Senior / Graduate Design

Aerospace Engineering Design Symposium 2013

When? → Friday, April 19, 2013, 8:00 am – 4:00 pm.

Where? → Discovery Learning Center (DLC), http://engineering.colorado.edu/dlc/ ; http://www.colorado.edu/campusmap/map.html?bldg=DLC

Questions? → patti.gassaway@colorado.edu, claire.yang@colorado.edu

* Graduate Projects

8:00 am	Registration	
8:30 am - Welcome by Chair Penina Axelrad Message		
Presentations		
	TEAM	**Sponsor/s**
8:45 am	ACES	CU-AES
9:00 am	LEOPARD	Lockheed Martin
9:15 am	LoCELS	BALL Aerospace
9:30 am	TRACSat	Surrey
9:45 am	TREADS	NASA-JPL
10:00 am	Xhab*	NASA-NSGF
10:15 am	MinXSS*	LASP/NSF/NASA
~10:30 am Coffee Break		
11:00 am	GLADYADR	Escape Dynamics
11:15 am	SCUA	CU-RECUV
11:30 am	Dream Chaser*	Sierra Nevada Corp
11:45 am	Hyperion*	Boeing
12:00 pm	CUGAR	Boeing/AES
12:15 pm	FROS-D	CU-AES
12:30 pm	Ice SPEAR	CU-AES
12:45 pm	HYSOR*	ULA
~1:00pm Message		
~1:10 pm Lunch and Poster Session		
4:00 pm	Adjourn	

Registration form is available from http://aeroprojects.colorado.edu/

Symposium announcement may be distributed to all interested parties

Senior / Graduate Design

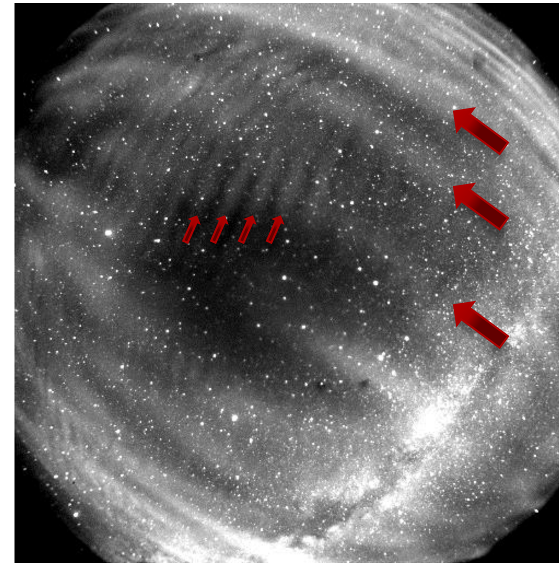
Project Name	Explanation of Acronym (Sponsor)	Brief Description
ACES	Aural Camera for Exploring Space	*Develop a ground-based imaging camera system with thermal control for capturing, transferring, and constructing images of near-infrared wavelengths in the night sky*
CUGAR	CU Green Aircraft Research	*Design a serial hybrid gas-electric propulsion system for integration into a UAV-sized airframe.*
Dream Chaser	Lifting Body Vehicle	*Provide engineering, management, and services in support of the conceptual development for the SNC Dream Chaser cockpit, displays and seating*
FROS-D	Free Standing Receiver of Snow Depth	*Design a reliable and cost effective unit that measures snow depth*
GLADYADR	Gliding Attitude Dynamics and Deployment Research	*Design, simulate, test, and verify the stability of a 1/10 Escape Dynamics spacecraft prototype*
Hyperion	UAV	*Design and development of a blended wing body aircraft*
HYSOR	Hybrid Sounding Rocket	*Design, test and launch a hybrid rocket to deliver a 2 kg payload to 10 km*
Ice SPEAR	Ice Surface Penetration for Arctic Research	*An autonomous system that can be deployed in the Arctic to penetrate new growth brine ice and deploy representative sensors 10m under the ice surface*
LEOPARD	Low Earth Orbit Project for the Acquisition and Recovery of Debris	*Develop a debris capture system capable of capturing 2 objects in sequence representative of a piece of tracked debris found in LEO*
LoCELS	Low Cost Exploration Landing System	*Create an economical method for delivering small payloads to the surface of the Moon*
MinXSS	Miniature X-ray Solar Spectrometer	*A sun pointing 3U CubeSat which will measure solar emission and transmit and store the data*
SCUA	Small Combined Unmanned Aircraft	*A box wing UAS capable of flying to a location as an assembly of units, that demonstrate the ability to separate into small assemblies*
TRACSat	Target Recognition and Acquisition Cube Sat	*A three degree of freedom real-time control system for a cold-gas propulsion unit*
TREADS	mulTiple RovEr Acquisition, Deployment, and Storage	*Investigate the feasibility of using a multi wheeled vehicle robotic system*
Xhab	eXploration Habitat	*A remotely operable biogenerative food system for long duration space missions.*

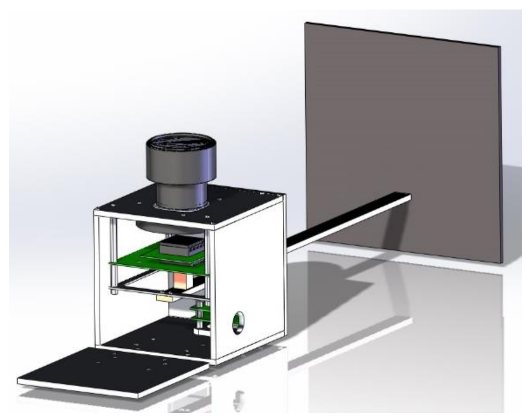
Symposium announcement may be distributed to all interested parties

Auroral Camera for Exploring Space

Goal: ACES will design, build, and verify a ground-based imaging camera system with thermal control for capturing, transferring, and constructing images of near-infrared wavelengths in the night sky.

Objective: To identify hydroxyl emission and gravity waves in the night sky within 780nm to 1000nm wavelengths while maintaining an image sensor operating temperature of 0°C or lower.





ACES Team: Ian Andrzejczak, Katie Brissenden, Matt Hegarty, Karla Rosario, Conrad Schmidt, Tyson Sparks, Ben Weingarten, Hannah Williams

Customer: Prof. Jeffrey Thayer

Advisor: Prof. Scott Palo

Low Earth Orbit Project for the Acquisition and Recovery of Debris

LEOPARD Lockheed Martin and Senior Design heritage project that will design, build, and test a debris capture system capable of capturing two objects in sequence representative of a piece of tracked debris that can be found low earth orbit.

Team

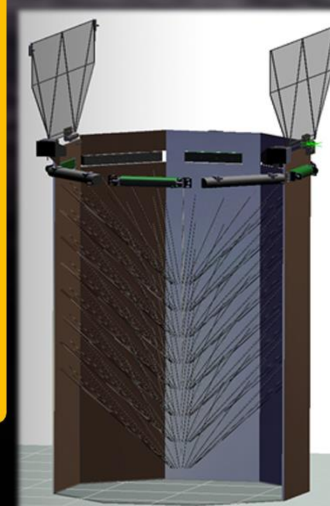
Samantha Archambault
Gautham Gopakumar
Jarred Langhals
Elizabeth Notary
Alexander Smith
Chelsea Welch
KatieRae Williamson
Jonathan Wu

PAB Advisor

Dr. Scott Palo

Main Objectives & Design

1) ***Capture debris in***
   Size range: 14 [cm] – 40 [cm]
   Mass range: 1.2 [kg] – 5 [kg]
2) ***Designed to:*** capture off-nominal incoming rajectories
3) ***Bristles:*** passively slow and secure debris



Customer: Lockheed Martin
Sponsor: Barbara Bicknell
Proj. Advisor: Jeffrey Weber

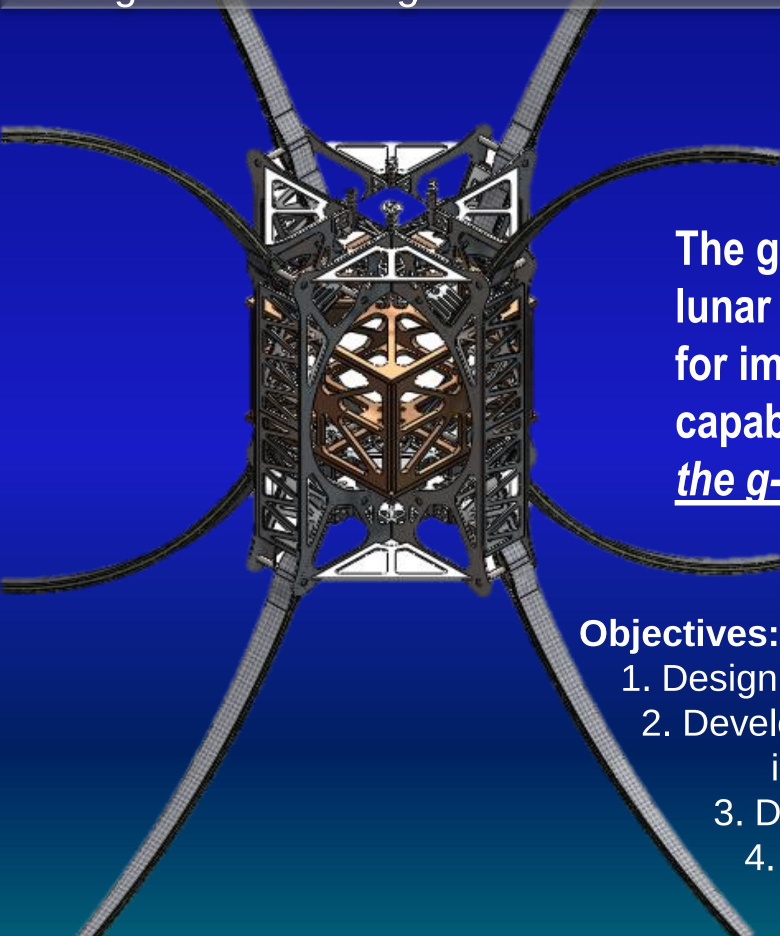
LoCELS

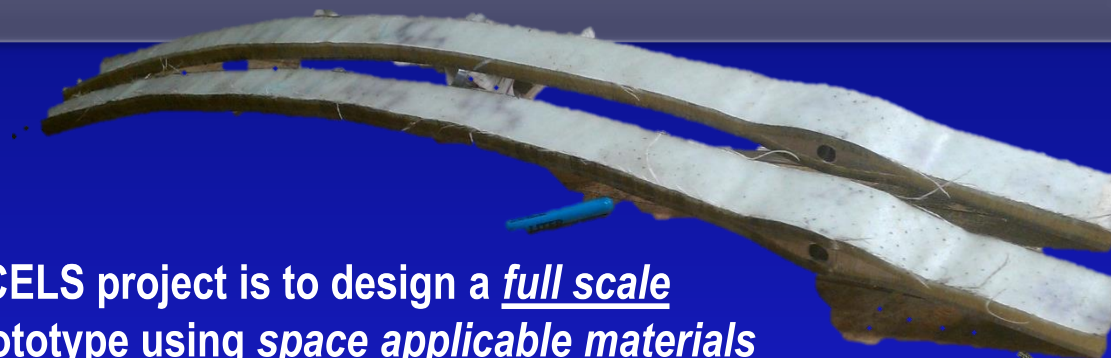
<u>L</u>ow <u>C</u>ost <u>E</u>xploration <u>L</u>anding <u>S</u>ystem

Amanda Kuker Matt Gosche Nicholas Mati Scott Leipprandt David Reid Adam Clarke Hyun Choi

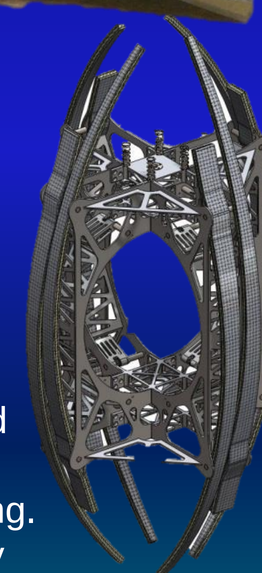
Customer: Tim Flora – Ball Aerospace Project Advisor: Joe Tanner - CU

The LoCELS project is focused on creating an <u>economical method</u> for delivering small ruggedized payloads to the surface of the Moon. LoCELS is designed to be carried as a <u>secondary payload on the Orion Vehicle</u>. The system uses <u>deployable composite struts</u> to cushion the impact of an uncontrolled drop from lunar orbit. The <u>payload is suspended</u> in the center of an aluminum structure which is designed to protect the payload during a hard landing.





The goal of LoCELS project is to design a *<u>full scale</u>* lunar lander prototype using *<u>space applicable materials</u>* for impact testing on earth. The lander prototype will be capable of carrying *<u>a 5 kg mass payload</u>*, while *<u>limiting the g-load</u>* on that payload to under 100 g's.

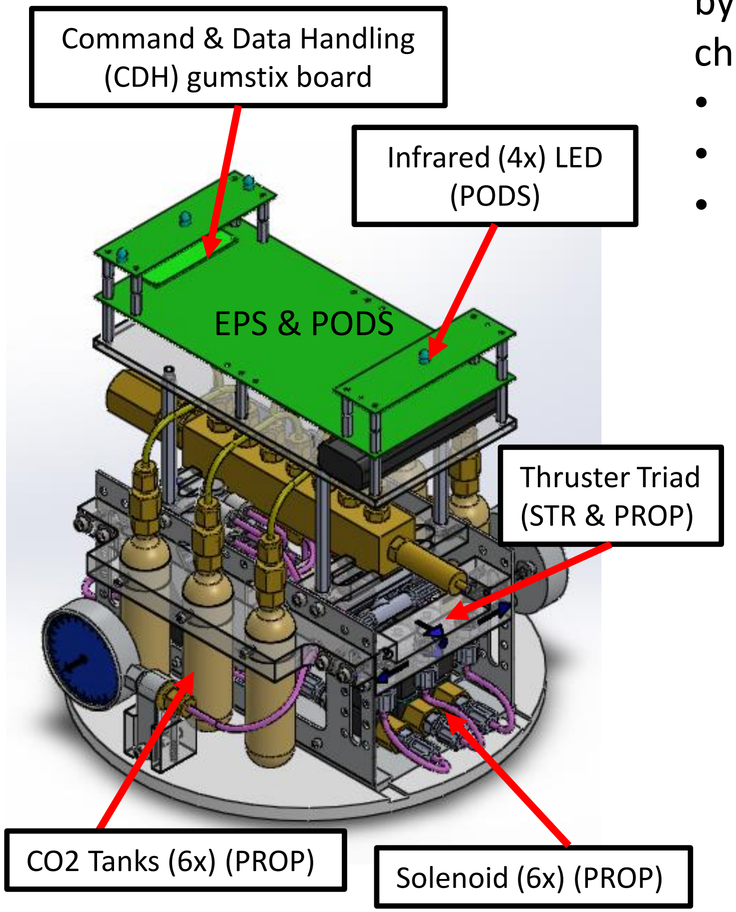


Objectives:

1. Design, construct, and test a lunar lander prototype.
2. Develop landing mechanism that allows the payload to survive a hard impact.
3. Develop and electrical system to record data during impact testing.
4. Learn and experience engineering design processes guided by project milestones.

TRACSat : Target Recognition and Acquisition Cube Sat

Mission Statement: The TRACSat project encompasses the design, integration and test of a three degree of freedom real-time control system for a cold-gas propulsion unit that will maneuver across a low-friction Earth based test environment then perform station keeping at a commanded location to mimic proximity operations of on orbit nanosatellites.



A vehicle maneuver to a commanded position will be performed by translational and rotational planar motion which will be used to characterize:

- Propellant Consumption
- Power Dissipation
- Time Duration of Maneuver

Defined Systems

Guidance, Navigation and Control (GNC)
- Simulink Modeled Controller

Propulsion (PROP)
- Cold Gas System – CO_2

Structures (STR)
- Aluminum 6061 and Acrylic

Software (SW)
- Onboard Data processing
- Wireless Command and Data Downlink

Power (EPS)
- Onboard battery and power system

Position Orientation and Determination System (PODS)
- Inertial Measurement Unit
- Infrared LEDs

Performance Requirements

- Translate 0.50 meters
- Pointing Accuracy: ±2.5° from defined body fixed sensor axis
- Position Accuracy: 2.5 radius from commanded position
- Maneuver Duration: < 10 minutes
- Station Keeping: 30 seconds

TREADS

MULTIPLE ROVER ACQUISITION, DEPLOYMENT, AND STORAGE

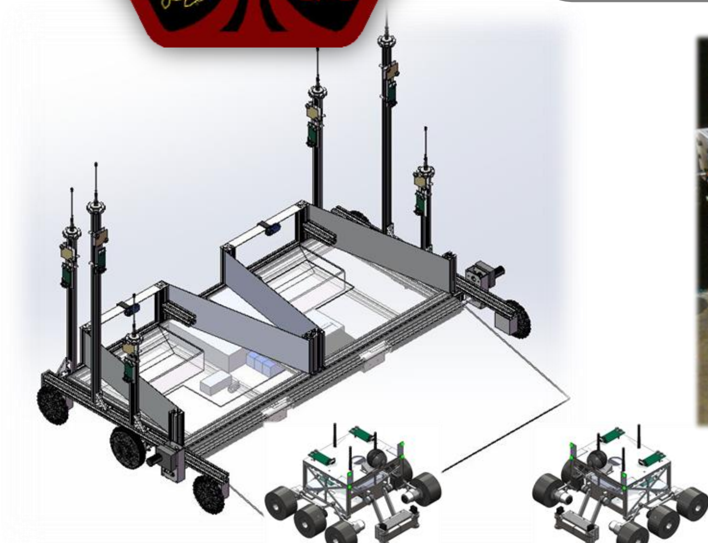
GOAL:

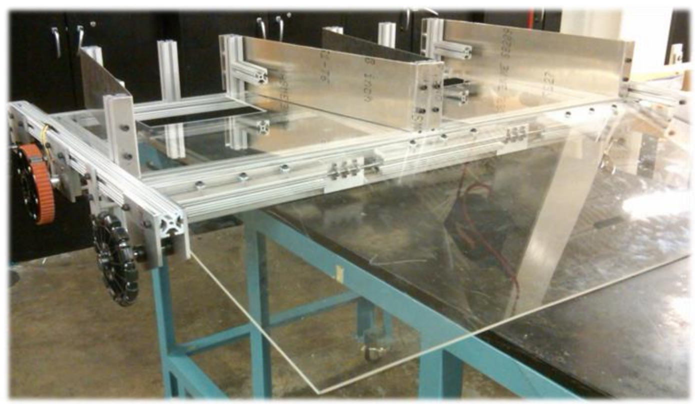
Investigate the feasibility of conducting unmanned planetary exploration using a multi-vehicle system consisting of a Mother Rover, two Child Rovers, and a Ground Station.

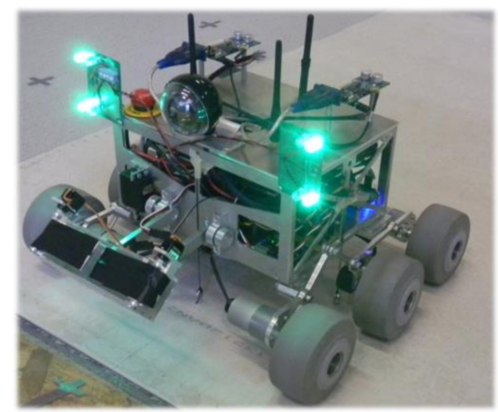
OBJECTIVES:

Design, fabricate, and test a new Mother Rover capable of:

- Separately storing two Child Rovers and their collected samples
- Driving to commanded locations of interest
- Deploying and recovering two Child Rovers via a retractable ramp
- Calculating the attitude and position of the Child Rovers prior to docking







Team Members:
Steven Ramm, Andrew Tsoi, Ed Meletyan, Brandon Campbell, Nick Stohl, Abraham Vanderburg, Stephen Hannan, Ted Maritz

Sponsor:
Barbara Streiffert, Jet Propulsion Laboratory (JPL)

Advisor:
Joe Tanner, University of Colorado at Boulder, Aerospace Engineering Sciences

eXploration Habitat: Remote Plant Food Production Capability

Rohit Dewani, Christine Fanchiang, Heather Hava, Keira Havens, Jordan Holquist, Emily Howard, Pileun Kim, Huy Le, Elizabeth Lombardi, Scott Mishra, Karuna Raja Reddy, Tim Villabona, Daniel Zukowski,

Advisors: Joe Tanner, Nikolaus Correll

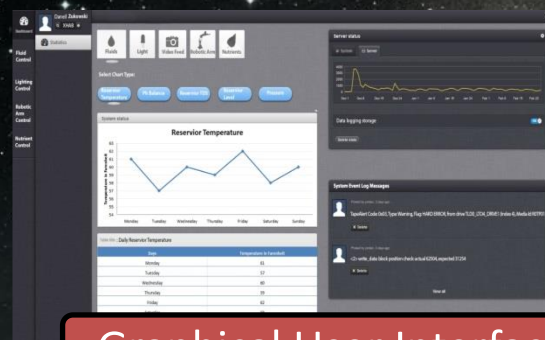
National Space Grant Foundation

X HAB ACADEMIC INNOVATION CHALLENGE

University of Colorado, Boulder, CO

Objective

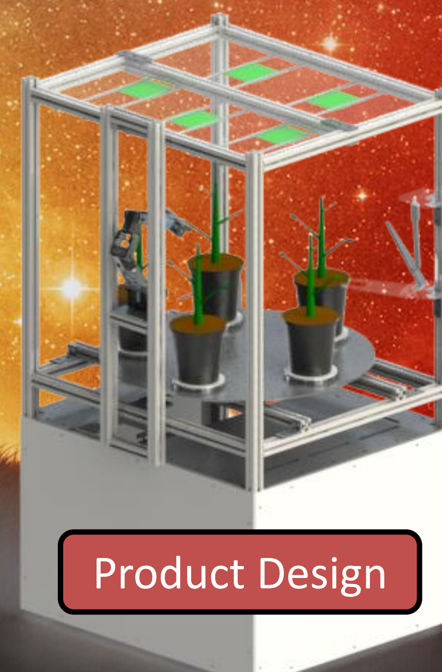
Develop a <u>remotely operable</u> bioregenerative food system that provides <u>plant production</u> capabilities for long duration space missions



Graphical User Interface

Plant Development

Robotic Manipulator

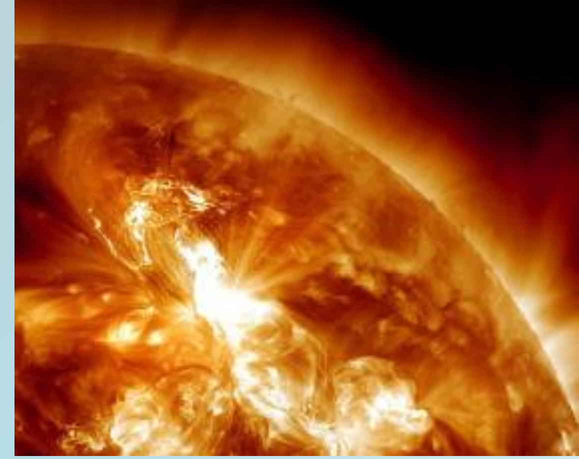


Product Design

<u>DELIVERY: MAY 2013</u>

FOOD PRODUCTION IN SPACE IS A *CRITICAL* NEED FOR LONG-DURATION SPACE MISSIONS

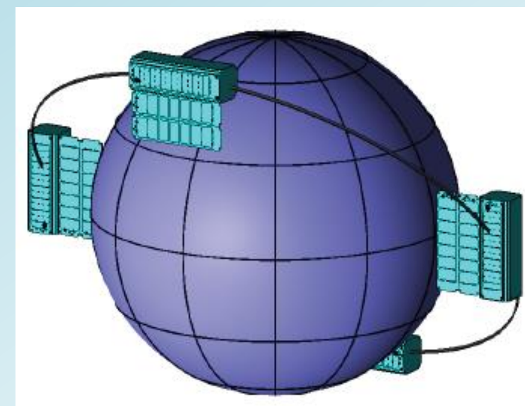
Miniature X-ray Solar Spectrometer



Courtesy of AP

<u>Goal:</u> To design, build, and test a sun pointing 3U CubeSat (10cm x10cm x30cm) which will measure solar emission data and transmit and store the data to further scientific understanding

<u>Science:</u> To better understand the solar irradiance energy distribution of solar flare soft X-ray (SXR) emission and its impact on Earth's ionosphere, thermosphere, and mesosphere



The Team:	11 graduate students in ASEN and ECEE
PM:	Sam Liner
SE:	Matt Carton
Advisors:	Dr. Xinlin Li, Dr. Scott Palo
PI:	Dr. Tom Woods
Customer:	LASP

LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS
UNIVERSITY OF COLORADO AT BOULDER

GLADYADR

GLiding Attitude DYnamics And Deployment Research

Customer: Escape Dynamics

Background: Customer is developing reusable launch vehicle incorporating the use of microwave energy beamed from the ground to deliver payloads into LEO.

Goal & Requirements: The goal of GLADYADR is to design, simulate, test, and verify the **stability** of a 1/10 Escape Dynamics spacecraft prototype.

Requirement	Description
0.PRJ.1	A 1/72 spacecraft replica shall verify Autodesk 360 virtual wind tunnel predictions for lift over drag ratio, stability, and pitching moment values.
0.PRJ.2	The 1/10 spacecraft replica shall be geometrically and spatially consistent to customer components of the spacecraft.
0.PRJ.3	The 1/10 spacecraft replica shall be deployed at conditions that are defined by steady gliding flight.
0.PRJ.4	The 1/10 spacecraft replica shall obtain a 15 degrees pitch and 0 degrees roll attitude during gliding flight.
0.PRJ.5	The 1/10 spacecraft replica shall maintain roll and pitch attitude in gliding flight for a minimum duration of 6.4 seconds.

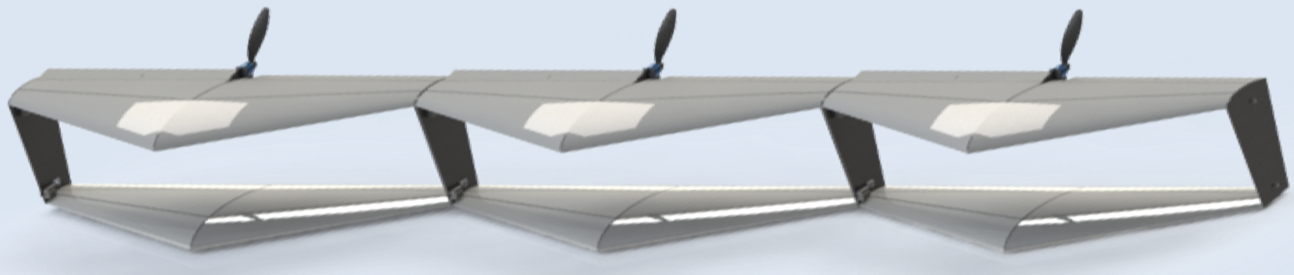
SCUA

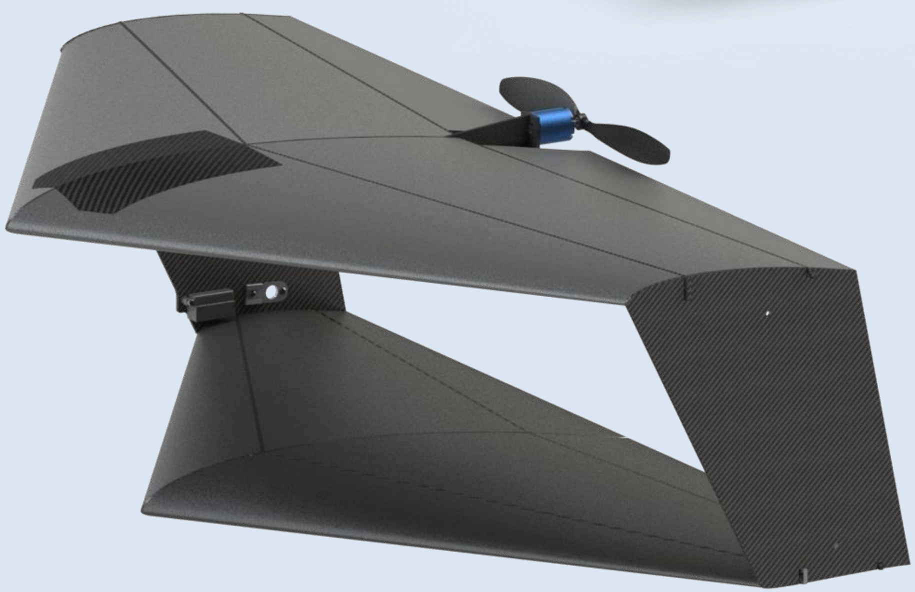
Small **C**ombined **U**nmanned **A**ircraft

Customer:
Dr. Brian Argrow

Design Team:
Grant Boerhave
Dominique Gaudyn
Garrett Hennig
Jennifer Milliken
Cameron Trussell
Jacob Varhus
Matthew Zeigler

Goal: To create **box wing** UAS units capable of flying to a location as an **assembly of units**, that demonstrate the ability to **separate** into small assemblies, and exhibit equal and independent **performance** capabilities.

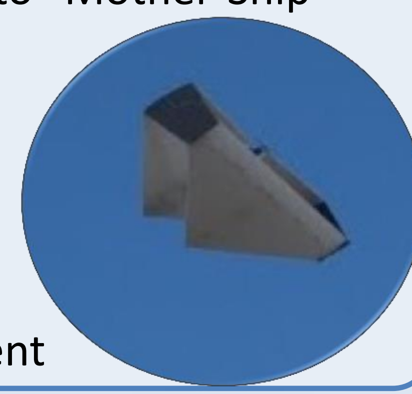




"Eagle Owl" box wing concept by Matt Osborne

Aircraft connected at wingtips for:
- Modular alternative to "Mother-Ship"
- Increased loiter time
- Increased efficiency

Future Applications:
- Communication
- Reconnaissance
- Weather measurement



Dream Chaser

Copp, B., Gleaves, A., Gonzalez, S., Green, D., Lawry, M., Logan, E., Oxenbury, J., Robinson, M., Williams, A.

Mission Statement:

"This project shall provide engineering, management, and services in support of the conceptual development for the SNC Dream Chaser cockpit, displays and seating."

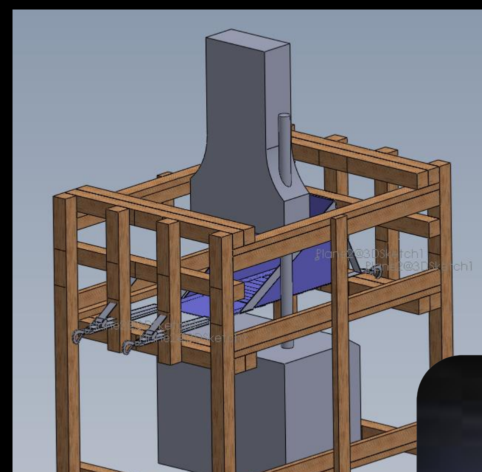
Advisors:

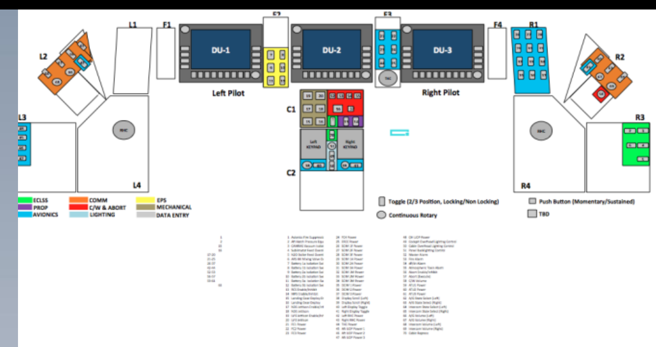
Col. Jim Voss, CU

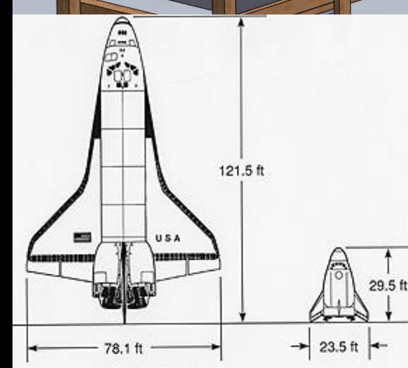
Ken Stroud, SNC

Objectives:

- Cockpit Design
  - Control Placement/Readability
  - Control Panel Dimensions
- Seating Design
  - Traditional Pilot Seat
  - Cloth Crew Seat
  - Load Testing Results
- Human Factors Tests
  - Cockpit Functionality
  - Ingress/Egress

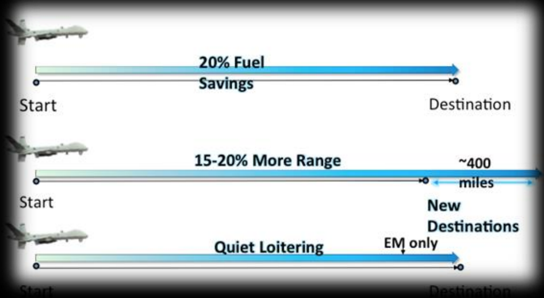




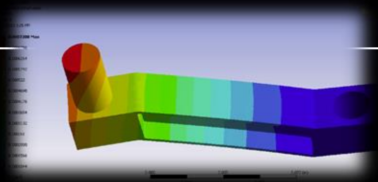


HYPERION's Goals align with NASA's 2030 reductions in:

- Emissions
- Fuel Consumption
- Noise



Analysis



THROUGH THESE NOVEL TECHNOLOGIES:

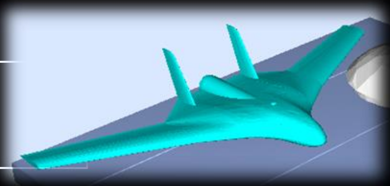
- BLENDED WING BODY DESIGN
- LIGHT WEIGHT CARBON FIBER STRUCTURE
- HYBRID GAS-ELECTRIC PROPULSION SYSTEM

Testing

Design

Prototyping

Manufacturing



HYPERION

CUGAR

CU Green Aircraft Research

Team

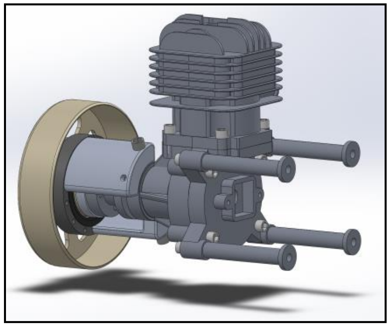
Project Customer
Dr. Jean Koster

Faculty Advisor
Hank Scott

Kai Amey
Josh Bromberg
Alex Eisenach
Elyssa Kaszynski
Daphne Perez
Adil Oubou
Alijah Smith
Andrew Thomas

Goal

The CUGAR team will design a **serial hybrid gas-electric propulsion system** for integration into a UAV-sized airframe. The system will **maintain the onboard battery state of charge** and demonstrate **electric takeoff and landing** capabilities.



Serial Hybrid Architecture

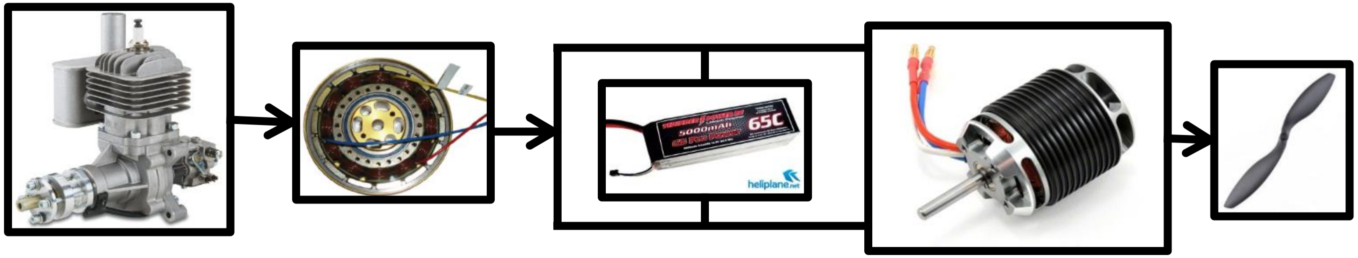
Capabilities

- All-electric takeoff/landing capability
- In-flight recharging

→

Benefits

- Reduces noise and harmful emissions
- Addresses NASA Environmentally Responsible Aviation (ERA) goals

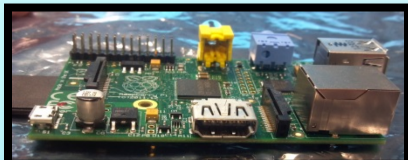


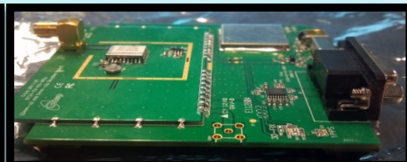
Gas Engine → Alternator → Battery → Electric Motor → Propeller

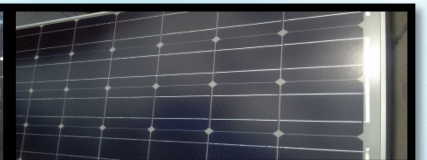
FROS-D

FREE STANDING RECEIVER OF SNOW DEPTH

Goal: Design a reliable and cost-effective unit that measures snow depth. The system receives GPS signals, analyzes and processes the data using a provided algorithm, and sends the calculated snow depth to an offsite location.







Objectives:

The devise shall -

- Autonomously power itself for a year
- Survive a temperature range from -40°C to 40°C
- Withstand 44 m/s (100 mph) winds
- Transmit height wirelessly 30 m
- Cost less than $1500

Customer:
Dr. Dennis Akos
Dr. Staffan Backen

Advisor:
Dr. Sedat Biringen
Alec Kucala

Jake Adams
Hamad Al Kaabi
Sabre Brill
Robert Even
Umair Khan
Mackenzie Miller
Josh Smith
Mary Whitney

Ice SPEAR

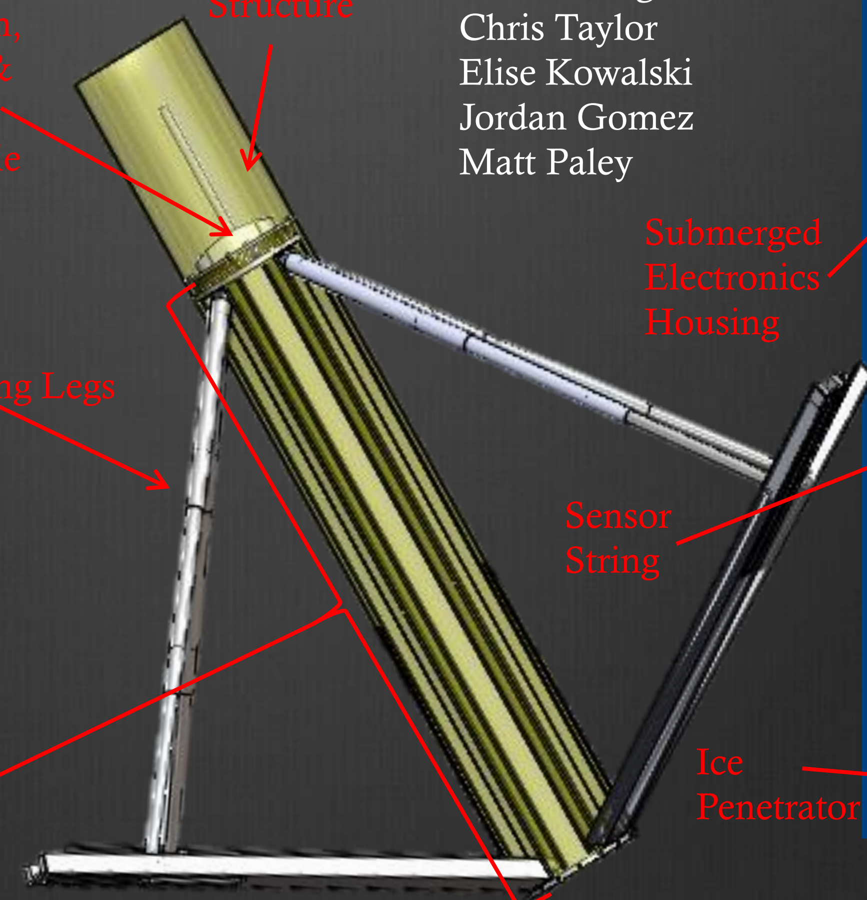
Ice Surface Penetration Experiment for Arctic Research

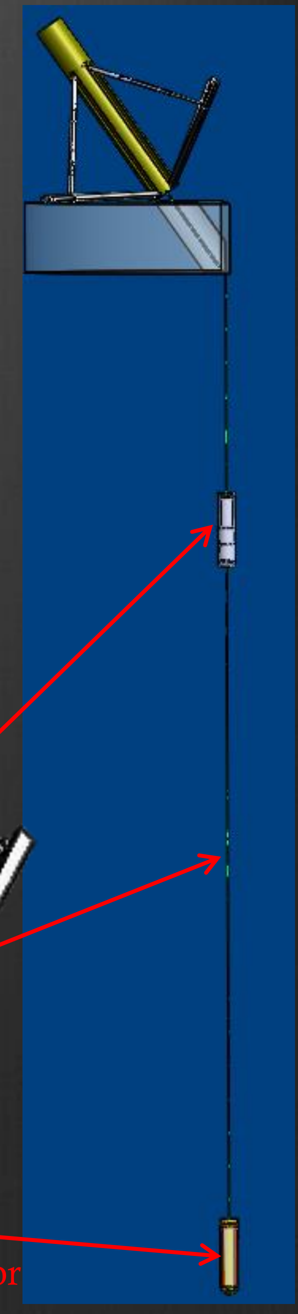
Customer: **CCAR** – Colorado Center for Astrodynamics Research

Team:
Christopher Allison
Jordan Dickard
Isaac Hayden
Jan Van Zeghbroeck
Chris Taylor
Elise Kowalski
Jordan Gomez
Matt Paley

Goal:
Design, build, and test an autonomous system that can be deployed in the Arctic to penetrate new growth brine ice and deploy representative sensors 10m under the ice surface.

Objectives:
Surviving an airdrop landing, penetrating the ice to allow for representative sensor deployment, collecting data, and relaying that information 10 km for analysis.





Engineering Excellence Fund

FRONTIER ASTRONAUTICS

HySoR
Hybrid Sounding Rocket

United Launch Alliance

Mission

- Design, test and launch a hybrid rocket to deliver a 2 kg payload to 10 km

Static Test Fire Fall 2012

Objectives

- Deliver a flight ready system by June 2013 with a launch target of Spring 2014
- Kick-start a hybrid rocketry program at CU

Team Members

Faculty Advisor

Joe Tanner

Bryce Schaefer
Brian Kohler
Chris Webber
Collin Bezrouk
Brian Michels
Jack Mills
Lance Markovchick
Tyler Mixa
Thomas Snow

Customer

Dr. Lakshmi Kantha

Specs

Thrust	1400 lbs
MEOP	2000 psi
Weight	135 lbs
Height	9 ft
Fuel	HTPB
Oxidizer	N_2O
Burn Time	30 sec

www.youtube.com/user/hysorofficial
Hysor.wordpress.com