**Aerocapture Benefits & Control**

**Benefits of Aerocapture**
- Minimal propellant requirements
- Potential large savings in mass and cost
- Studies have shown conceptual & technical viability

**Lack of flight demonstration inhibits use of aerocapture on actual missions**

**Aerocapture Conceptual Drag Modulation**
- Ballistic coefficient changes used to alter vehicle’s trajectory
- Simple to implement compared to traditional lifting methods:
  - No CG off rectified
  - Simple avionics algorithms

**Philosophy:**
- Benefits of vehicle's trajectory
- Ballistic coefficient changes used to alter technical viability
- Studies have shown conceptual & minimal propellant requirements

**Maneuver (PRM)**
- Perigee Raise
- Atmospheric Descent
- Orbit Transfer (GTO)

**Atmospheric Descent Orbits**
- Low Earth Orbit (LEO) to Mars Transfer Orbit (GTO)
- GTO to LEO

**Flight System Overview**

**Aerocapture**
- Aerocapture is a promising architecture to effectively target desired orbit
- Dynamic, event jettison drag modulation
- Jettison guidance algorithm is able to modify entry FPA and atmospheric acceleration
- Monte Carlo results show robustness to uncertainties in entry FPA, atmospheric, and burns

**Mission Concept**

**Purpose:**
- Develop SmallSat mission concept for flight test demonstrating aerocapture at Earth
- Deliverable: Fully-documented mission concept in anticipation of future SmallSat proposal opportunities

**Mission Timeline**

1. **Event**
   - GTO Period: 10 hrs
   - Separation from Host
   - Perigee Lowering Maneuver (PLM)
   - Descent Orbit Duration: 5 hrs
   - Atmospheric Interface Altitude: 125 km
   - Aerocapture AV: 2 km/s
   - Post-Aerocapture Orbit 60 km x 1730 km
   - Perigee Raise Maneuver
   - Final Orbit 200 km x 1750 km

**Aerocapture**
- Aerocapture AV: 2 km/s
- Event jettison drag modulation is a promising architecture to effectively target desired orbit
- Jettison guidance algorithm is able to modify entry FPA and atmospheric acceleration
- Monte Carlo results show robustness to uncertainties in entry FPA, atmospheric, and burns

**Trajectory Modeling**

**End-to-End Monte Carlo Results:**
- 10000 Samples, Target = 1730 km
- Parameters:
  - Mean: 1746.0 km
  - Std Error: 104.4 km
  - Minimum: 1516.1 km
  - Maximum: 1813.7 km

**Conclusions**

**Takeaways**
- A SmallSat mission featuring single-event jettison drag modulation is a promising architecture to demonstrate ~2 km/s aerocapture maneuver at Earth
- Structural and mission design analyses have led to a ~25 kg flight system featuring COTS hardware
- Trajectory analyses and Monte Carlo results show robustness of system design to uncertainties

**For more information:**
Michael Werner mwerner9@gatech.edu