

# Duke University AERO Perseus

## 2025 IREC 30k-SRAD-Solid Competition

# 400

### Duke AERO

- Began in 2017
- ~ 40 active members
- Major Projects in 24-25:
  - Liquid & Solid Prop.
  - Canards
  - Airbrakes
  - Vibration-Sensing Fins
  - Computer Vision Payload
  - Guided Recovery



Fig. 1 Team Photo at SAC 2024

### Perseus Overview

- First AERO vehicle in the 30k-SRAD category
- Payload ejected @ apogee; uses CV to dodge obstacles
- Third year flying variable-drag airbrakes system
- Second year flying FINSight & SRAD solid motor
- First year flying roll-stabilizing canards system

### SRAD Solid Motor



Fig. 2 SHF O-Class Motor

- APCP formulation "CP-7" with stepped BATES grains
- Hybrid graphite nozzle and aluminum carrier; RTV-sealed

Designations	O-Class, Kn = 220
Burn Time	8.44 s
Total Impulse	~ 35,000 Ns

### Airframe

- 135" long & 6" internal diameter
- 120 lbs wet weight; 50.7 lbs dry weight
- 6061 aluminum internal structures; fiberglass tubes
- Forged carbon airbrake petals & canard fins
- G10 fiberglass-core fins; carbon fiber tip-to-tip & epoxy fillets
- All structural components manufactured in-house

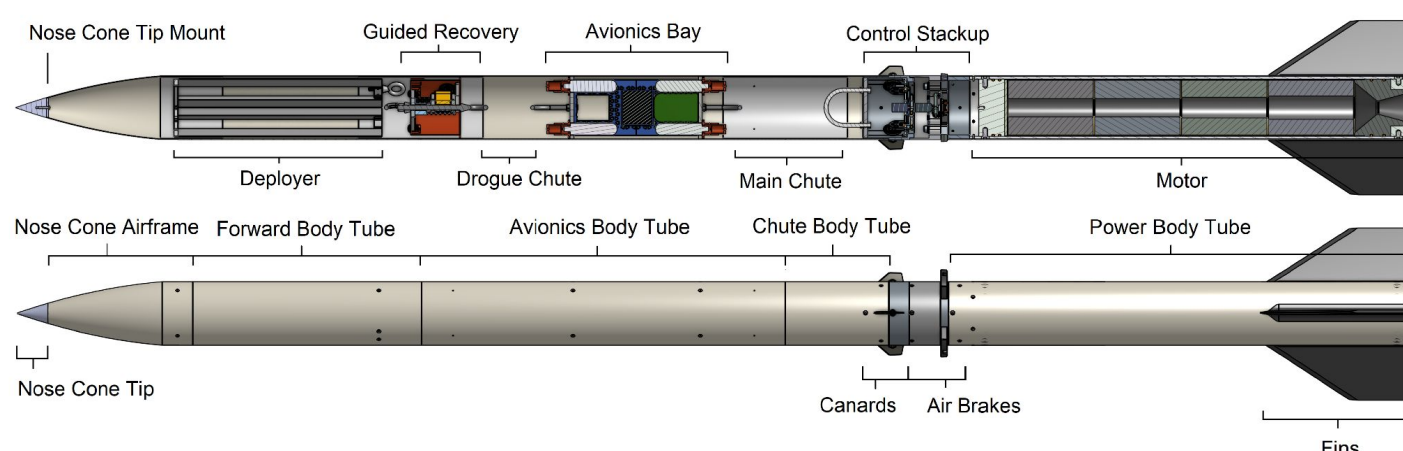


Fig. 3 Perseus CAD, internal & external views

### Roll-Stabilizing Canards

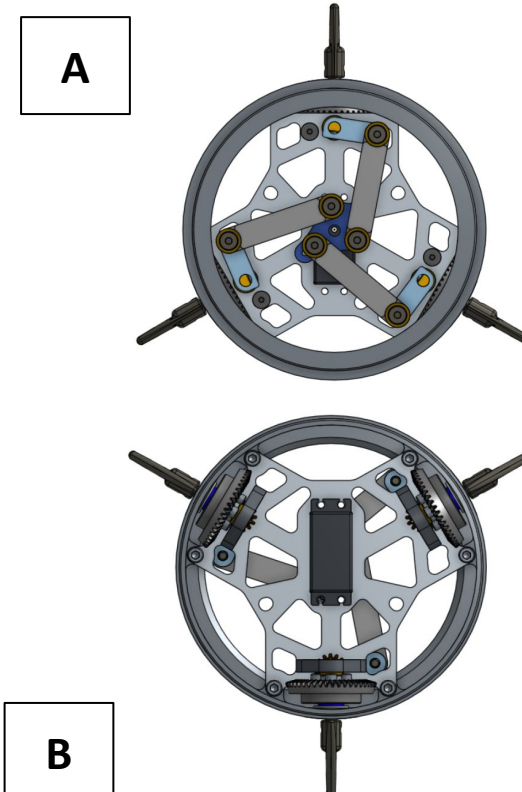


Fig. 4a Bevelled Gear Interface  
Fig. 4b 4-Bar Linkage Interface

- 4-bar linkage + bevel gear system
- Varies AoA to counteract roll
- Pivot forward CoP by design
- Location informed by CFD
- PI-controlled

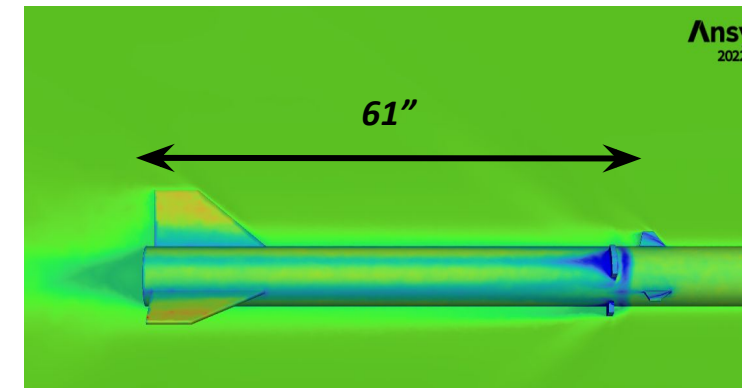


Fig. 5 Dynamic Pressure Contour on Perseus

### FINSight Version 2

- 8 accelerometers per fin
- Sense vibrations to inform fin design
- Follows 23-24 strain gauge fins
- Accels placement determined by modal simulations
- Wires along external airframe into measurement module

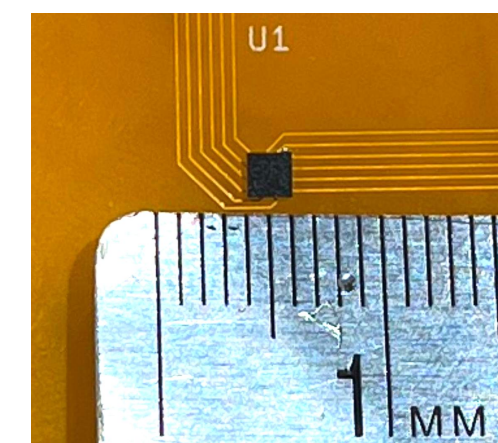


Fig. 6 FINSight Accel

### Variable Drag Airbrake System

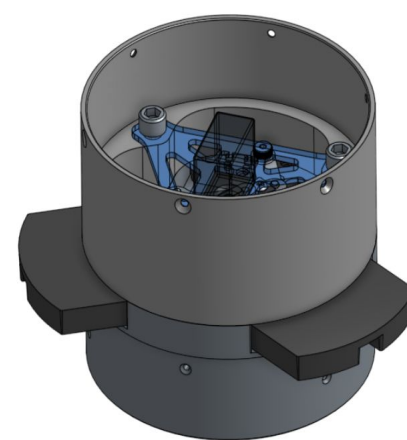
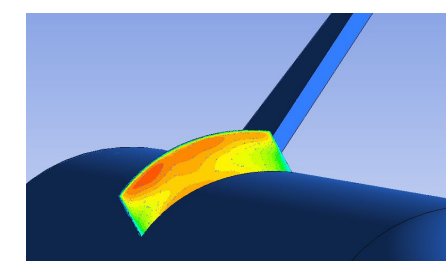


Fig. 7 Airbrakes Housing CAD

- Generates flight path based on 50% deployment & adjusts as necessary
- Petal strength validated in flight tests & simulations

Fig. 8  
Dynamic  
Pressure on  
Airbrakes



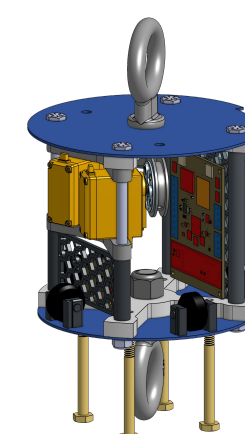
### Guided Recovery

- SRAD cruciform parachute
- PID-controlled dynamic lines

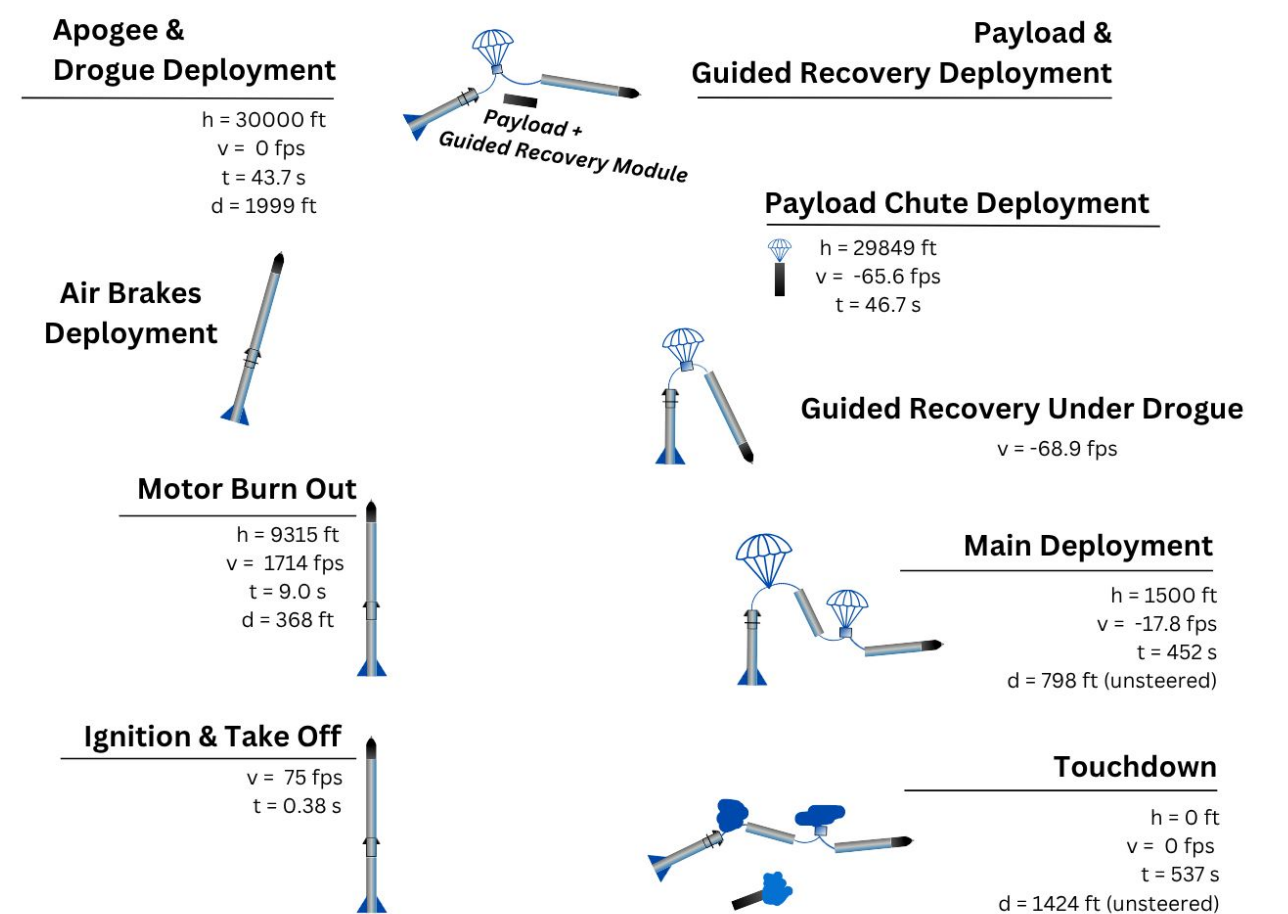


Fig. 9 Drogue and Main Parachutes

Fig. 10  
Guided  
Recovery  
Module



### Concept of Operations (CONOPS)



### Minerva (5U CubeSat)

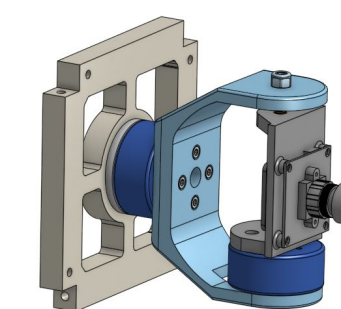


Fig. 11 Gimbal Camera

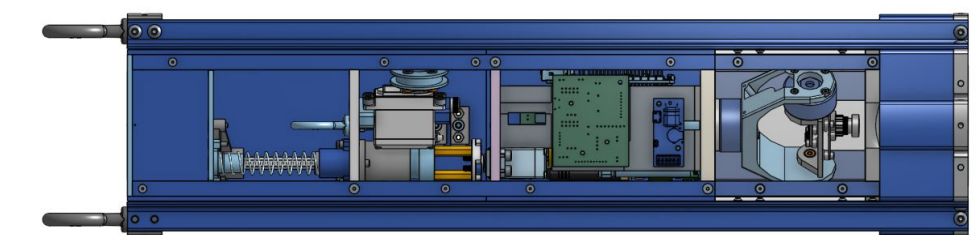


Fig. 12 Integrated CubeSat and Deployer

- Deployed @ apogee; guided SRAD cruciform parachute
- 2-DOF gimbal camera (s.f. 11) encased in acrylic frame
- Live video & computer vision capabilities

### AERO Milestones 24-25

- Critical Design Review (CDR) on January 12
- Ground separation test on April 5
- Static Hot Fire (SHF) on April 5

### AERO Sponsors

