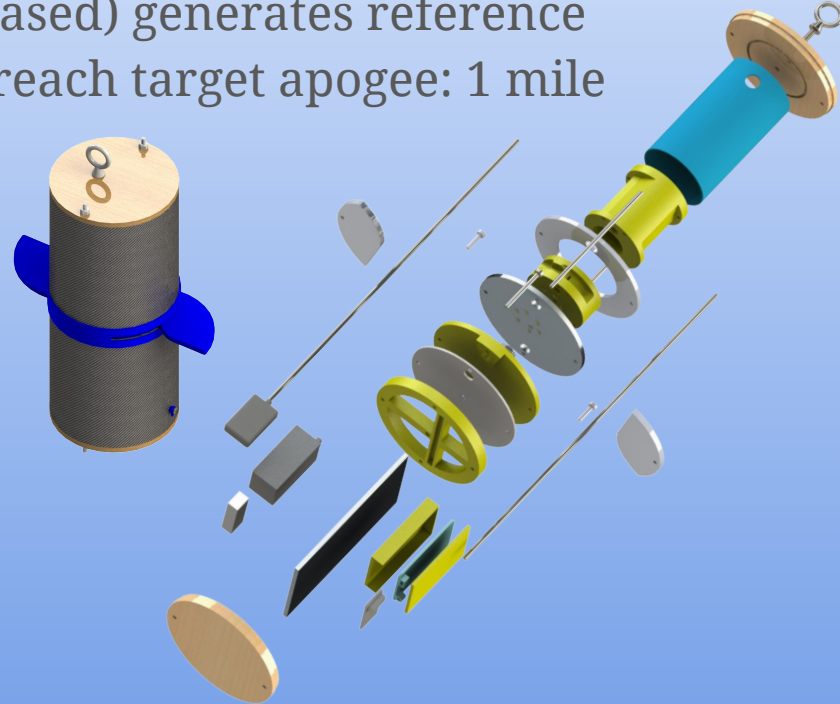
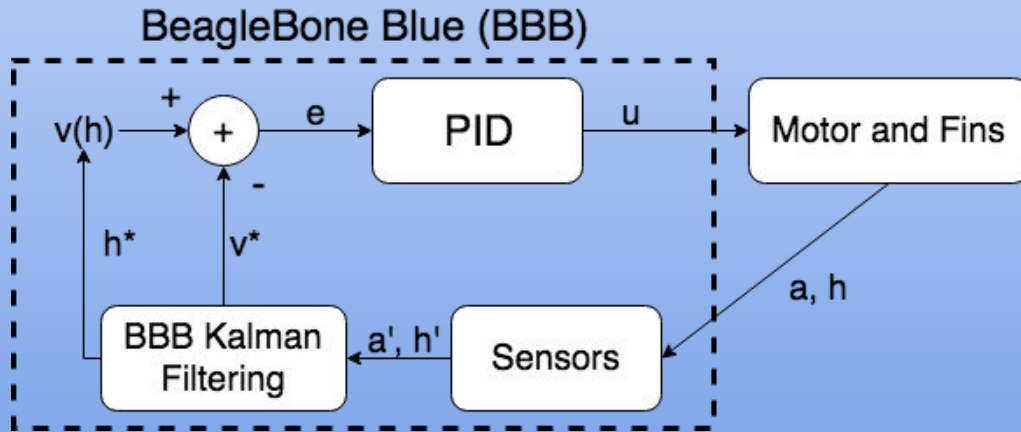
- Treads
- Custom 3D printed Chassis

Soil Collection

- Bulldozer design

Adaptive Aerobraking System (ADAS)

Homemade simulation (1D Euler method-based) generates reference trajectory for control of fin deployment to reach target apogee: 1 mile



Requirements Verification

- 78 Incomplete: 48.75%
- 24 In Progress: 15%
- 58 Complete: 36.25%

