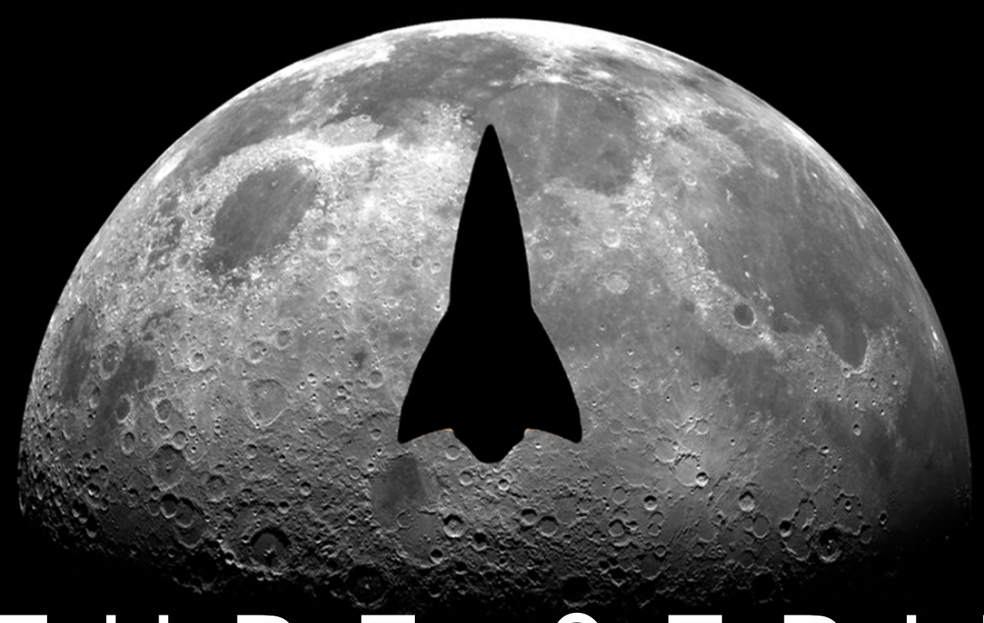
Caltech
SPACE CHALLENGE
March 26-31, 2017

sponsored by AIRBUS DEFENCE & SPACE



PUBLIC LECTURE SERIES

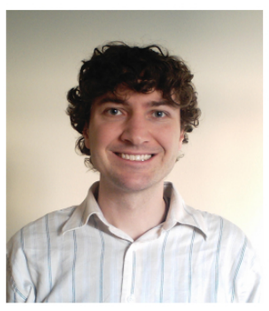
MARCH 27-31, LEES-KUBOTA LECTURE HALL, GUGGENHEIM 133

Mar 27 9 am

Space Mission Formulation and System Engineering

Steve Matousek, NASA JPL

Where do space missions come from? What level of maturity does a space mission concept have? These questions are covered as well as what makes a sound concept. Roles and how the team works together are as important as the technical and business model for the concept. The best practices for systems engineering and ensuring the concept covers all important aspects are vital. Finally, figures of merit and how a concept is judged is covered. This short lecture will give a taste of what it is like to work on early advanced concepts and expose what it takes for a concept to be carried forward to the next step.



Orbital Mechanics: Designing a Mission to a Lunarport

Damon Landau, NASA JPL

Mar 27 10 am

When designing a mission to a Lunarport there are many options up for consideration: inject onto a fast, high-energy trajectory or enjoy a more “lethargic” route, choice of propulsion technologies and deceleration systems, where to stage and store resources, and the inclusion and timing of critical events. Often the choice of mission design isn't driven by engineering, but by programmatic concerns: mission timeline and timeframe, development schedule, budgets, operational complexity, and compatibility with existing and encouraged technologies. The talk will touch upon these bases and details on trajectory options around the Moon. The talk will also provide a few suggestions for the (hoped to be) more promising mission architectures around the Moon.

Mar 27 1 pm

Blue Origin: Vehicles and Technologies to Lower the Cost and Increase the Safety of Human Spaceflight

A.C. Charania, Blue Origin

Founded by Jeff Bezos, founder and CEO of Amazon.com, Blue Origin is focused on developing vehicles and technologies to lower the cost and increase the safety of human spaceflight. Driven by our company motto, Gradatim Ferociter or “step by step, ferociously,” our incremental development process builds upon each success as we develop ground-breaking spaceflight systems. Blue Origin is developing the New Shepard suborbital system to take astronauts into space for space tourism and science purposes, demonstrating a reusable, vertical landing rocket. Our New Glenn family of orbital launch vehicles will carry astronauts and payloads to low-Earth orbit destinations and beyond. Similar to our suborbital vehicle, the first stage booster will separate and land back on Earth. Expendable second and third stages will propel the capsule into orbit, toward scientific research and exploration. At Blue Origin, we envision a future with millions of people living and working in space.

Lunar Prospecting & Mining

Kris Zacny, Honeybee Robotics

Mar 28 11 am

This presentation will detail two projects currently under development at Honeybee Robotics for near term lunar ISRU-focused missions. The first project involves development of a sampling drill for volatile-rich lunar regolith as part of NASA's Lunar Resource Prospector. The talk will describe the technology development required to reach TRL 6, as well as the range of tests the system was subjected to. These tests include drilling in volatile-rich lunar analog soil and sample delivery inside a lunar chamber. The second project involves volatile extraction technology for large-scale mining operations. In a more conventional approach, feedstock is mined and transported to a processing plant. Here, an alternative design will be presented that combines the mining and extraction steps into one and eliminates the transport step. I will present several approaches, vacuum chamber test data, and lessons learned.

Mar 28 1 pm

Robotic Refueling and Cryogen Replenishment for Future Space Applications

Brian Roberts, NASA Goddard

This talk will highlight the work of NASA’s Satellite Servicing Projects Division in Robotic Refueling and Cryogen Replenishment on the ISS as a precursor for technology demonstration missions. This presentation will focus on the challenges associated with robotics, cryogen transfer in space and the planning needed for future exploration missions.

Operational Issues in Lunar Polar Resource Exploration

Jay Trimble, NASA Ames

Mar 30 9 am

NASA’s Resource Prospector (RP), planned for a 2022 launch, will explore a polar region of the Moon in search of volatiles. To locate, characterize and analyze volatiles, the mission includes a rover for mobility, prospecting instruments to locate and characterize volatiles, a drill to collect regolith samples, and an in-situ resource utilization (ISRU) payload for analysis. The lunar polar regions are a unique operational environment. Temperatures are among the coldest in the Solar System. The likely volatile rich areas are in permanently shadowed regions (PSR). The regolith characteristics of PSR’s are not well understood, posing issues for rover design and driving. Any extended operations in a PSR requires a non-solar power system, and/or power storage. The proximity of the Earth to the Moon allows for moving computational power to the ground for some operations, though communications systems may impose data rate limits.

Mar 30 1 pm

Pegasus!

Antonio Elias, Orbital ATK

Pegasus was conceived on April 8, 1987 as the smallest economically practicable space launch vehicle that could be developed within the budget and capabilities of a small start-up with no government or large financial backing. Air-dropping the rocket rather than lifting off vertically from pad both reduced the size of the rocket and eliminated the need to develop multiple launch sites for different orbits. Pegasus was developed by a small (40 person) fully-dedicated team in three days short of three years, and is still in use today, having successfully placed in orbit 80 satellites in 40 launches in the past 26 years. The speaker was personally involved in the development and early flights of Pegasus, and will share his recollections, lessons learned, successes and disappointments.

Caltech Space Challenge Final Presentations

Mar 31 2 pm

Humans have lived in space, walked on the Moon, and now have Mars in sight. Sending humans beyond LEO has many challenges, including that the mass of fuel required to leave Earth significantly limits the mass available for the remainder of the mission. But what if we could refuel in space? Caltech Space Challenge participants will present their design for Lunarport, a launch and supply station for deep space missions. Lunar in-situ resource utilization will allow more massive payloads to be launched from Earth, bringing deep-space a little closer for human exploration.

AIRBUS DEFENCE & SPACE · Microsoft · Keck Institute for Space Studies · Orbital ATK · Northrop Grumman · Moore-Hufstedler Fund mhf.caltech.edu · Blue Origin · Boeing · Lockheed Martin · Schlumberger · Honeybee Robotics Spacecraft Mechanisms Corporation · GALCIT · JPL · Caltech Division of Engineering and Applied Science