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The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

ESMD-Faculty Fellowship Report

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Southeastern Regional Space Grant Meeting

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Charleston, SC

NASA Kennedy Space Center
Higher Education Programs
ESMD Space Grant Project

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Purpose of the NASA ESMD Faculty Fellowship

- Prepares a number of selected university faculty to mentor senior design students to complete projects during the 2010-2011 academic year with potential contribution to NASA ESMD objectives.
    - The faculty gain extensive knowledge on the ESMD project and develop materials for use by their senior design students using a systems engineering approach.

Project Goal

2010 Faculty Fellowship Solicitation

- 8 weeks on a selected ESMD project
- At Kennedy Space Center (KSC) for one week
- Incorporate project into an existing senior design course or capstone course in the 2010/2011 academic year.
- Work side-by-side with a NASA technical expert.
- Gain extensive knowledge on the ESMD project and associated requirements, interfaces and issues affecting the design and potential solution(s).
- Develop materials for use during the 2010/2011 academic year
- Use a systems engineering approach

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Overview of ESMD projects

Spacecraft

Guidance, navigation, and control; Thermal; Electrical; Avionics; Power systems; High-speed reentry; Interoperability/Commonality; Advanced spacecraft materials; Crew/Vehicle health monitoring; Life-support systems; Command/Communication software; Modeling and simulation

Propulsion

Methods that utilize materials found on the Moon and Mars; On-orbit propellant storage; Methods for soft-landing

Ground Operations

Pre-launch; Launch; Mission operations; Command, control, and communications; Landing and recovery operations

Lunar & Planetary Surface Systems

Precision landing software; In-situ resource utilization; Navigation systems; Extended surface operations; Robotics; Environmental sensors and analysis; Radiation protection; Life-support systems; Electrical power and efficient power management systems

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Significance of ESMD Projects to NASA's Mission and ESMD Objectives

- Education and outreach of ESMD
- Gathering ideas while creating experience
- Create long lasting experience that translates to students for many years
- Create translation to lower level students for further development of workforce
- 600 students exposed this year alone

Course Integration

- Material covering the basics of System Engineering will be incorporated into the course at UNC Charlotte via lecture
- A specific lecture will be given detailing the System Engineering process
- An additional lecture on documentation maintenance and configuration control is also scheduled

Overview of knowledge gained during summer experience

- System Engineering
- On-center and NASA procedures
- Great space-flight immersion
- Specific Project Knowledge
  - Lunar Regolith Physical Properties
  - Current Design Work and Philosophy
  - Stakeholder Meetings
  - Embedded with current design team, working with design engineers tasked with the project

Project Definition - Cryogenic Fluid and Electrical Quick Connect System

- Quick connect functionality for both electrical and fluid connectors used in extraterrestrial
- Use of commercial off the shelf (COTS) electrical and fluid connectors as a design basis will help in minimizing system costs.
- The project's goals are to create quick connect/disconnect hardware that is operable by an astronaut wearing a space suit, in any gravity condition.
  - The hardware shall operate in zero gravity and near perfect vacuum and be adaptable to non-terrestrial locations with aggressive atmospheres and unusual contaminants.

Project Definition (ctd) - Cryogenic Fluid and Electrical Quick Connect System

- The system shall also include an installation tool to overcome large mating forces
- The system shall feature geometry to assure correct connector alignment for engagement
- The system shall have a dust exclusion system to minimize, if not eliminate, any dust that could impinge or collect on the connector interface surfaces.
  - This design effort will include a standardization effort, such that three distinct sizes of connector systems result.

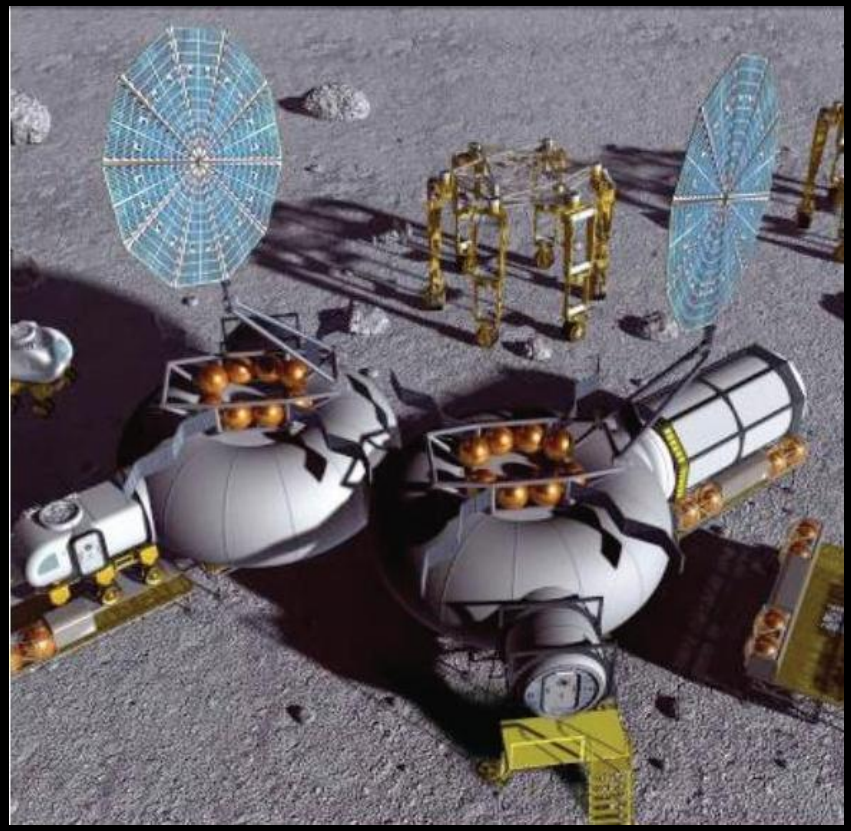
Lunar Regolith Design Case

- Particle Shape
- Particle Size Distribution
- Composition
- Lessons Learned
- Simulants
- Hard Vacuum
- Other Planets / Bodies

Outpost Infrastructure

- Modular Layout
- Water
- Atmosphere
- Fuel
- Process Fluids
- Electric Power (High Voltage)
- Electric Signals (Low Voltage)

Proposed Outpost Layout



Complementary Technologies

- Consumables Scavenging
- Consumables Transport
- Consumables Production
- Suit Exterior Interface Station
- Construction Equipment
- Desert Operations

Use of Existing Standards / COTS

- Mil-C-24231
- Mil-C-24217
- Mil-DTL-26482
- ISO 7241

Conclusions

- Bridges the gap between academia and the NASA vision and mission. Students connect to real world space-related work.
- Exposes students to new and novel approaches to space exploration that better prepare them for future space-related careers.
- Creates greater awareness of current NASA research to new faculty who have never been previously associated with or exposed to the NASA vision and mission.
- Motivates incorporation of Systems Engineering curriculum to enrich the experience and increase the knowledge base of participants.