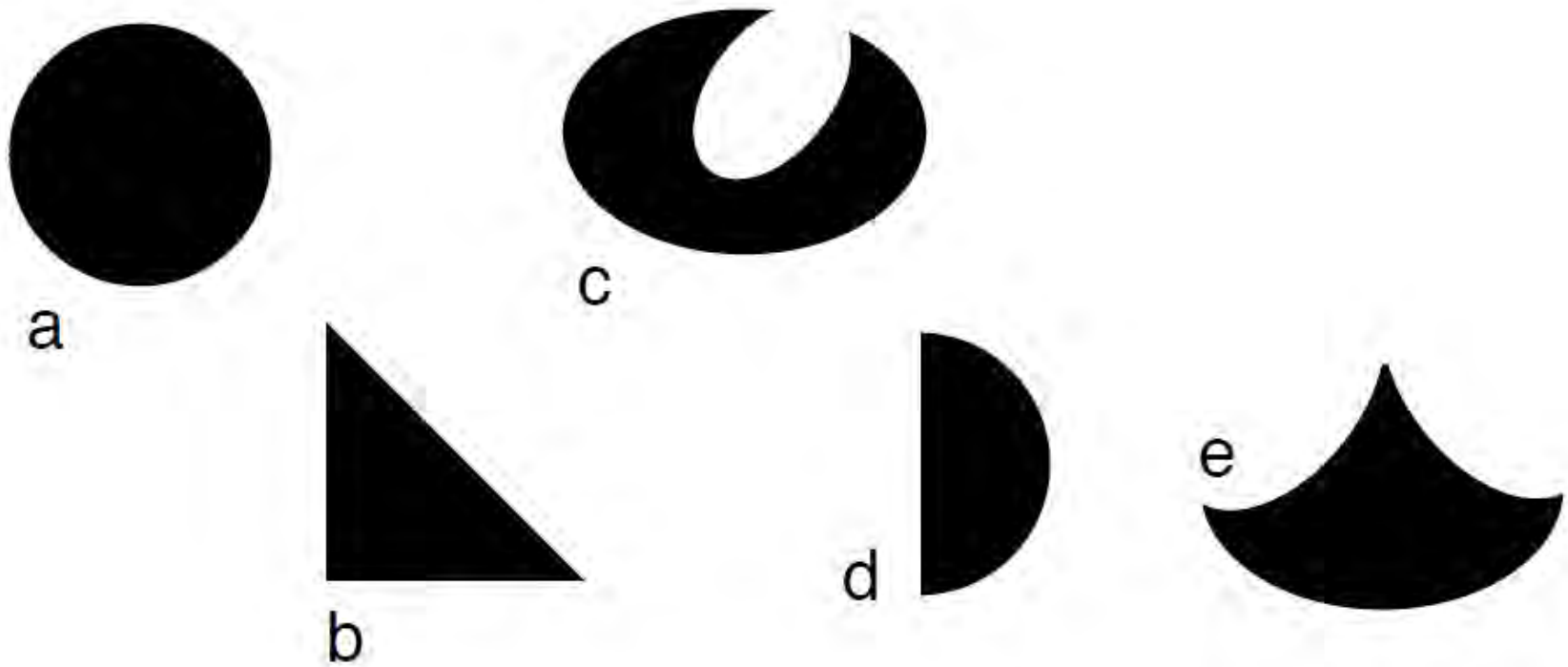
Mini Quiz

- Which object is different from all the others?



1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

b

Congratulations!

The only one with all straight lines

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

C

Congratulations!

The only one that is asymmetric

The one made from two same shapes

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

a

Congratulations!

The only one with no points

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

Congratulations!

The only one made with line and arc

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

Congratulations!

The only one that is the projection of a triangle onto a curved surface

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

- There are many right answers

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

- There are many right answers

  … and even more wrong answers

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Design – Potential Definition 1

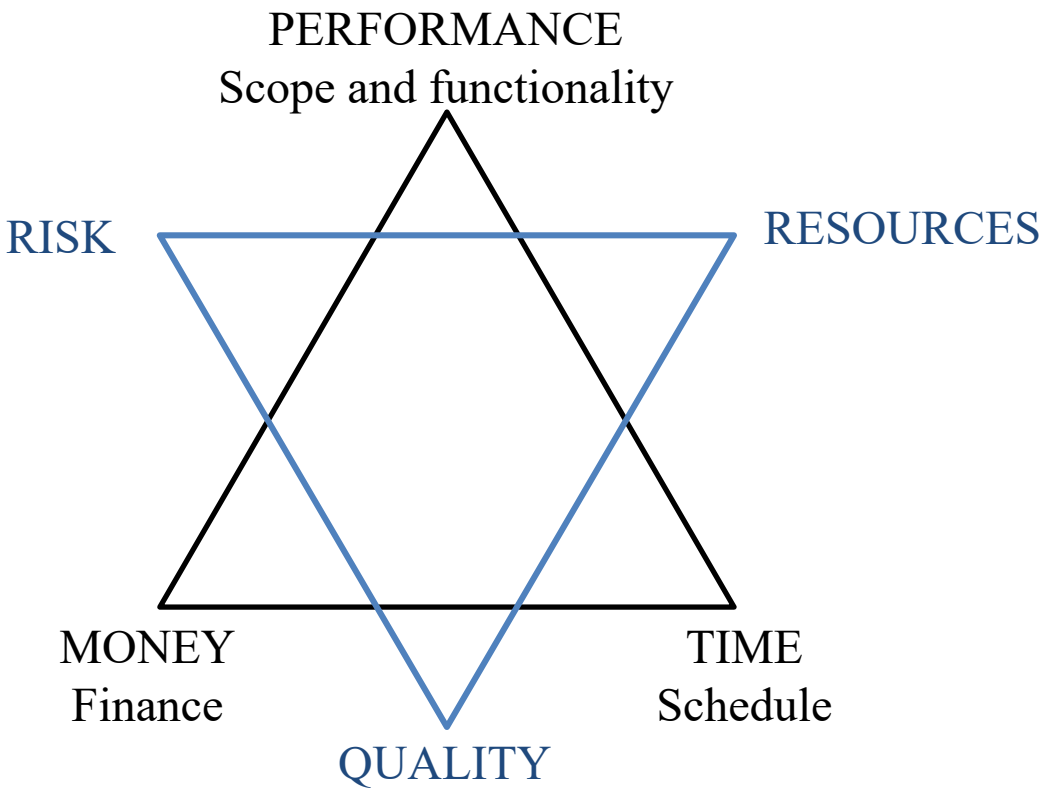
- Find a "cost effective" solution that lies amongst the RIGHT answers.
  - Creativity to generate solutions
    - Inherent understanding of physics of problem
  - Ability to *see* many unique viewpoints
    - Lateral thinking
  - Capability to understand/analyze/model/test viewpoints
    - Majority of your formal education up to this point
    - Engineer can do with $1 what a "maker" can do with $10.

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Design – Potential Definition 2

- Creating new devices or improving exiting devices in an attempt to provide the "best," or "optimum" design consistent with the constraints of time, money, risk, safety, ethics, environmental considerations, etc. as dictated by the application and the marketplace.
- Most design problems don't have unique solutions.

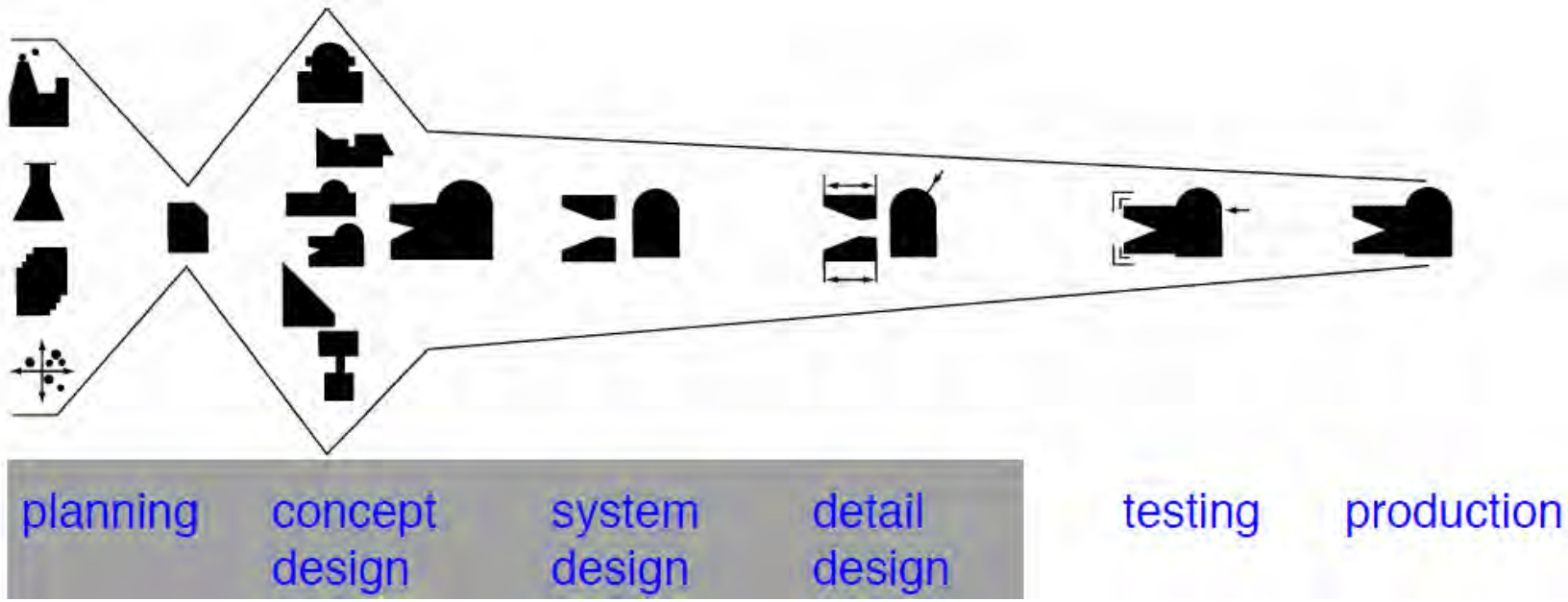
The Iron Triangle



Design Process

- A collection of strategies to help ensure that you have a high likelihood of being successful.

ON TIME, every time.



1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Who is Dr. Trimble

Gizmologist

- RIP Lab Website

Who is Dr. Sorensen?

Newcastle NSW Australia

Newcastle NSW Australia

Amateur Rocketry in Australia

KU Undergrad 1970-73

Trevor, KU Student, 1972

Trevor, senior photo, 1973

Aircraft Structural Engineer in Dayton, OH

1973-74

KU Grad School 1974-1976

Trevor Sorensen (right) and Steve Ericson

Pioneer Venus – NASA Ames

NASA Ames Research Center 1977-79

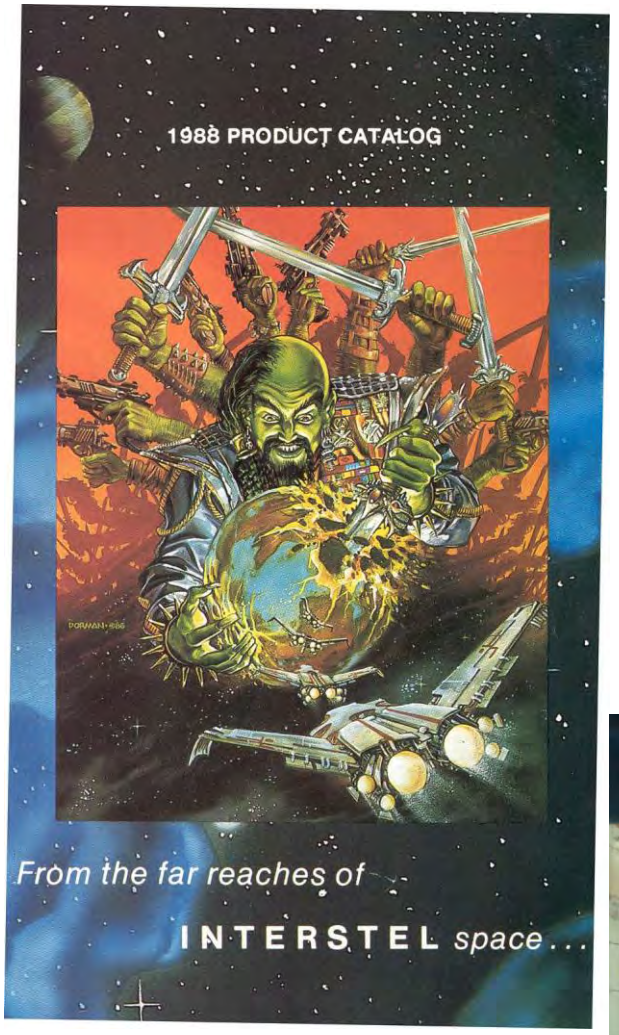
JSC, Houston 1980-87

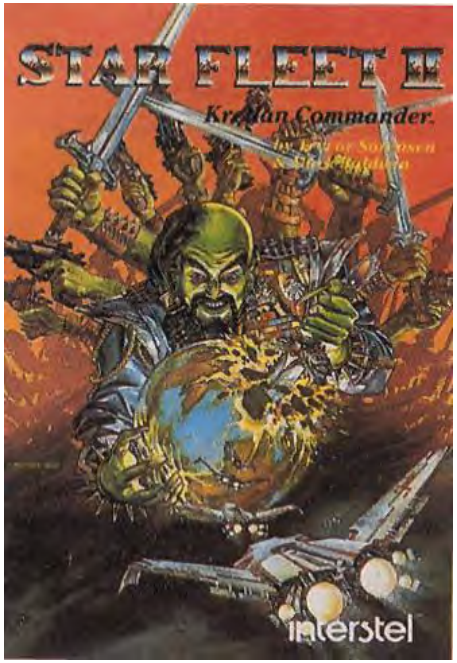
- Guidance and Control Engineer
  - STS-1, 2 Ascent Aborts
- Assistant to the Flight Directors
  - 1981-85
- Software Engineering Task Manager
  - Ascent Design System
  - Space Vehicle Dynamic Simulator

Mission Control in Houston

Mission Control in Houston

Software Business 1983-92





Author of 4 published games

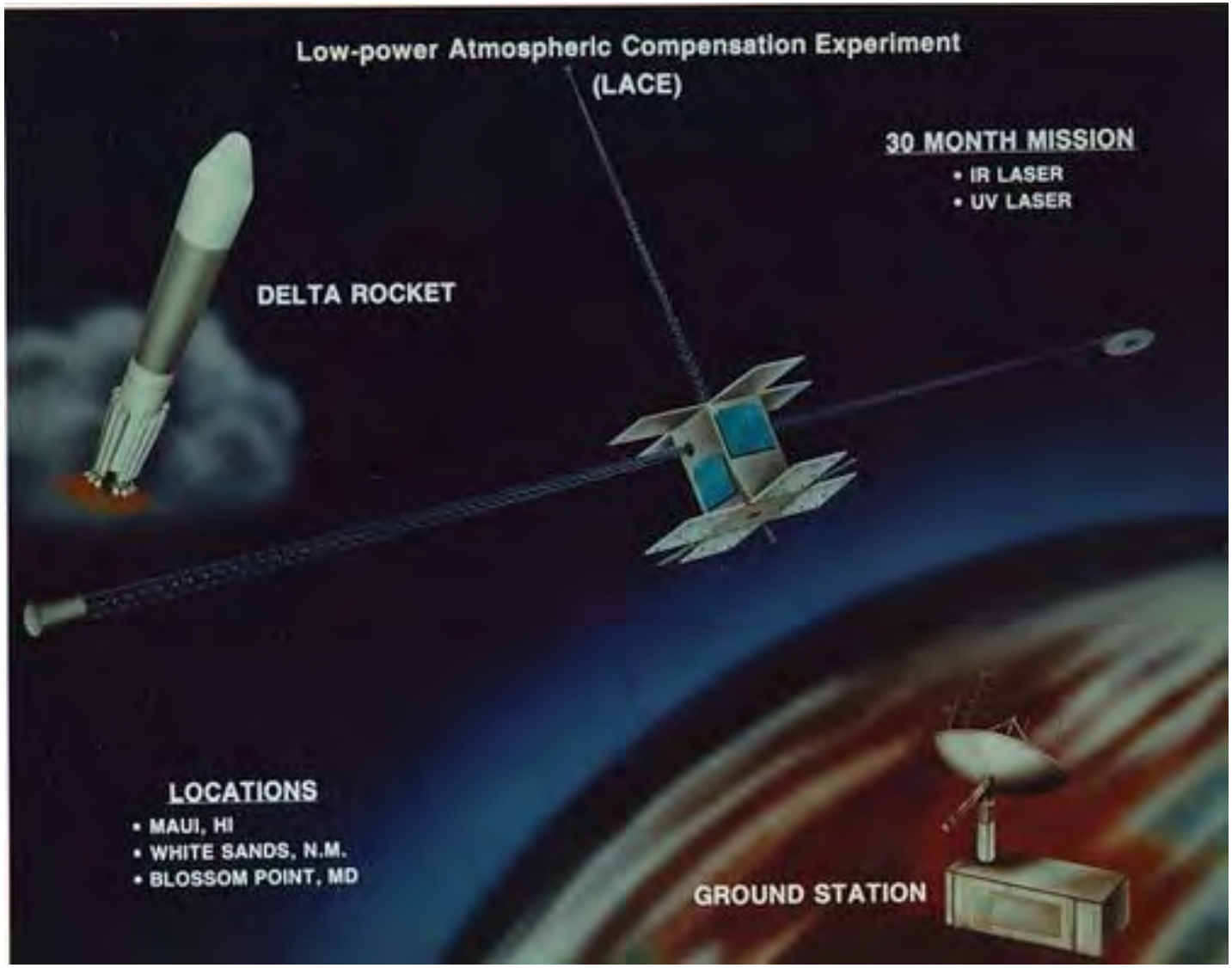
CEO of Interstel at surprise birthday party

The Batcave, Alexandria, VA

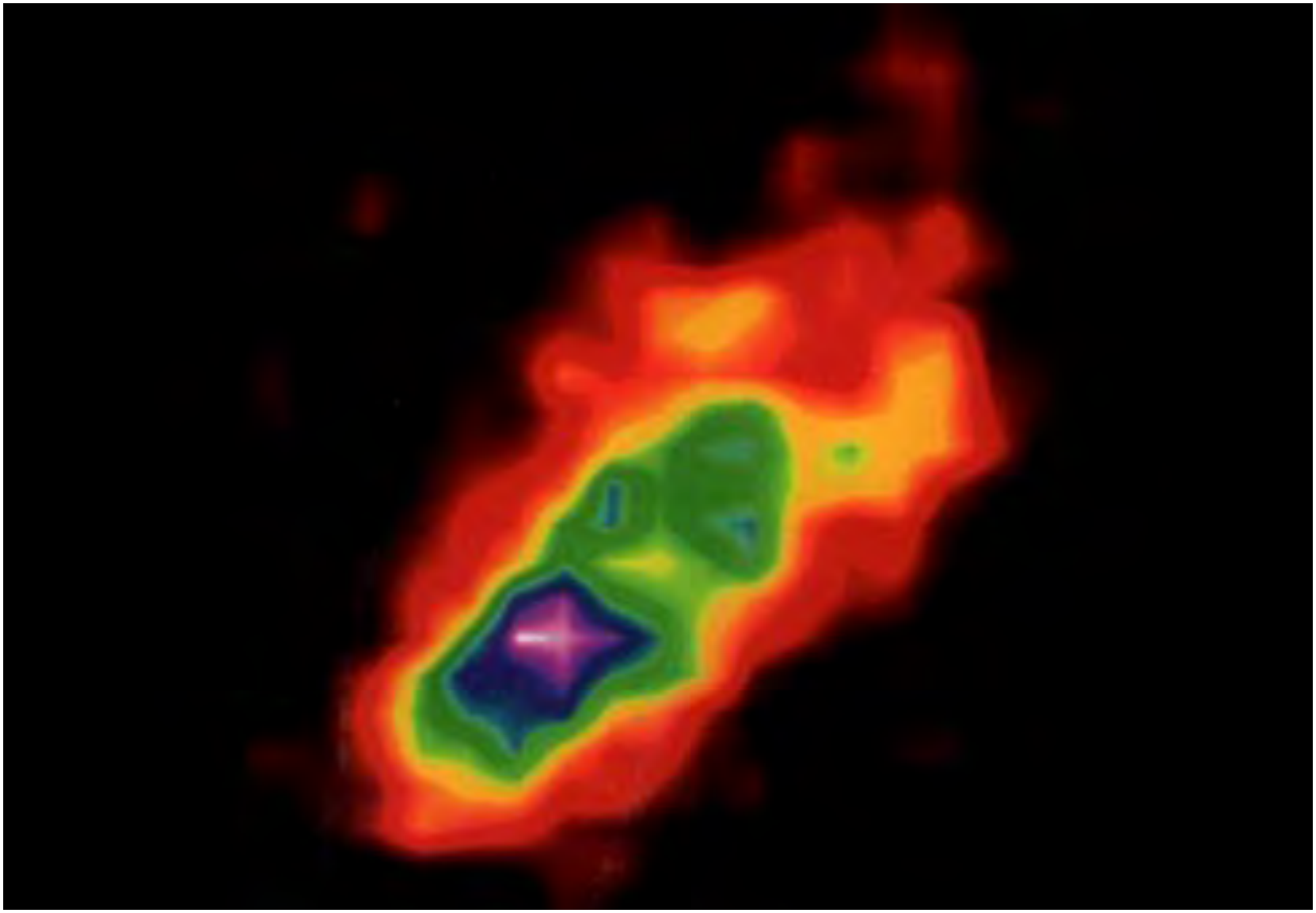
1990-97

LACE Satellite

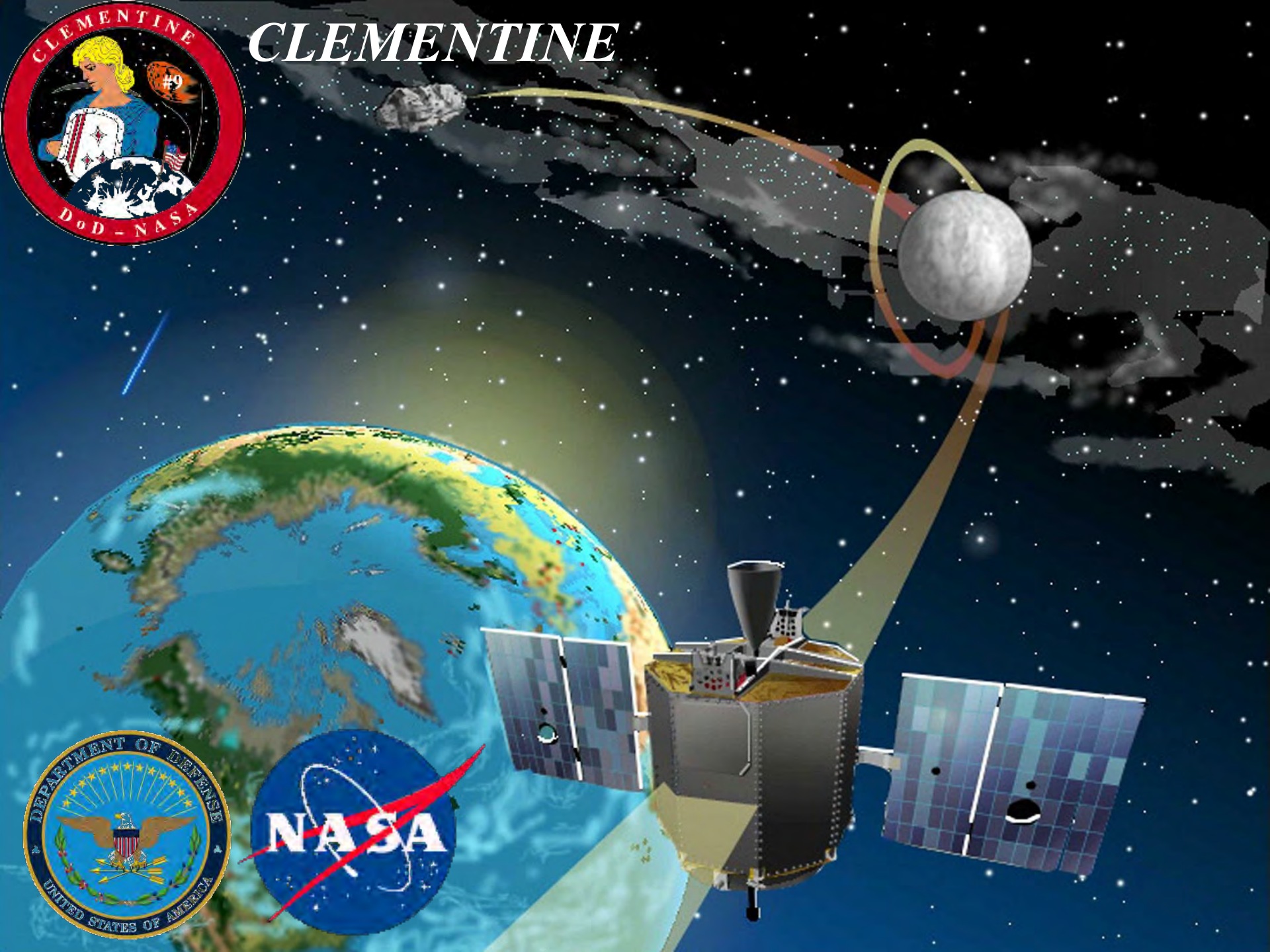
1990-92



LACE Satellite

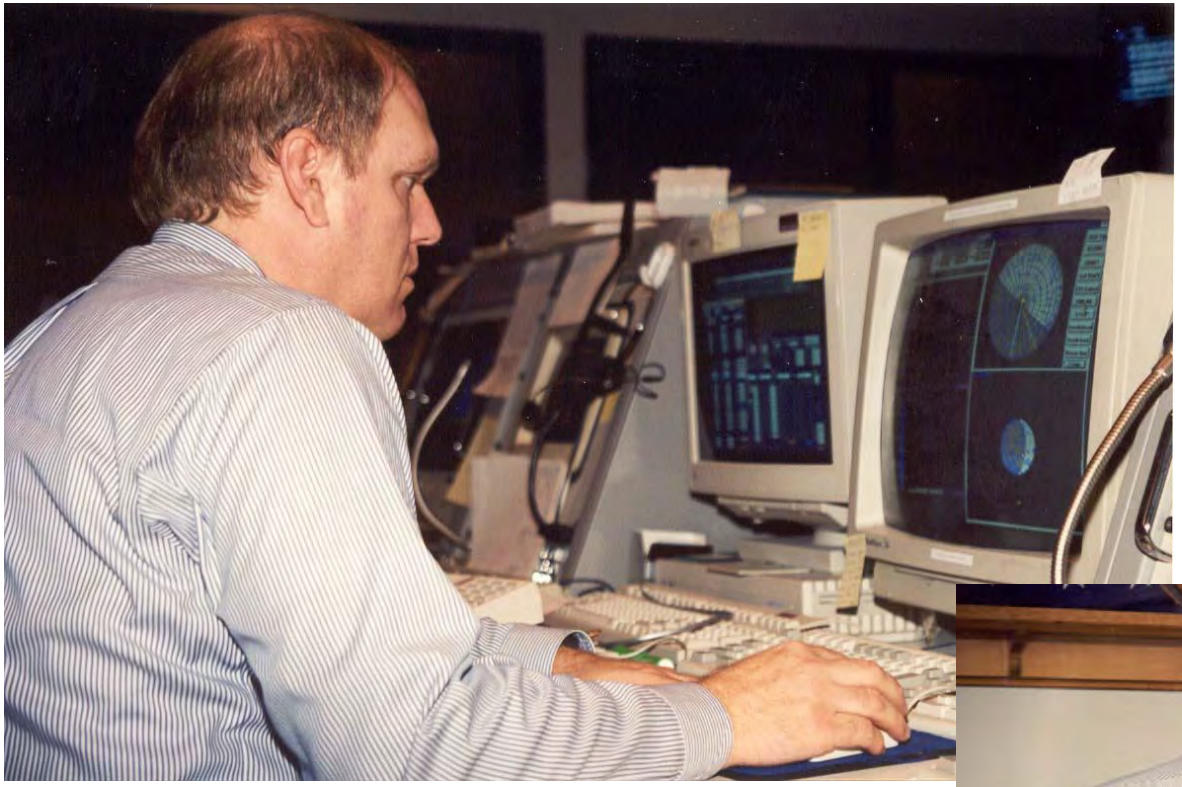


CLEMENTINE

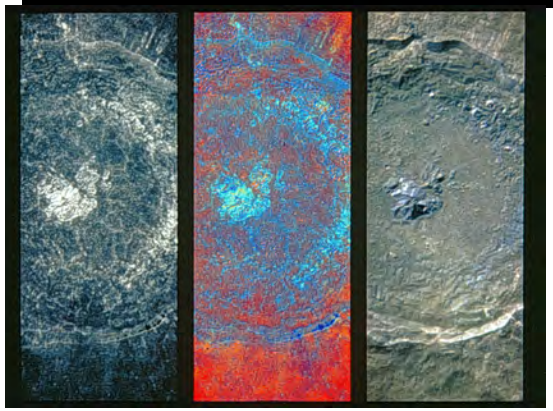

CLEMENTINE
#9
DoD – NASA
DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA
NASA

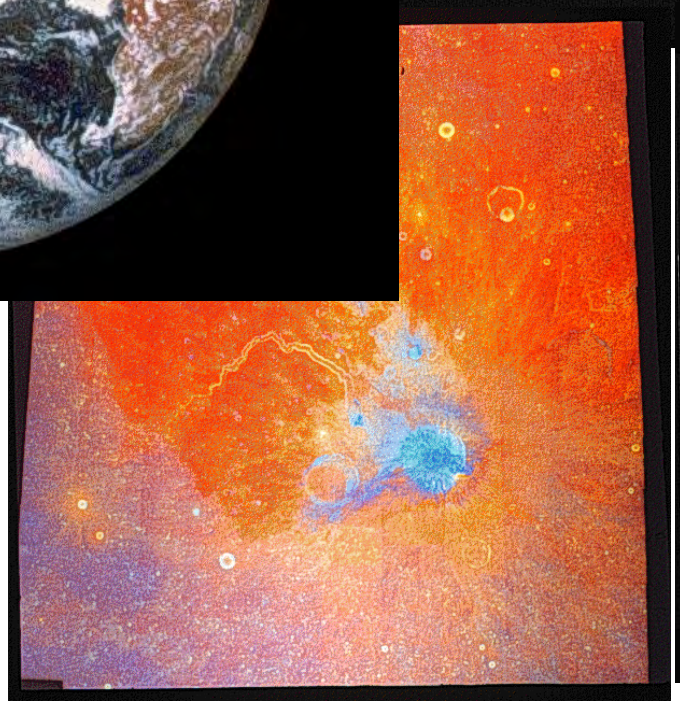
Clementine

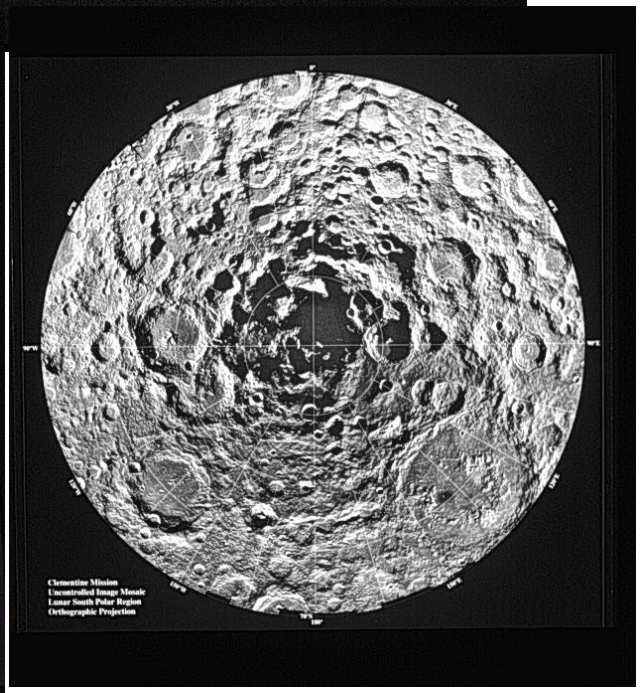
Lunar Mission Manager 1992-95



Clementine






Clementine Mission
Uncontrolled Image Mosaic
Lunar South Polar Region
Orthographic Projection

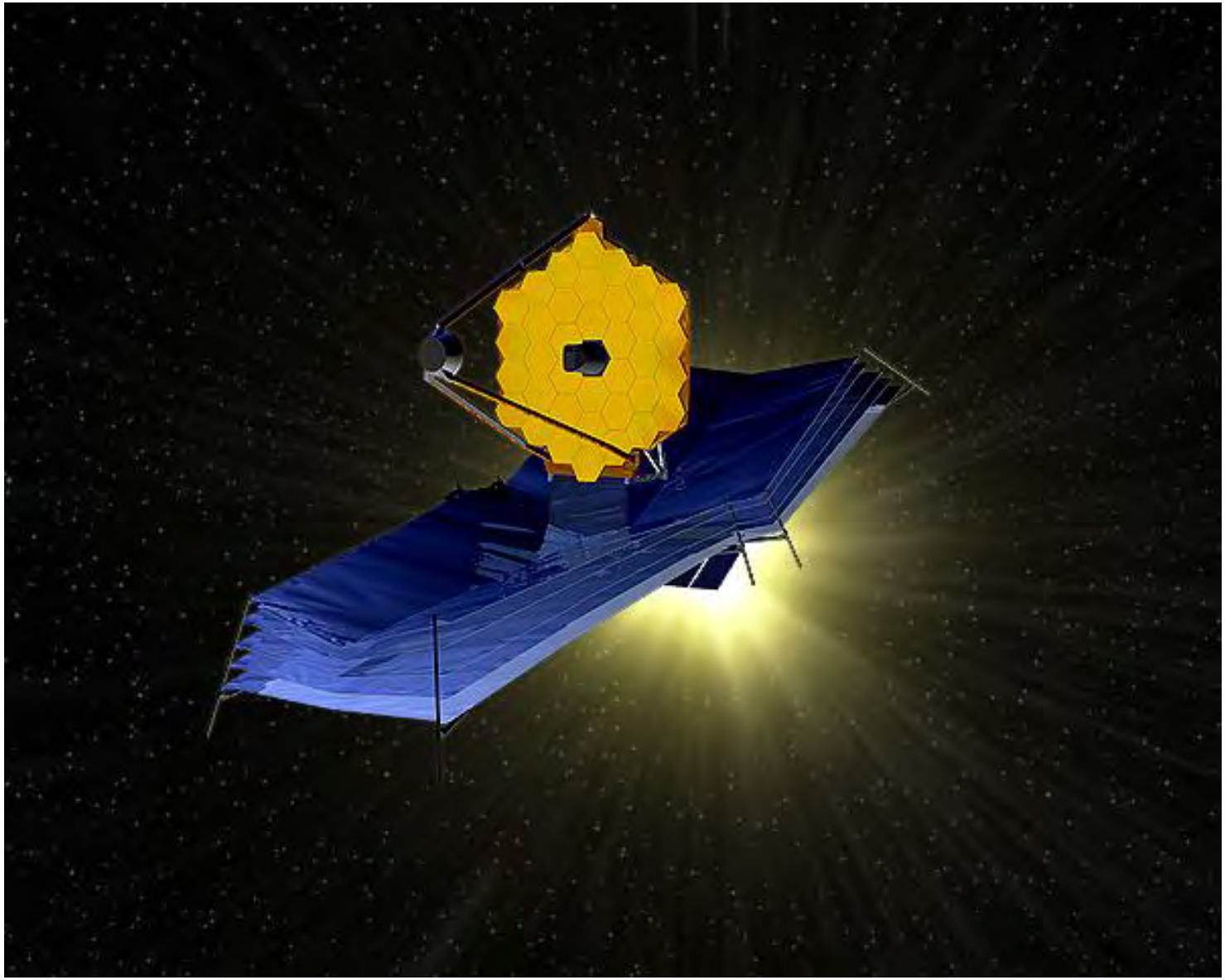
USAF MSTI-3 (1996-97)

DataLynx (1998-2000)

Deputy Project Manager and
Technical Lead
$16 million satellite tracking network
Honeywell

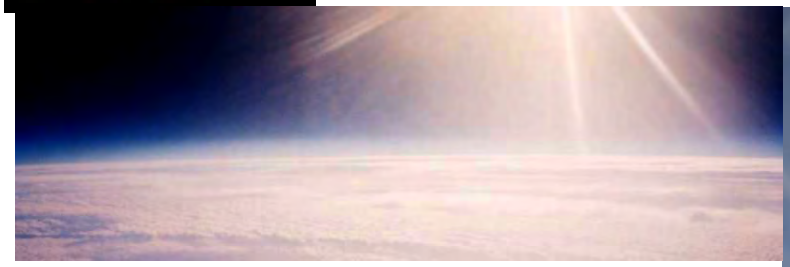
Honeywell

James Webb Space Telescope (NGST)



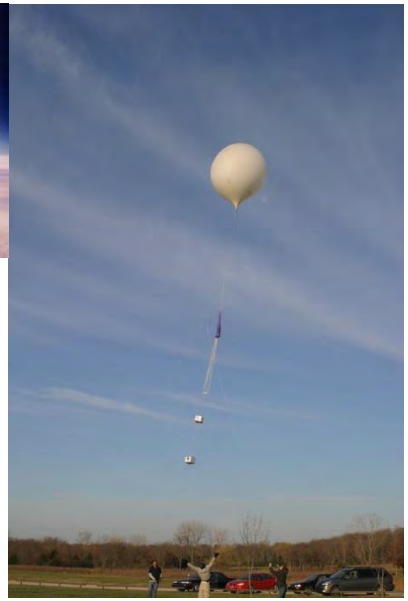
Galileo (JPL – 2001, 2003-4)

KU Projects



HABS-6 view from 100K ft.

HABS



MicroGravity Experiments

CanSat

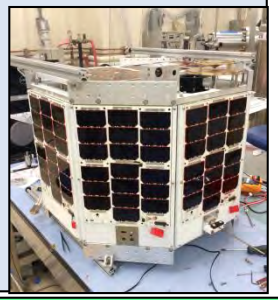
KUTESat
(launched 2006)

The Hawaii Space Flight Laboratory

Major Project Elements

Spacecraft

- Partner with NASA Centers and others to advance small spacecraft design.
- Design, build, launch, and operate 5-100 kg small satellites for science and education tasks.
- Support technology validation missions as well as other University missions.



Integration and Test

- Clean rooms in UH/POST are used to assemble & test satellites
  - Systems integration
  - Thermo-vac testing
  - Vibration/shock testing
  - Payload spin balancing
  - Attitude control testing

Instruments

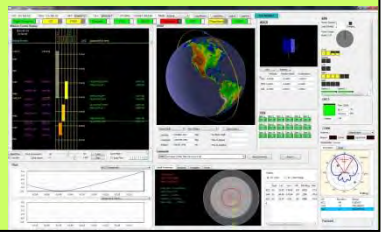
- The HSFL can call on a diverse group of instrument-developing faculty from HIGP and SOEST.
- A number of businesses in Hawaii also develop a wide array of instrumentation. The HSFL will partner with these organizations to provide technology demonstration opportunities.
- NASA Centers (Ames and JPL) are interested in joint technology missions.

Launch Vehicle and Launch Support

- **Pacific Missile Range Facility (PMRF)**
  - Local launch facility and mission support
  - Modify existing PMRF launch pad for rail-fitted and modified VAFB Scout launcher.
- **Kauai Test Facility (KTF)/ Sandia National Lab**
  - Experience with solid rockets and missile design. Use Super-Strypi launch vehicle.
  - Can lift ~270 kg (594 pounds)to low-Earth orbit (400 km).
  - Heritage working with PMRF as on-site vehicle integrator and launch agent.

Ground Station & Mission Operations

- UH/HSFL maintains UHF/VHF receiving stations with Kauai CC and Honolulu CC staff.
- Ground station provides command and control broadcast as well as data downlink capabilities.
- Mission Ops Center and COSMOS mission support tools.

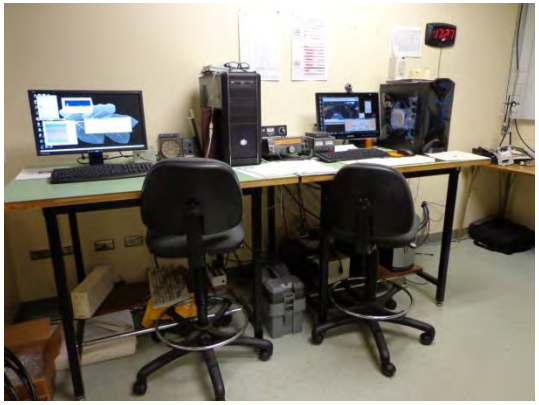


HiakaSat Integration Completed

ORS-4 Launch

- First Super Strypi Launch, Nov. 3 2015
- Failed during first stage
- Next launch in 2020

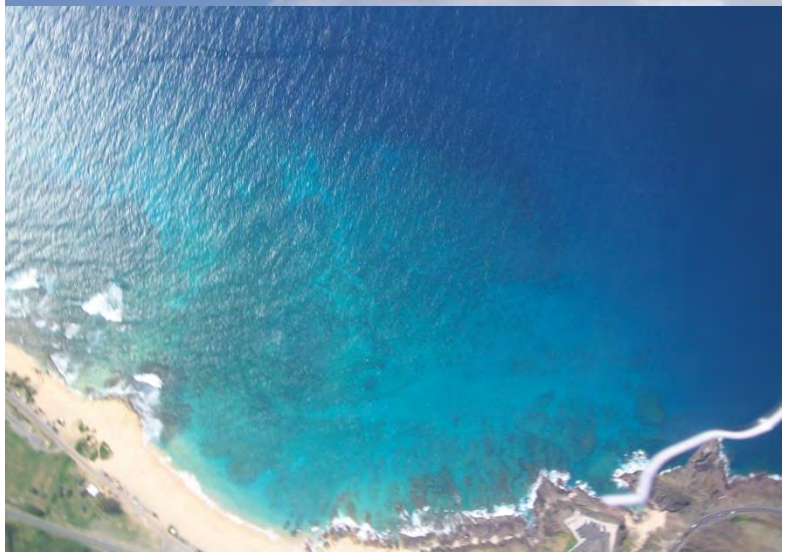
HSFL Ground Stations



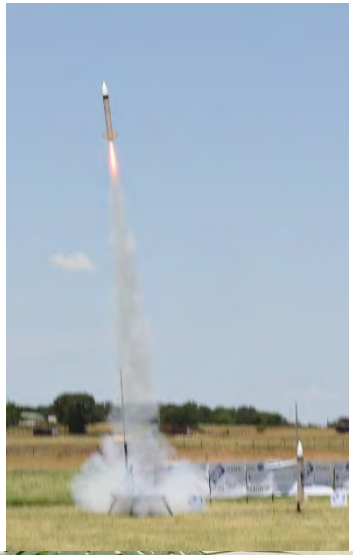
Affiliated Ground Stations:

- Alaska Space Facility (S-band)
- Surrey Space Centre/SSTL (UHF/VHF/S-band)

UHM Projects



UHABS

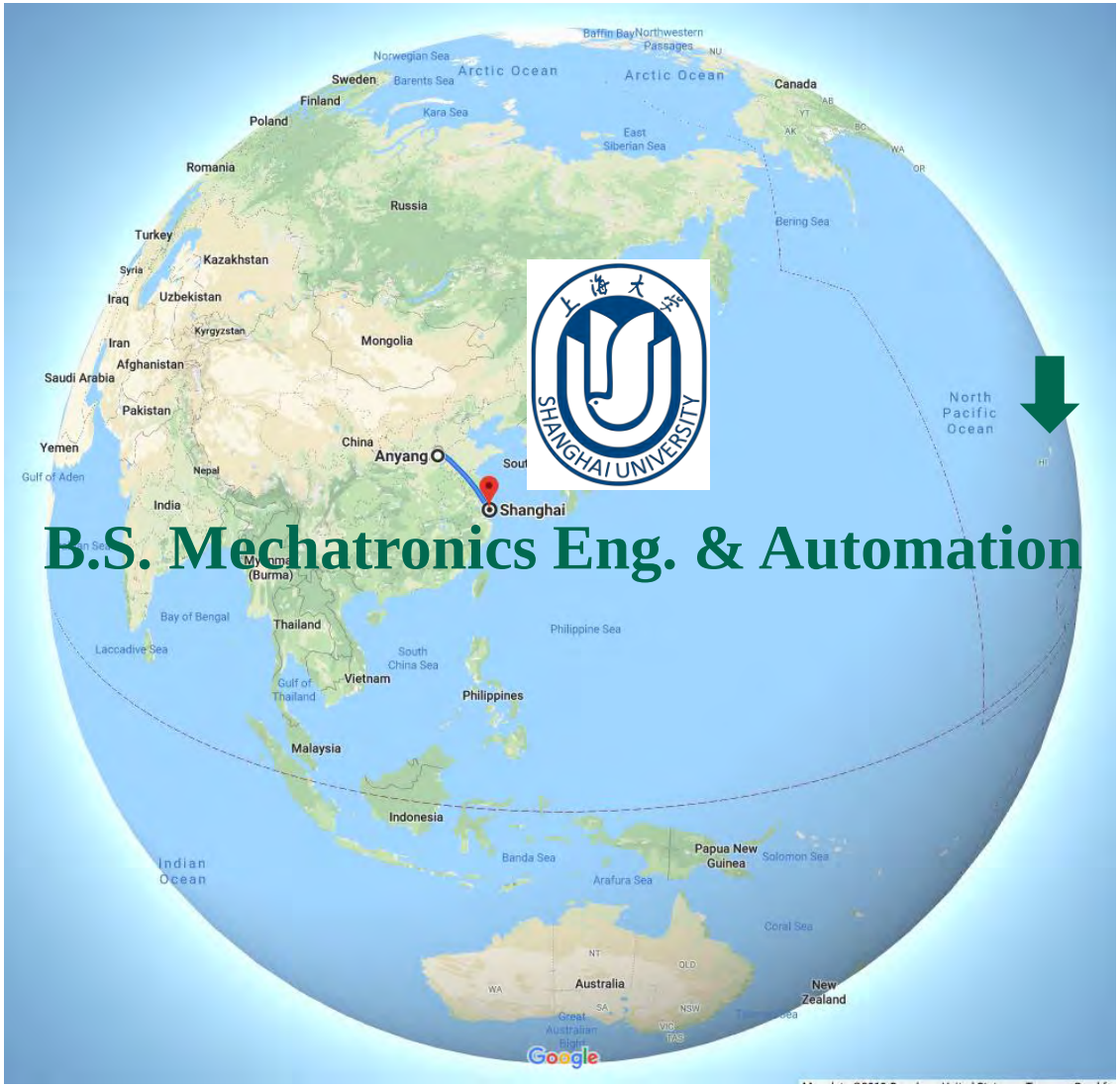


CanSat

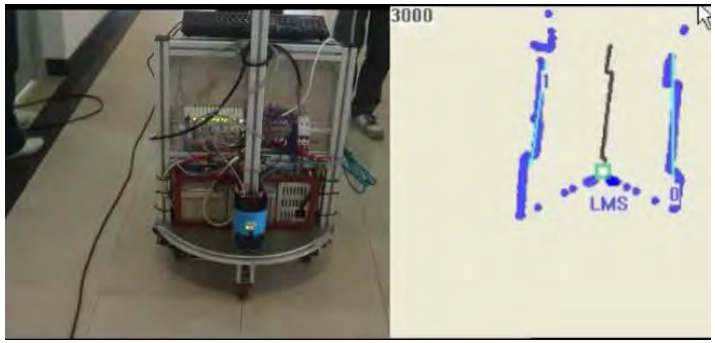
Mahalo!

Who is Dr. Song?

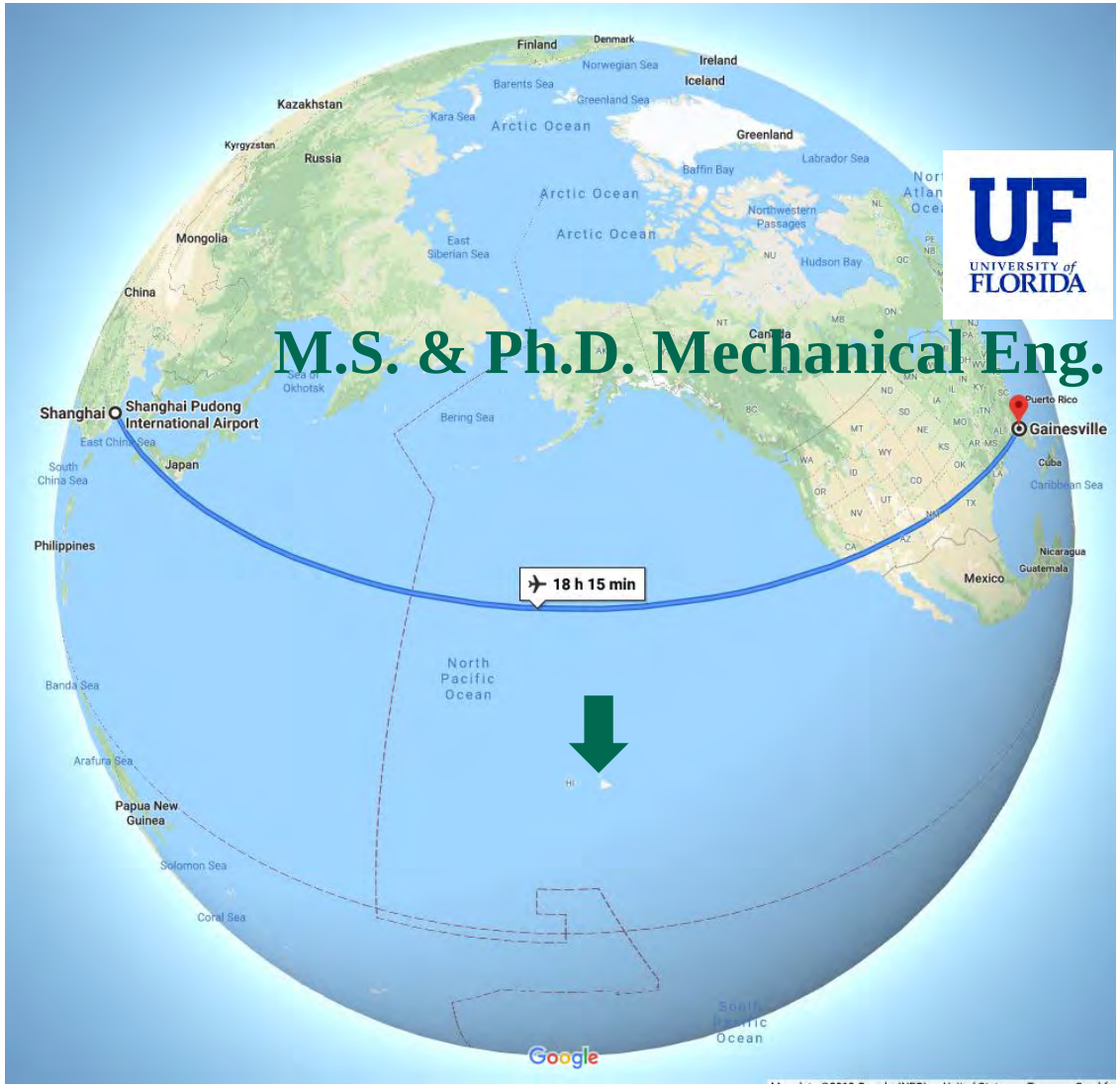
Who is Dr. Song?



B.S. Mechatronics Eng. & Automation



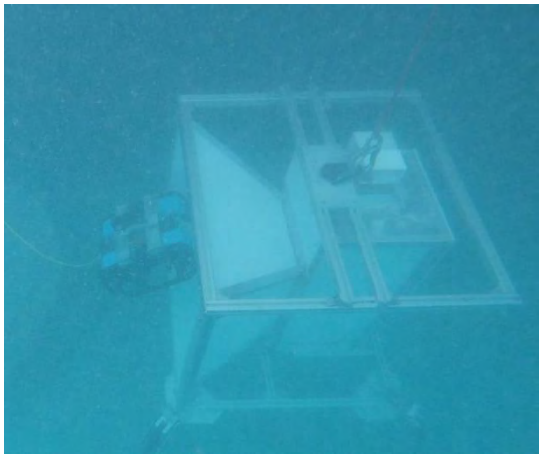
Who is Dr. Song?

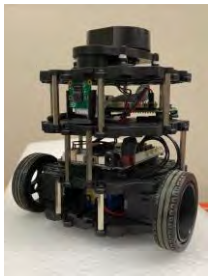


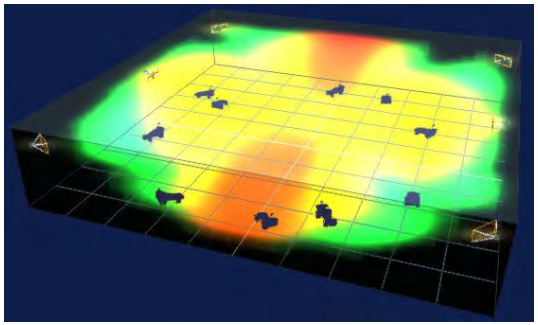
M.S. & Ph.D. Mechanical Eng.

Research Interests:

GPS-denied localization (SLAM), autonomous navigation, underwater robots, multi-robot systems.

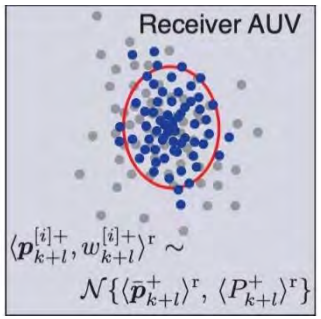


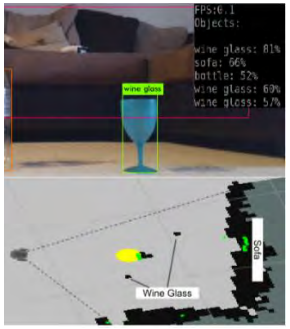


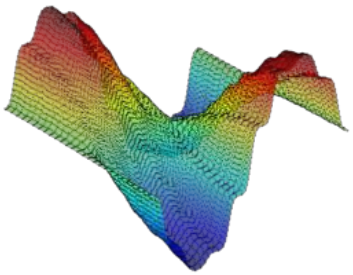


ME 481 – A Trimble, T. Sorensen, Z. Song

Research Interests







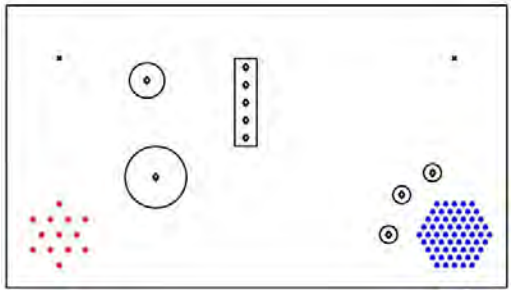
Stochastic inference

Statistical learning

Data-driven modeling

State Estimation
Perception
Decision Making

Swarm intelligence

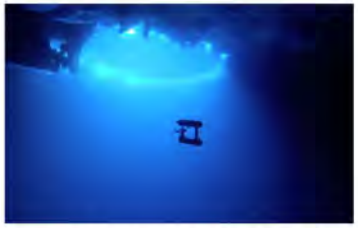


Rich Features:

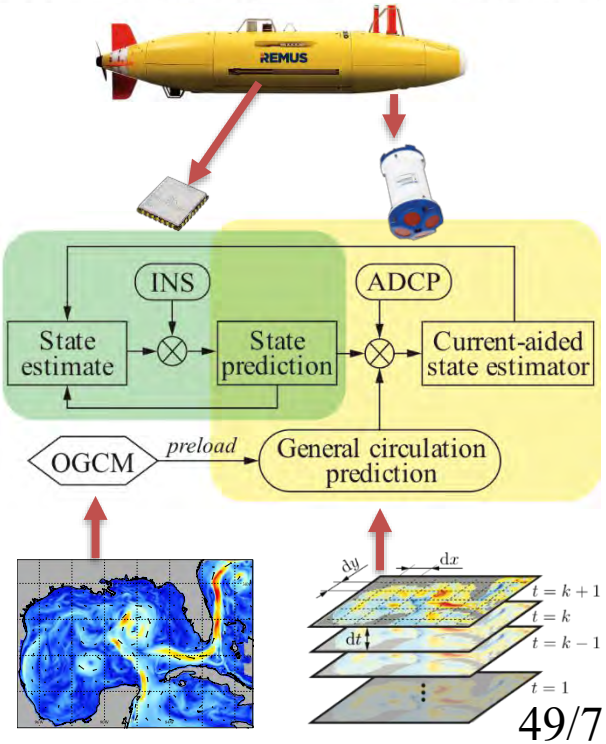
Google street view

Poor Features:

Inside Irma (NOAA)



Underwater (WOHI)



Course Mechanics

- Safety
- Lab Access
- Syllabus & Calendar
- Funding and Purchasing

Safety

- Safety culture
  - Nothing we do here is worth getting hurt over.
  - According to OSHA[1] the #1 workplace injury is "strains"
    - i.e. little stuff that people just don't even think will get them hurt.
  - Safety policy isn't to encourage sneaking or hiding violations or to deter the reporting of incidents – incidents aren't necessarily violations.
    - Report stuff immediately (close the feedback loop) if there is a problem we want to get if fixed. Make sure everyone knows why it happened so it never happens again.
- Lab specific training
  - Anywhere you work make sure you have been trained about the specific hazards of that lab and the safety procedures.
    - Including location of first aid kits, eyewash stations, etc.
- Safety Glasses
  - We try to provide, but officially since this is a lab course you as a student are responsible to have your own personal pair of safety glasses (just like chem lab).
  - We will continue to try and provide safety glasses to make life easier, but "there wasn't any safety glasses left" is not an excuse for being in the lab without safety glasses. If there aren't any left then don't go into the lab until you get some.

1. https://www.osha.gov/oshstats/commonstats.html

Lab Access and Usage Policy

- Lab Access
  1. Read Safety Manual
     - Posted to website
  2. Online Quiz
     - We anticipate the link to go active in week 2
  3. Safety Briefing
     - 9/18/2019 – do not miss or be late
- Equipment Usage
  - Training Modules: *Online course, Online quiz, Hands-on check-off*

    1. *Red*: Hand tools, Drill press, Band Saw, Grinders
    2. *Yellow*: Mill, Lathe, Welders
    3. *Green*: Train other students, Work on Personal Projects
    4. *Specialty*: E.g. Epoxy/Composites, High Risk Electrical
- Must be renewed every *Academic Year*

Safety Enforcement Policy

- Violation of any of the safety policies results in your lab privileges and access being revoked until you can complete a safety assessment and refresher with Mr. Moore.
  - I.e. I'm done telling people to put safety glasses on. If you're in the lab without PPE that is a violation.
- Mr. Moore will complete safety assessments and refreshers as necessary at most once per week.
- If you are found in the lab during a time your access is revoked you will receive an automatic 10% reduction of your grade for each offense.
- A second and all subsequent offenses also results in a 5% reduction for your team.

Syllabus and Calendar

- Syllabus & Calendar

A few final philosophical ramblings

- Science
  - Any organized body of knowledge
- Art
  - A skill or set of skills acquired through a combination of study, observation, practice, and experience, or by intuitive capability or creative insight.
- Engineering
  - A judicious blend of science and art in which natural resources, including energy sources, are transformed into useful products, structures, or machines that benefit humankind.
  - Engineer's objective: fulfillment of some human need or desire
  - Engineers utilize or apply scientific knowledge together with artistic capability and experience to produce products or plans for products.

Fail Early and Often

- Yet it is that discipline of quickly leaving mistakes in the past that distinguishes the superstars from the "also-rans.“
  - Simon Constable

- Toddler Effect
  - Must get your hands dirty
  - Focus on end goal – Final success, but not incremental failures
- Mark Rober, “The Super Mario Effect,” TEDxPenn, YouTube.
  - Attitude
    - “Okay, that sucked, but what did I learn and what correction do I need to make or what else should I try”
    - Reframe your challenges
    - Learn from but not focus on the failures

Heuristic Course

"… we run the danger of losing sight of the larger purpose of learning. When learning is reduced to the acquisition of information, and education's only purpose is to build a resume and get a job, then something critical is lost."

- Charles Inouye

ase.tufts.edu

Projects

- Not all projects presented will be available
- Maximum bandwidth of about 9 projects
- Scope, potential for success, existing obligations

Integrated Industrial Automation of a Pneumatics System (IIAPS)

- What is this project?
  - An Industrial project that addresses the lack of trained engineers in the industrial air distribution industry of Hawaii.
- Who in the local industry is involved?
  - Victor Industries, Diamond Bakery LLC
- How will this benefit students?
  - Real-world experience with a professional in the industry; theory, design, modeling, prototyping, implementation.
  - Experience with industry standard software, State of Hawaii regulations, and expectations of professional engineers.
  - Practical application of all undergraduate topics.

The skills gained through this project are all in <u>high demand</u> and <u>not available locally</u>. The project provides an opportunity to have a student led engineering design implemented into the operation of an active local industrial factory.

Funding and materials will be provided by Diamond Bakery LLC.

Sand Sifter Improvement/Automation

East side beaches of Hawai'i are covered in microplastics, and the same is true for any windward facing beach in the world

The current state of the art requires volunteers to sift by hand using rudimentary tools

Together, we can create an automated or more efficient sand sifter that will help save the world from the threat of microplastics

sustainable coastlines Hawaii

SURFRIDER FOUNDATION

4ocean

karmagawa

SAVE THE REEF

PARLEY

We have direct contact with these organizations for funding support

For more info, contact Shane: sabrown4@hawaii.edu

Myoelectric Interface "Prosthosis"

Spasticity

- The continued "spasm" or contraction of muscles that can prohibit the ability to function independently
- Working with a patient suffering from spasticity to target what she would like in this device

Our Proposal

- Design a "prosthosis", an exoskeletion like device capable of correcting myoelectric signals in patients with spasticity
- One-on-one patient contact allows for ability to see direct impact in community

Support

- Won $2000 in the Medical Needs category from MIND Hawaii
- Continuation of this project which has been underway for a year
- Collaboration with doctors and patients from Kapiolani Medical Center

SAE Electric Formula

SAE Formula is going Electric

- Funding/Support
  - HECO
  - NISSAN USA
  - Tesla
  - Ulupono
- Multidisciplinary
  - EE

RWR - SAE Formula 2018 Team

RWR Racing: uhmfsae.org

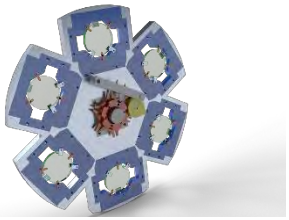
UH Drone Technologies (UHDT)

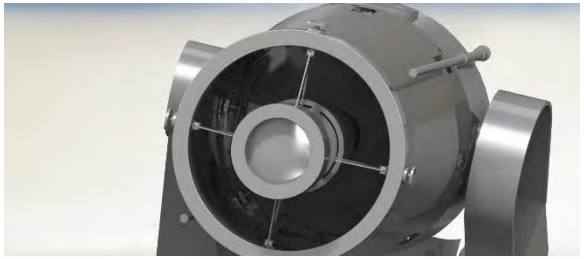
- Vertically Integrated Project (VIP)
- Focused on unmanned aerial and ground vehicles
  - With package delivery and search and rescue capabilities
- Competed in an international aerial systems competition for the past 4 years (AUVSI SUAS Competition)

- Contact info- uhdronetech@gmail.com & ehihara@hawaii.edu

Manoa Astronomical Technologies (MAT)

- Multidisciplinary VIP Project

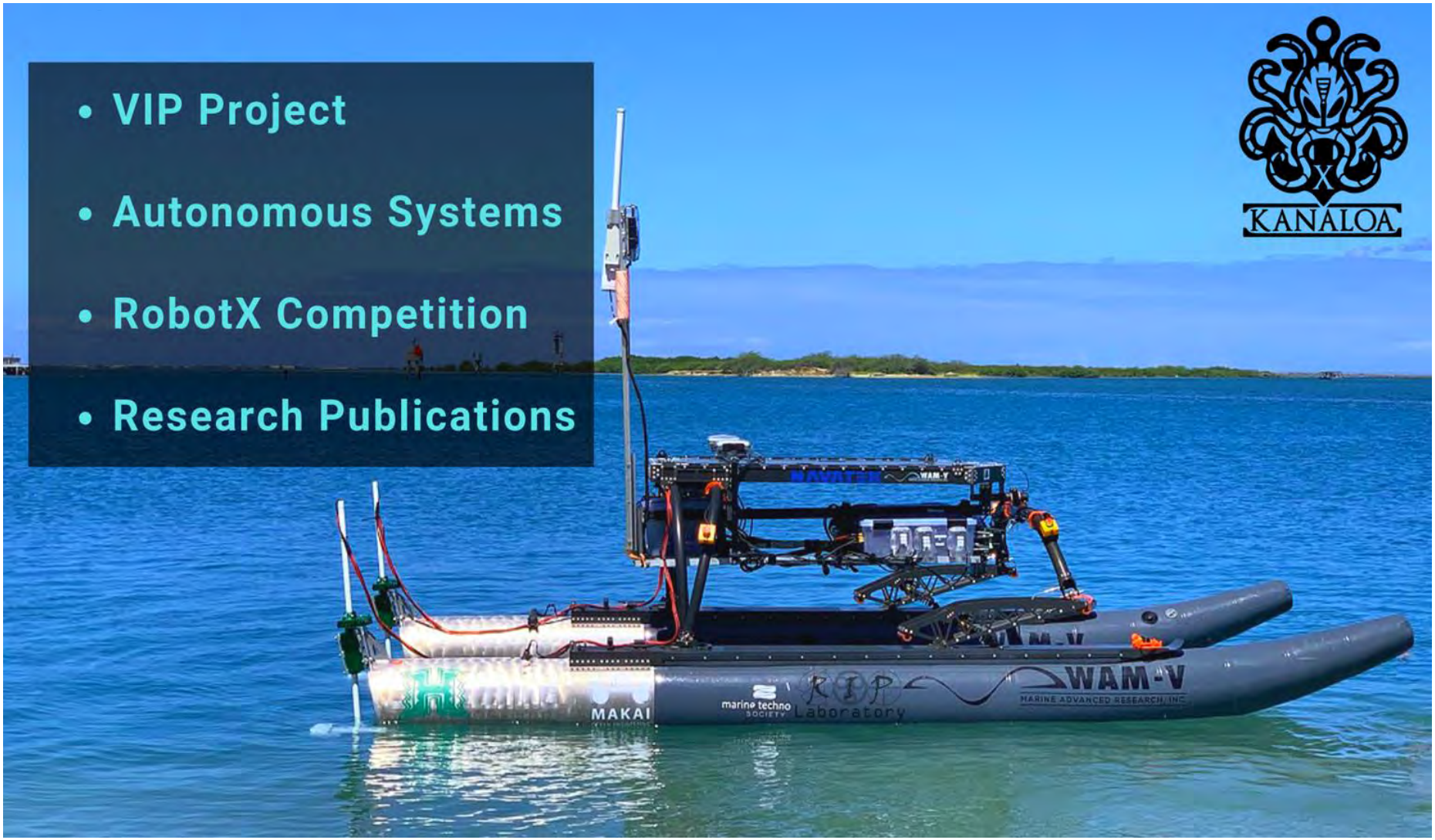




Pioneer 1A's inaugural run

First Light Image (Jupiter and Europa) taken at UH Manoa – yeah despite the light pollution.

Team Kanaloa



- VIP Project
- Autonomous Systems
- RobotX Competition
- Research Publications

Section 1 Project 1: BalloonSat

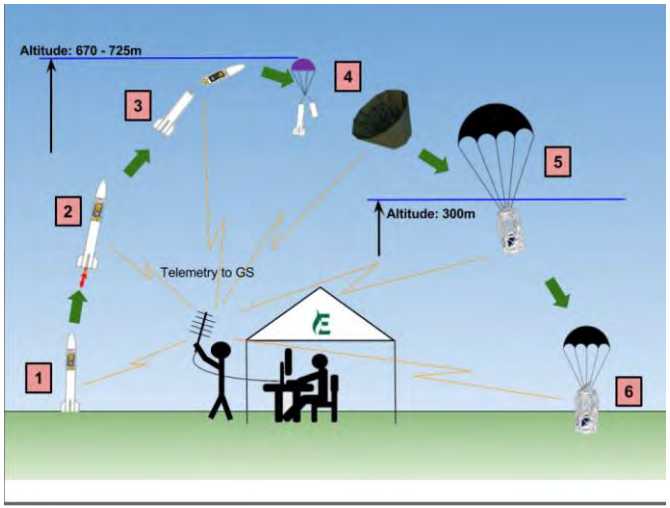
CanSat Competition Overview

- International competition (~100 teams from >10 countries)
- Held in early June (Texas?)
- Maximum 10 students on team
- Develop payload to be launched by a high-power rocket according to mission specifications

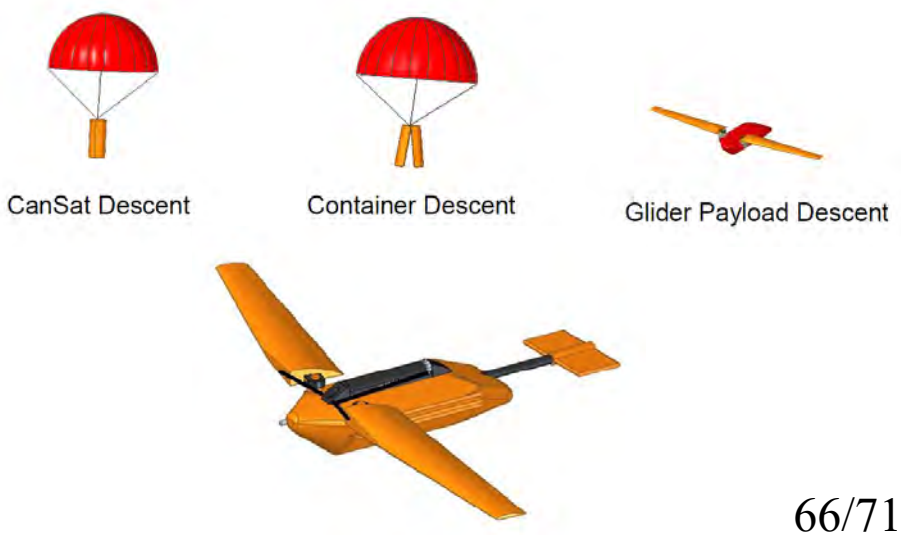
2020 Mission

- Design a Cansat that will consist of a container and a science payload. The science payload shall be a delta wing glider that will glide in a circular pattern, once released.
- The Cansat shall be launched to an altitude ranging 670 meters to 725 meters above the launch site and deployed near apogee (peak altitude).
- Once the CanSat is deployed from the rocket, the CanSat shall descend using a parachute at a descent rate of 20 m/s. At 450 meters, the container shall release the science payload. The science payload shall glide in a circular pattern collecting sensor data for one minute and remain above 100 meters after being released. Afterwards, the glider shall deploy a parachute to cause the glider to stop gliding and drop to the ground at a rate of 10 meters/second.
- The science payload shall monitor altitude, air speed and the science payload shall be a particulate matter/dust sensor to detect particulates in the air while gliding.

Typical CanSat Flight Profile



From 2016 CanSat Team

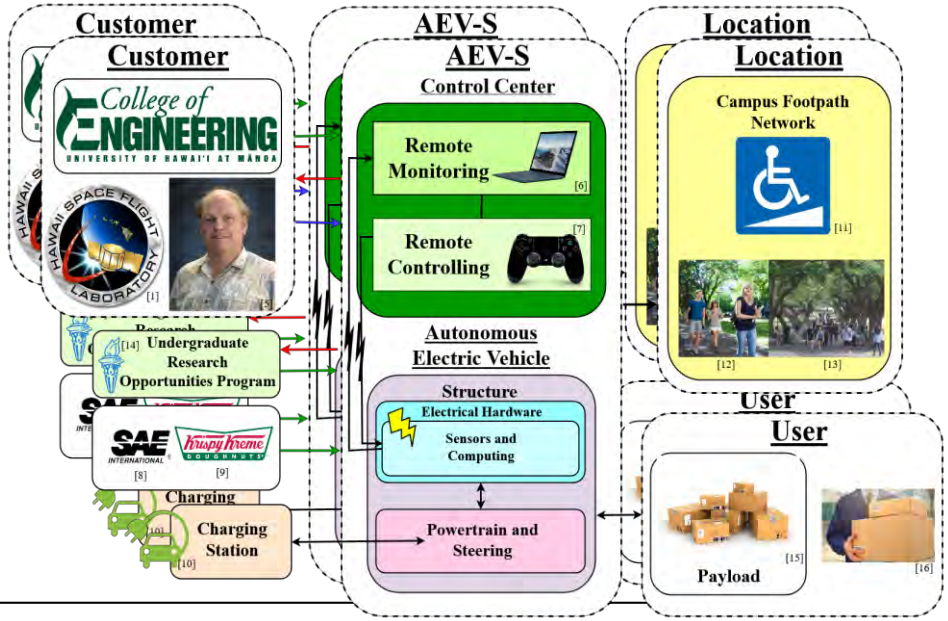


Section 1 Project 3: AEVS

Autonomous Electric Vehicle System Overview

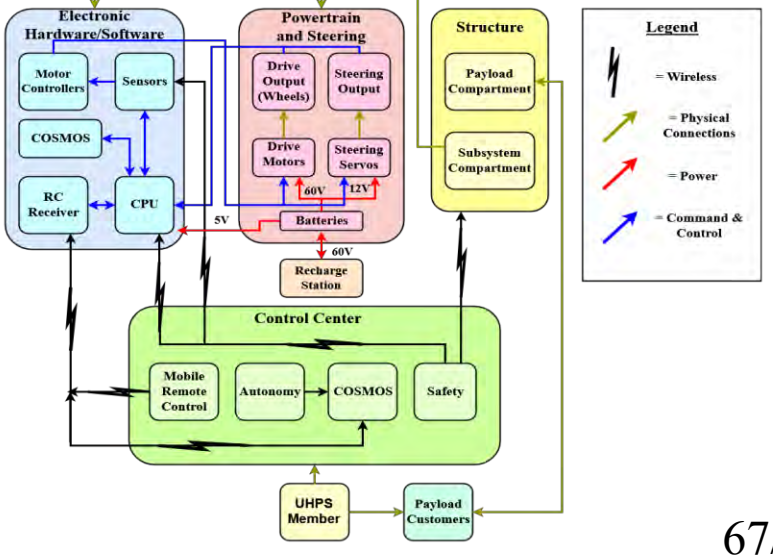
- **The goal of the project is to create an AEVS that will consist of a fleet of autonomous electric vehicles that will be able to carry cargo while navigating the upper campus of the University of Hawai'i at Manoa (UHM), delivering packages to buildings along specified routes.**
- The 2017-18 class built a prototype vehicle that was operated either by remote control or by a driver
- The 2018-19 class built a different prototype vehicle that was operate by remote control or by limited autonomous control. A basic ground control system was developed using HSFL's Comprehensive Open-architecture Solution for Mission Operations Systems (COSMOS)
- The 2020 class will develop a more autonomous vehicle that will be a final prototype before production.

System Architecture



Final 2019 Prototype Vehicle

Functional Flow Block Diagram (FFBD)



Section 1 Project 4: Rocket

Overview

- Team Hokulele is a project under the Aerospace Technologies VIP group. It focuses on the design, fabrication, and testing of high-powered rocketry systems.
- During the 2018-19 school year, the team built a solid motor propelled rocket intended to reach an altitude of 10,000 ft. This rocket was flown at the Spaceport America Cup competition
- For 2020 school year, the team will design and construct a new rocket system which will be flown at the 2020 Spaceport America Cup competition.

2020 Mission

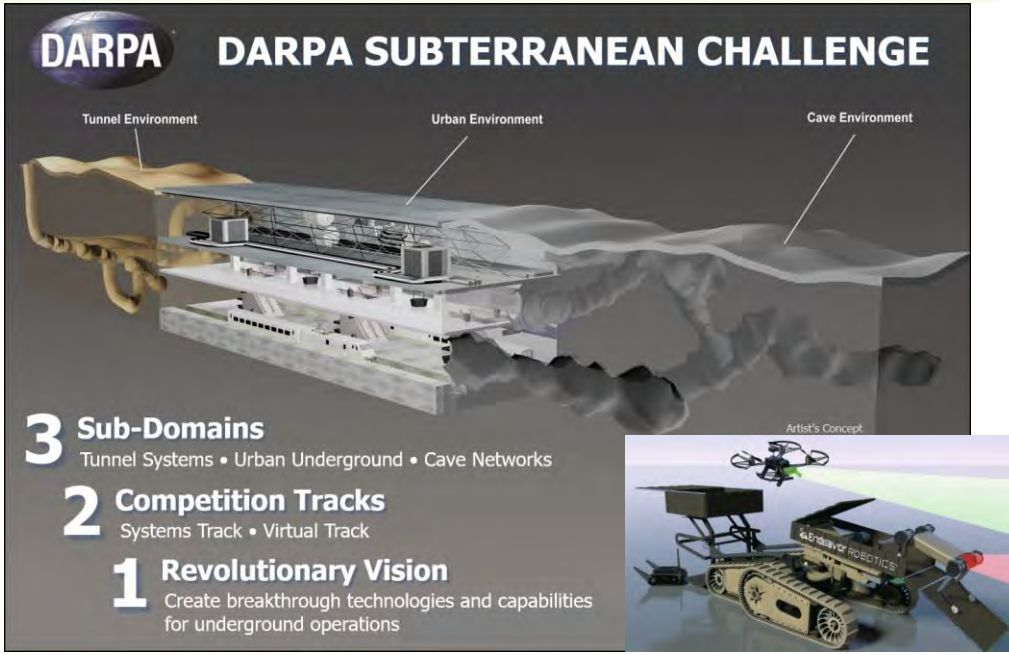
- This rocket would compete in the "Commercial Off The Shelf" (COTS) 30K category and the Space Dynamics Laboratory (SDL) Payload Challenge at the Spaceport America Cup. Below is a list of potential experiments and payloads that could be flown in this rocket.
  - Vertical Autonomous Landing System (Mars Lander)
  - Autonomous/Remote Controlled Deployable Drone
  - VR 360 Camera Payload
  - Biological Payload

Consider flying CanSat as payload

Subterranean Autonomous Vehicle (SubTAV)

Objective: Design and test SubTAVs for autonomous mapping of caves/lava tubes

- Reference the DARPA SubT Challenge
- 4 challenges: *Autonomy*, *perception*, *networking*, and *mobility*
- Partner with UH West Oahu Disaster Preparedness & Emergency Management (DPEM) program
- DPEM students will act as student program officers



Mermaid cave

Halona lava tube

Makua cave

Collaborators:

- Prof. Jason Levy (UHWO)
- Reiko Lovan (DPEM, Air Force)
- Dayna Akagi (DPEM, Army)
- Mattew Kaea (Fed. Fire Dept)

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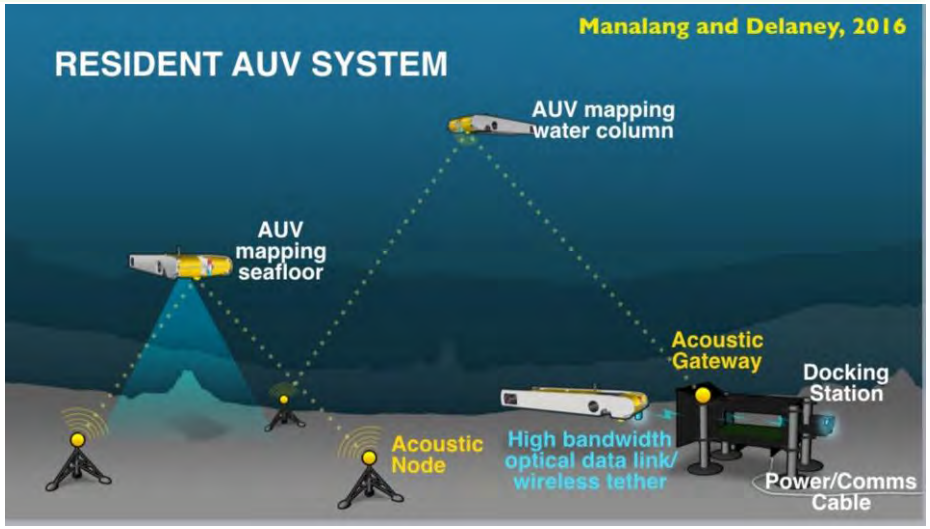
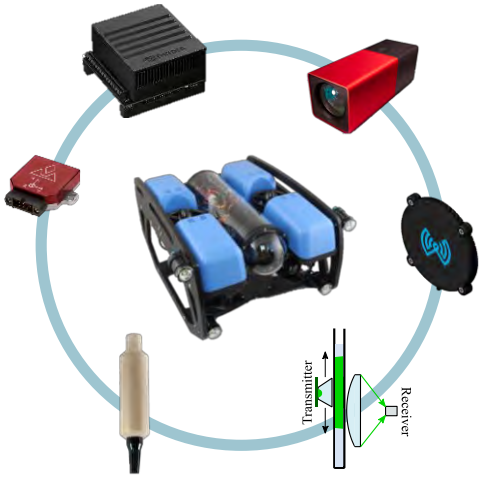
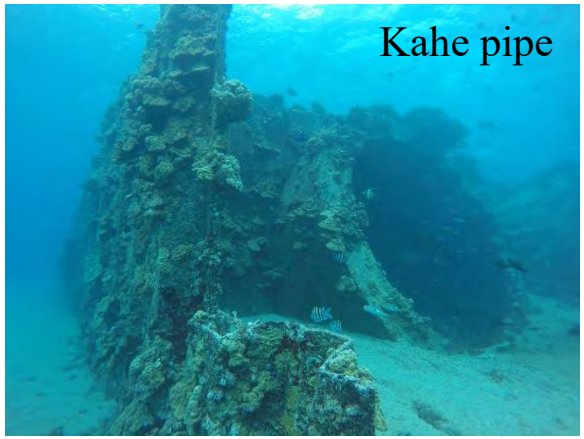
Resident Autonomous Underwater Vehicle - Research (RAUV-R)

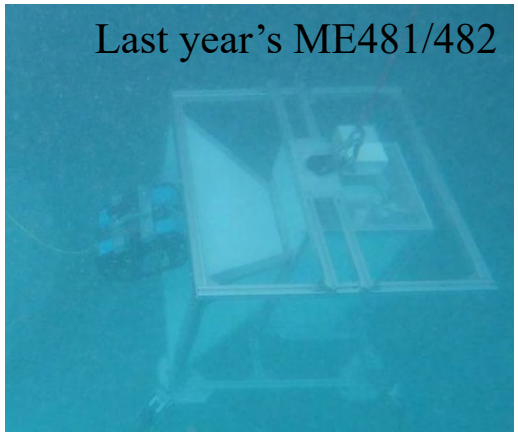
Objective: Adapt a BlueROV2 (provided) into an RAUV capable of diver assistance

- *Missions*:
  - Sensor selection and calibration
  - Data acquisition and visualization
  - Autonomous system development
  - Custom components design and fabrication
  - System integration









- Partner with UHWO DPEM program
- Demonstrate capability in inspection of Kahe powerplant outflow pipe

Collaborators:

- Prof. Jason Levy (UHWO)
- Joshua Hayworth (DPEM, PADI dive master)

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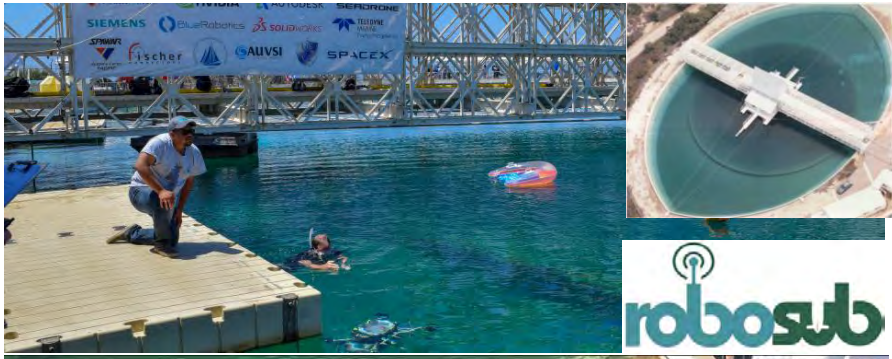
Resident Autonomous Underwater Vehicle - Competition (RAUV-C)

Objective: Develop and test a competitive autonomous underwater vehicle for RoboSub 2020

- *Time*:
  - July/August 2020
- *Location*:
  - NIWC Pacific TRANSDEC, San Diego, CA
- *Missions* (RoboSub 2019):
  - Navigate through gates
  - Touch buoys
  - Drop markers
  - Manipulation/torpedoes
  - Retrieve object(s), surface, move/release object(s)



Collaborators:

- Jonathan Wallen (ME PhD student)
- Weihang Mai (VIP EE student)