SAN DIEGO STATE UNIVERSITY

SDSU's First Successful Fin-Controlled Rocket

ANCS

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Mission Objectives

Our mission is to develop SDSU's first autonomous fin controlled rocket.

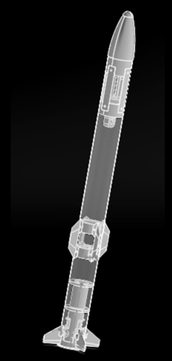
Milestones:

- Full roll control ✓
- Full Attitude (Pitch and Yaw) Control ✓
- Successful Z.E.M. Waypoint interception (active testing)

Design

Structures

- 3D printed components from nose cone to fins
- Four deflecting fins as control surfaces
- False canards for passive stability
- Solid I175W rocket motor
- Nylon parachute recovery

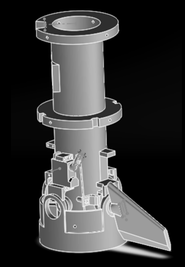


Avionics

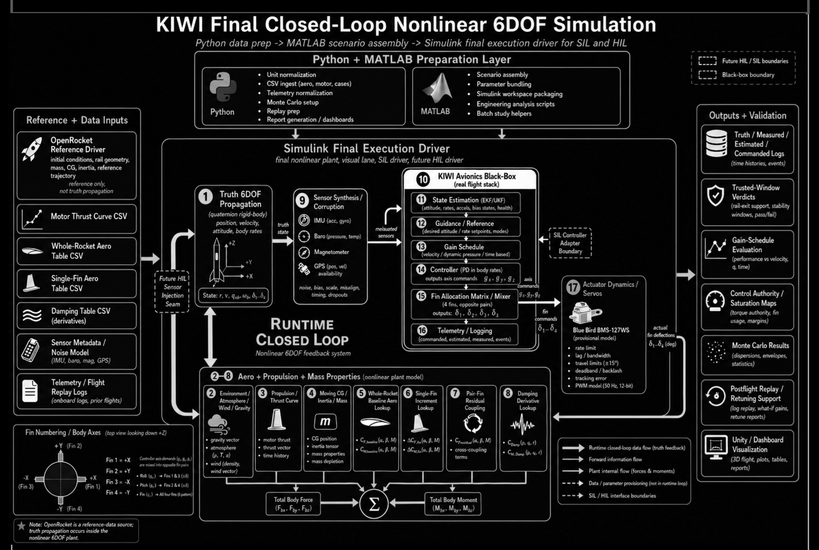
- Nose cone-attached avionics bay
- Vertical, single flight computer PCB
- Teensy 4.1 microcontroller, IMU's, accelerometers, GPS, and more
- Completely custom built hardware & software, no OSS

Servo

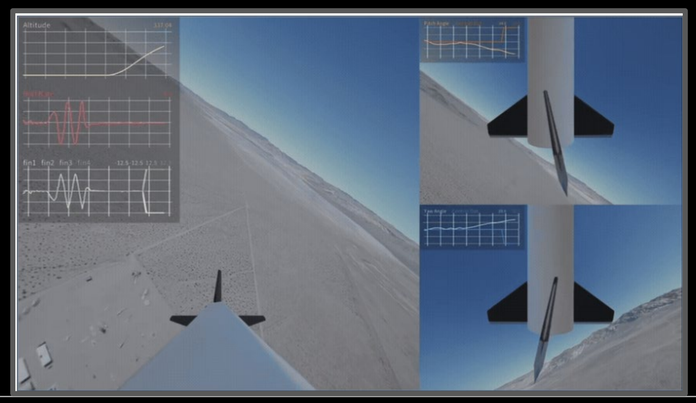
- 4 servos optimized for torque and precision
- Protective housing from rocket motor
- Multi-lever arm control system for fins



Controls

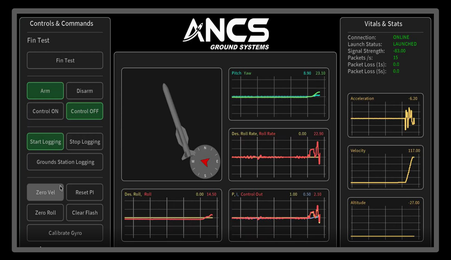


- Accepts interchangeable vehicle and mission inputs, OpenRocket reference data, mass and inertia histories, thrust curves, whole rocket aero tables, single fin force tables, damping data, sensor models, and actuator models
- Environment can test sign and polarity validation, fin allocation verification, gain schedule evaluation, control authority, saturation assessment, stability and instability mapping across flight conditions
- Monte Carlo allows for sweeping of wind, mass properties, thrust variation, sensor error, actuator error, and aero uncertainty
- Post simulation csv's are create for unity representation

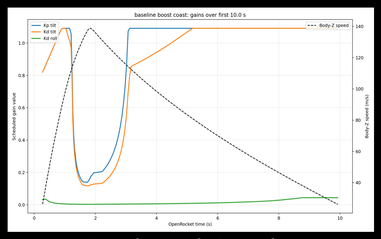


Testing and Results

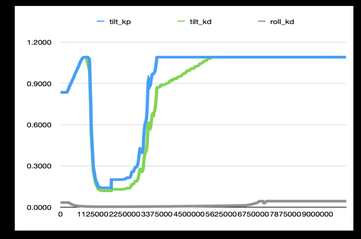
- Roll control only until 4s or 30° tilt detected
- Commanded 0° from vertical flight path
- Full attitude control for rest of flight



- Retuned gains from roll only launch was validated in full attitude 0° hold
- Results showed attitude control within 5% of simulated values



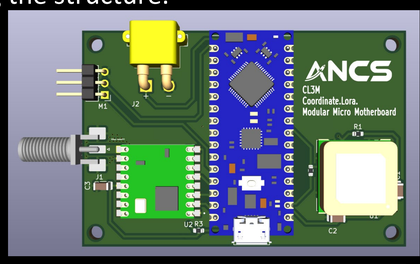
Predicted Results

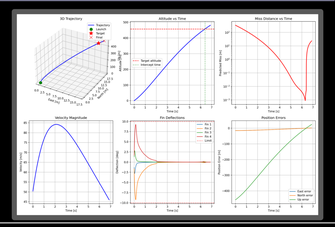


Flight Data

Future Work

- Developing GPS transmitting weather balloon
  - finalizing the weather balloon avionics to a flight ready state.
  - 3D modeling and producing the structure.
  - operation
- Designing telemetry software
  - Rocket must receive RF frequency and know how to react to new appropriately to new information
  - Updating Groundstation to receive, record, and display new information.
- Adjusting rocket control system logic to consistently and smoothly hit a point in space and recovery





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