Aerospace Engineering Design Symposium AY 2010/11

When?   → Friday, April 15, 2011, 8:00 am – 4:00 pm.

Where? → University of Colorado at Boulder, Discovery Learning Center (DLC),
http://engineering.colorado.edu/dlc/

Questions + Registration → Patti.Gassaway@colorado.edu, (303)735-4900

Department of Aerospace Engineering Sciences, http://www.colorado.edu/aerospace/

Agenda:

* Senior Projects.   # Graduate Projects.   + Joint Graduate/Senior Projects

Time	Presentations TEAM	Sponsor/s
8:00 am	Registration	
8:30 am	Welcome by Chair Jeff Forbes	
8:40 am	HPMS*	Ball Aerospace Corp
9:00 am	XROVER*	NASA-JPL
9:20 am	REDCROC*	Lockheed Martin Corp
9:40 am	EPICSat*	LASP
10:00 am	THEIA*	CSGC
10:20 am	Dream Chaser[#]	SNC
Break 10:40-10:50		
10:50 am	GoJett-Biomite[+]	eSpace
11:30 am	HySoR-HALO[+]	ULA/eSpace
12:10 pm	HYPERION- SOLSTICE[+]	Boeing/eSpace
12:50 pm Lunch		
Poster Sessions		
12:50 pm	Student Poster Presentations	
3:00 pm	AES undergraduate students view posters	
4:00 pm Adjourn		

Capstone Senior Design Project Website: http://aeroprojects.colorado.edu/

No registration fee. Parking fee all day: $7.75, http://tinyurl.com/CUParking

Please RSVP or register before April 10 is suggested and appreciated.

Hotels in walking distance: Millenium Harvest House (www.millenniumhotels.com)
Best Western Boulder Inn (http://www.boulderinn.com/)

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| Project Name	Explanation of Acronym (Sponsor)	Brief Description
Biomite	Biofueled Miniature Turbojet Engine (eSpace)	Competitive turbojet product for an expanding UAV propulsion market
Dream Chaser	Dream Chaser Cockpit design (SNC)	Develop a cockpit design architecture focusing on displays, controls, and layout for the SNC Dream Chaser space system based on advances in cockpit technology.
EPICSat	Express Payload Integration CubeSat (LASP)	Design, develop and test a fully functional CubeSat bus using commercial off the shelf parts.
GoJett	Supersonic UAV (eSpace)	Design, build, and fly 1 meter span, 50kg mass, 250 lbs thrust UAV at Mach 1.2
HALO	HySoR Apparatus for Launch Operations (ULA)	Design a portable, scalable, reusable launch support system intended to safely launch the HySoR rocket
HPMS	Hydrazine Propulsion Management System (Ball)	Validate the AFT Impulse software that they use to simulate water hammer effects in their propulsion systems
HYPERION	UAV with hybrid propulsion system (Boeing, eSpace)	Conceive Design, Implement, and Operate an environmentally responsible blended flying wing with a global team of students to explore follow-the-sun design processes.
HySoR	Hybrid Sounding Rocket (ULA, eSpace)	Design, build, and launch a hybrid sounding rocket capable of lifting a 2 kg payload to an altitude of 50 km
REDCROC	REsearch and Development for the Capture and Removal of Orbital Clutter (Lockheed Martin)	Design, build, test, and evaluate an Earth-based demonstration device for the capture of orbital debris
SOLSTICE	Standalone-electric Optimized Lifting System, Transitionable Internal Combustion Engine (eSpace)	Design, manufacture & operate a hybrid engine capable of performing the Hyperion concepts of operation
THEIA	Telescopic High-definition Earth Imaging Apparatus	Design and construct an optical payload engineering unit compatible with the ALL-STAR bus that images earth in full color
XROVER	Extended Range of Versatility Exploration Rovers (JPL)	Add relay capability to the existing R3 multi-rover system in order to explore locations where communication is obstructed with the Mother Rover

Project details can be found on: http://aeroprojects.colorado.edu/

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Dream Chaser Graduate Project

Mission Statement:
"To develop a cockpit design architecture focusing on displays, controls, and layout for the SNC Dream Chaser space system based on advances in cockpit technology balanced with NASA heritage systems."

Sponsors:
- Sierra Nevada Corp.
- University of Colorado at Boulder
- NASA

Final Deliverables:
- Initial displays and controls architecture
- Physical Mockup (Two stages of fidelity) including the design architecture
- Human Factors Evaluation Plan and evaluation testing
- Design considerations for the Engineering Test Article

SIERRA NEVADA CORPORATION
Space Systems

EPICSat

Express
Payload
Integration
CubeSat

Goal: Design, develop and test a fully functional CubeSat bus using commercial off the shelf (COTS) parts.

Emphasis: Interfacing capability to accommodate a sensor payload, and to allow for multiple mission use.

|	
Project Manager	Erin Tucker
Systems Engineer	Swarandeep Singh
Testing Engineer	Joseph Freelong
Structural Engineer	Erin Halin
Controls Engineer/CFO	Greg Miller
Software Engineer	Chris Sawyer
Electronics Engineer	Jeff Severson
Safety Engineer	Evan Townsend
Communications Engineer	Erin Tucker

Customer
Dr. Scott Palo, ____ ____?
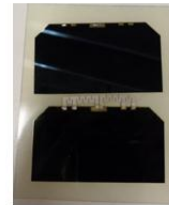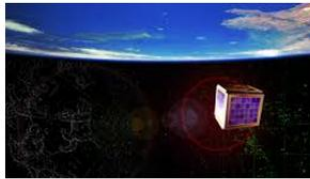
Key Interfacing Components
- Electrical Power System (EPS)
- Command & Data Handling (C&DH)
- Communications System (COMM)
- Attitude Determination & Control System (ADCS)
- Modular Structure

Core Concepts
- Design an original 1 cube unit (1U) CubeSat bus structure, and an interfacing system to connect either a 1U or 2U payload structure.
- Adhere to official CubeSat Design Specifications (mass, dimensions, loading requirements)
- Construct system interfacing components to accommodate a sensor payload, with capability for upgrades
- Ensure EPS, C&DH and COMM subsystems consist of COTS parts, and 50% of ADCS

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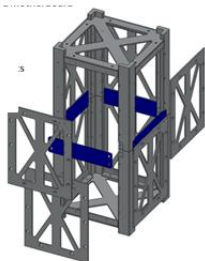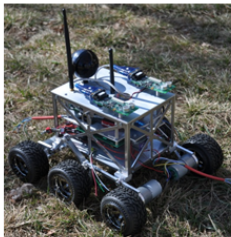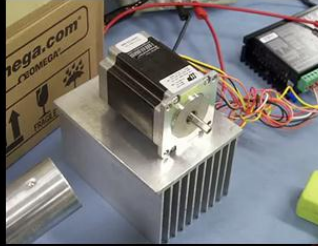
REDCROC

REsearch and Development for the Capture and Removal of Orbital Clutter

Purpose:

To design, build, test, and evaluate an Earth-based demonstration device for the capture of orbital debris.

Objectives:

1) Simulating rendezvous between the device and the debris

2) Deploying the capture device from the system chassis

3) Sensing debris capture

4) Securing the debris

Team XROVER
(Extended Range of Versatility Exploration Rovers)

Goal: The goal of X-ROVER is to add relay capability to the existing R3 multi-rover system in order to explore locations where communication is obstructed with the MR. This functionality will be supplemented by the ability of the system to navigate and communicate over TBD terrain.

Customer: Barbara Streiffert, **JPL**

Objectives:
1. Deploy and Dock on Terrain
2. Traverse through Terrain to Location of Interest
3. Communicate Around Obstacles using a Relay System
4. Maintain Previous Capabilities from REMUS and R3

Relay Point

MR

Location of Interest

Senior Design
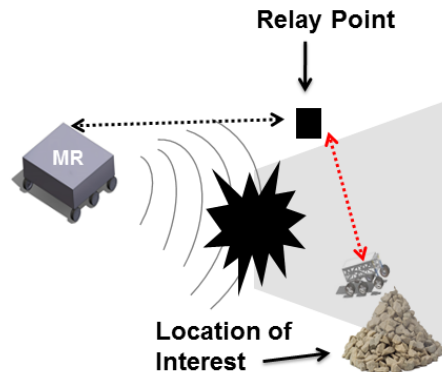
Hydrazine Propulsion Management System (HPMS)

- Customer, Ball Aerospace and Technologies Corporation (BATC), has a **need to validate the AFT Impulse software** that they use to simulate water hammer effects in their propulsion systems.

Applied Flow Technologies (AFT) Impulse Software

- Models water hammer effects in pipe flow
- Widely used in petroleum industry, chemical plants
- Ball Aerospace uses this software to model propulsion flow circuitry
- Not specifically validated for customer's applications

System Requirements:

Mechanical
- Create Representative Flow Circuitry of Mono-Propellant Propulsion System
- Provide Structural Stability for Flow Circuitry Components
- Provide Capability to Change Fluid Momentum

Electrical
- Provide Power to Necessary System Components
- Operate Mechanical Components In Order to Create Water Hammer
- Measure Water Hammer Pressure Variations

Software
- Develop Independant Analytical Model
- Provide System Control via User Interface
- Create AFT Impulse Model of Test Stand
- Manipulate and Compare Experiment Data to AFT Impulse Data

Test and Validation
- Measure K Loss Factors and Valve Opening Time
- Conduct Intermediate System Tests to Ensure Functionality
- Conduct Full System Tests
- Assist with Data Comparison
- Determine and Mitigaste Sources of Error

Concept of Operations

Environment: Indoors

Safety Procedure—to begin TESTING

Begin Testing Procedure
- Bleed pipes
- Check for leaks

User Inputs will go into LabVIEW

WATER HAMMER TEST STAND

Begin Testing Procedure
1.) Fill tank
2.) Pressurize the tank
3.) Operate Valves

LabVIEW will send a signal to stop the flow of water ELECTRONICALLY

LabVIEW will store data to spread sheet for further AFT verification

Every sensor will send data back to LabVIEW ELECTRONICALLY

The Goal of HPMS is to validate the AFT Impulse software by:

- Designing, building and testing a ground based test stand using water to represent the flow pattern of a mono propellant hydrazine propulsion (MPHP) system.

Team:
John Maguire
John Wallace
Brandi Casey
Phil Lauffenburger
Peter DeBiase
Felix Bidner
Matt Zemel
Robert Whitehill
Jeremy Klammer

HYDRAZINE HAMMER
BALL AEROSPACE

Test Stand Assembly

COSGC   NASA
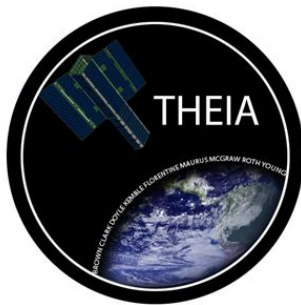
Telescopic High-definition Earth Imaging Apparatus (THEIA)

THEIA

The THEIA team will **design and construct an optical payload** engineering unit compatible with the ALL-STAR bus that **images earth in full color** ultimately to **verify all capabilities of the ALL-STAR bus**, providing a **marketable proof of concept**.

Customer:
Colorado Space Grant Consortium
Christopher Koehler

PAB Advisor:
Dr.Scott Palo

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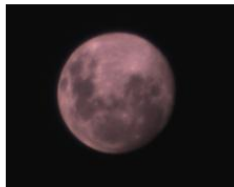
Hybrid Sounding Rocket

To design, build, and launch a hybrid sounding rocket capable of lifting a 2 kg payload to an altitude of 50 km.

- Apogee — Separate payload from rocket body / Record apogee for later analysis
- Payload Separation
- Payload Descent and Operation
- Coast to Apogee — Exhaust propellant mass
- Begin collecting payload data
- Boost Phase — Burn rocket propellant / Collect motor performance data
- Deploy recovery system
- Parachute Deployment
- Launch and Rail Release — **HALO Team:** Prep on-board electronics / Fill oxidizer tank and launch
- Booster falls without recovery / Payload lands and is recovered by team
- Booster Impact
- Payload Splashdown and Recovery

HALO (HySoR Apparatus for Launch Operations)

- **Team Members:** Nathan Luallen, Aaron Young, James Nelson, Josh Hecht, Patrick Quealy, Jessi Watson, Derek Houtz, Chris Lapanse, Eric Donahue

- **Costumer:** Dr. Lakshmi Kantha

- **The goal** of the HALO project is to design a portable, scalable, reusable launch support system intended to safely launch the HySoR rocket or a hybrid rocket of similar design. The launch system shall consist of a launch structure, remote oxidizer fill/dump system, and a remote ignition system.

- **Objectives:**
  - The launch structure needs to be able to support the rocket during pre-flight operations and the initial stage of launch. It must withstand any static and dynamic loads the rocket produces before and during lift off.
  - Must be able to Fill flight ready rocket with 40 – 80 kg (TBR) of nitrous oxide.
  - The system shall send a reliable, remote ignition signal to the Hybrid rocket to start the rocket's ignition system.

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GOJETT Supersonic UAV

Characteristics

- 2 meter length, 1 meter span
- 50kg mass
- Fluidic injection thrust vectoring
- 250 lbs thrust with afterburner
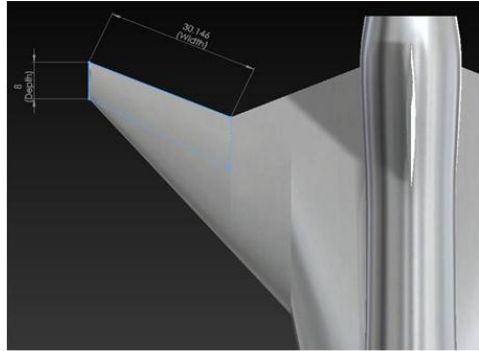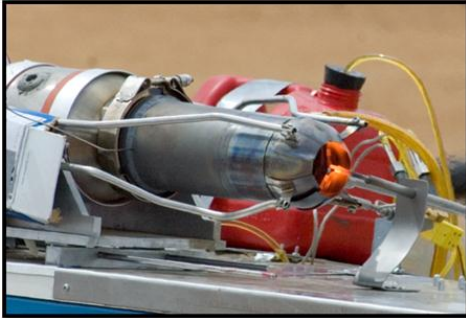
Capabilities

- World's fastest UAV at Mach 1.2
- Tailless flight
- 100km range
- HTOL

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Biofueled **Mi**niature **T**urbojet **E**ngine BIOMITE

- **Competitive** turbojet **product** for an expanding UAV propulsion market:
  - Adapt the engine as necessary to burn a **biofuel**.
  - Increase the **thrust-to-weight** ratio of the engine.

  - **Engine modifications:**
    - Add a variable area nozzle
    - Combustion system redesign
    - Fuel change to Synthetic Paraffinic Kerosene biofuel analog
    - Commercial-off-the-shelf turbine replacement
  - **Supporting analysis:**
    - Real Brayton cycle analysis
    - Shapiro and Ballal flow analysis
    - ANSYS turbine thermomechanical models
    - Shaft natural frequency and rotordynamics modeling

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