2009 ESMD Higher Education: Faculty Fellowship Project
Subset of ESMD Projects

Project ID	NASA Center	ESMD Related Area	Title	Description
ARC4-08-SD	Ames Research Center (ARC)	Spacecraft	Fluidized Bed Synthesis of Carbon Nanotubes	The project involves producing carbon nanotubes in large enough quantities to fabricate composites for civil and space aviation.
ARC5-06-SD	Ames Research Center (ARC)	Ground Operations	Prognostics for Complex Systems - Damage Propatation Modeling	The Prognostics Center of Excellence at NASA Ames Research Center is conducting research in systems health management. This involves the early assessment of abnormal conditions and damage as well as the estimation of "remaining life" of a component or subsystem. The goal is to research damage propagation mechanisms and to model damage using a physics-based approach for select application domains (e.g., power semiconductors, electro-mechanical actuators, composite structures, batteries, ?)
ARC5-07-SD	Ames Research Center (ARC)	Ground Operations	Prognostics for Complex Systems	The Prognostics Center of Excellence at NASA Ames Research Center is conducting research in systems health management. This involves the early assessment of abnormal conditions and damage as well as the estimation of "remaining life" of a component or subsystem. The goal is to contribute towards the state of the art in uncertainty management which is a critical component of prognostics.
GSFC1-01-SD	Goddard Space Flight Center (GSFC)	Lunar and Planetary Surface Systems	Design of a Spacecraft to Support a Lunar Mission	Engineers would give the students a set of instruments and a lunar orbit and let them design the spacecraft to support the mission. This project would be suitable for a class where the student already knows something of designing spacecraft.
GSFC1-07-SD	Goddard Space Flight Center (GSFC)	Lunar and Planetary Surface Systems	Lunar Terrain Categorization	Lunar Terrain Categorization: Surface mission operational planning has been identified as one area of special interest within the Scientific Context of the Moon Exploration. Specifically, technologies that will enable scientists to perform terrain categorization, and in particular to detect, identify and characterize rocks, will be studied. Once lunar data is geo-registered & mosaiced to a common Lunar Geodetic Grid, these tools will assist scientists in determining general regions of interest, in performing precise targeting of specific types of samples, & in avoiding hazardous landing sites. Regions of interest will mainly be determined by understanding and characterizing potential lunar resources (minerals, ice, etc.) and their spatial distribution, their abundance, density, and distribution, relative to future missions and in-situ instruments that will be needed to perform additional detailed analyses. Rock identification will play an essential role in targeting specific samples, and rock location and distribution will be essential for selecting landing sites while avoiding hazards.

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GSFC1-11-SD	Goddard Space Flight Center (GSFC)	Lunar and Planetary Surface Systems	Inverse Synthetic Aperture Radar (ISAR) for Interior Mapping of Asteroid	This project has a goal to develop hardware & software for low frequency wideband step frequency ISAR radar. Low frequency ISAR is used to image interior structure of an unknown target such as asteroid/comet and other planetary bodies. ISAR consists of 3 basic subsystems: (1) Base band signal generation and base band I & Q data processing, (2) Analog RF front end, and (3) Antenna. Using either Xlinx/Altera FPGA board and Analog Devices' DDS chips entire base band operation will be programmed and implemented. The analog RF front end will be assembled from commercially available RF components. The data acquisition and processing will be implemented through the FPGA. Development of data processing algorithm to form a 2-D image of interior portion of a target will also be part of this project.
GSFC1-13-SD	Goddard Space Flight Center (GSFC)	Lunar and Planetary Surface Systems	Communications, Standards, & Technology Laboratory	The student intern will participate in the development & integration of technologies and systems into the GSFC Communications, Standards, & Technology Laboratory (CSTL). The CSTL is a facility capable of testing and demonstrating complete end-to-end mission communications scenarios from onboard spacecraft computer systems, ground station RF systems, terrestrial networking systems, to the mission control center. The work available ranges from software development to digital and RF hardware design. Current activities include demonstrations and development of Lunar Surface communications scenarios.
JSC1-19-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Producing Oxygen from Lunar Soil	America will send a new generation of explorers to the moon. Once on the moon, astronauts will stay in pressurized habitats. This project involves the design of in-situ resource utilization oxygen production pilot plants. These plants will produce pure oxygen from lunar regolith (soil) to enable a sustainable lunar outpost.
JSC1-20-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Proton Exchange Membrane Fuel Cells	Fuel cells are likely to be key to lunar lander and lunar outpost operations. Key to developing lightweight and reliable fuel cell plants is the ability to manage reactants and water with no active pumps or other components. This project would examine the technologies needed for passive reactant control, passive cooling, and water removal by wicking. Prototyping of one or many of these technologies is desirable.
JSC1-38-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Biotechnology System Development for Lunar Outpost in Situ Resource Utilization	This project seeks to develop and test an innovative biotechnology-based resource production system for future space exploration. This research will provide new opportunities for the in situ resource utilization (ISRU) enterprise for cleaner, safer, and more efficient production of oxygen, metals, fuels, and organics for lunar outpost needs. The objective is to develop a sustainable integrated system covering the whole life cycle of products to enhance human activity at the lunar outpost. We propose to develop and test a hybrid, geobiochemical, light-driven reactor to provide outpost resources. The process is based on our discovery that the extracellular products synthesized by litholitic cyanobacteria are able to dissolve (synonyms: leach, deteriorate, break down, weather) rocks; e.g., ilmenite, an analog of lunar glasses. In the initial phase, we will extend our current studies on biomining by litholitic cyanobacteria to characterize the biogeochemical dissolution (leaching, etc.) of lunar soils and minerals within the system 'microbes' rocks.) The major objective is to develop an effective biotechnological process to extract elements

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KSC1-05-SD	Kennedy Space Center (KSC)	Lunar and Planetary Surface Systems	Lunar Regolith Excavation O2 Prod/Outpost Emplace	The feedstock required for O2 production on the moon is Lunar Regolith (soil). 100 metric tonnes (MT) of Lunar Regolith will be required each year for Oxygen Production of 1 MT. In addition up to 2,000 MT of regolith excavation will be required per year in the initial stages of Outpost construction. This project will investigate concepts for Lunar Regolith excavation equipment and propose solutions in the form of completed designs and prototypes.
KSC1-06-SD	Kennedy Space Center (KSC)	Lunar and Planetary Surface Systems	Lunar Operations Cryogenics Consumables Transfer	Oxygen that is produced on the moon must be transferred to the end user. In addition there will be residual propellants on the descent stage that can be scavenged and re-used as valuable commodities. This project will identify methods for cryogenics consumables transfer and appropriate dust tolerant interfaces.
KSC1-07-SD	Kennedy Space Center (KSC)	Lunar and Planetary Surface Systems	Umbilicals and Quick Disconnect Couplings for Lunar Cryogenics Consumables Transfer	A Quick Disconnect (QD) Fluid Coupling that is dust tolerant and does not leak is required for transferring cryogenic and other liquid consumables on the moon.
LARC1-12-09	Langley Research Center (LaRC)	Lunar and Planetary Surface Systems	Development of Lunar Technology Educational Display	The primary objective for this project is to develop an educational display and/or software to understand the challenges engineers face as they create technologies that will enable humans to live and work on the Moon. The display or software could include a simulation of the Small Pressurized Vehicle, which will help astronauts work on the Moon.
LARC1-17-09	Langley Research Center (LaRC)	Lunar and Planetary Surface Systems	Design, Modeling, and Performance Simulation of Lidar Systems for Sensing Trace Gases	Lidars for sensing water vapor, ice, and several atmospheric trace gases are being investigated. Students will develop computer models for evaluating the merits of several lidar techniques for optimum system development. There could be some test experiments, provided students have requisite training in using lasers that includes laser safety training and eye exams.
LARC1-18-09	Langley Research Center (LaRC)	Lunar and Planetary Surface Systems	Development of Mid-IR Laser-Based Differential Absorption Lidar (DIAL) for Water Vapor Detection	Students will be involved in developing the capability (modeling and simulation) of sensing water vapor on Mars and in other planetary atmospheres using lidars. (There could be some test experiments provided students have requisite training in using lasers that include laser safety training and eye exams.)
MSFC1-07-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Radiation Effects on Electronics Modeling	Develop advanced models of the natural radiation environment to diagnose and predict the effects of Single Event Effects (SEEs) on modern electronic architectures.
MSFC1-08-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Reconfigurable Computers	Provide reconfigurable computing capability, resulting in reduction of flight spares and risk reduction for limited circuit lifetimes.

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Project ID	NASA Center	ESMD Related Area	Title	Description
MSFC1-20-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	NASA X-TOOLSS (eXploration Toolset for Optimization Of Launch and Space Systems)	Description: Use of the NASA X-TOOLSS software for design optimization of conceptual space systems. NASA X-TOOLSS is based on genetic and evolutionary algorithms, which have proven successful for global optimization of complex systems, and for applications where unique and innovative designs are sought. An advantage of NASA X-TOOLSS and genetic/evolutionary optimization is that the design space is not limited to existing designs and approaches. Example applications of interest for NASA X-TOOLSS include habitats for the Moon and Mars, lunar surface mobility and power systems, lunar descent module and lander concepts, and thermal/structural design of small satellites and other spaceflight hardware.
MSFC1-22-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Development, Characterization and Evaluation of Lunar Regolith and Simulants	MSFC is developing a method to create lunar regolith simulants that will match the properties of the lunar surface. This process requires preparation of silicate mineral separates from inneous rocks. Design, testing and cost analysis of a system able to produce batches of separates between 1 and 100 tons is needed. A successful method will be an important step in an overall effort involving a dynamic national and international team.
MSFC3-06-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Nuclear Fission Surface Power Design	This project will focus on the design and potential utilization of a 20?40 kWe Fission Surface Power System for use anywhere on the surface of the moon or Mars. The project will include performing a top level design of the Fission Surface Power System, including the reactor, shield, power conversion, power management and distribution, and radiator. Potential uses of the electrical or thermal energy from the reactor should be identified. Methods for emplacing and deploying the system should also be discussed. Emphasis should be on systems that minimize programmatic risk and utilize well proven technologies.
SSC3-5-09-SD	Stennis Space Center (SSC)	Propulsion	Cryogenic Pipe Stress	At NASA Stennis Space Center the use of cryogenics is very important to the testing of rocket engines used for space exploration. It is important to know the characteristics of piping that carry cryogenic fluid to the testing stands. For this project we need to be able to evaluate piping surface temperature and stress as a function of flow condition (full LN flow, trickle LN flow and no flow) and environment for a pipe containing Liquid Nitrogen (LN). For example, if the pipe is chilled with LN we should be able to measure the surface temperature and pipe stress for the different flow conditions. Next we should be able to expose the top of the pipe to sunlight and rain to see how that affects the pipe outer temperatures and stresses along with the varied flow conditions. The collected data should be compared with a model of the system in ANSYS or equivalent software.

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LARC4-20-SD	Langley Research Center (LaRC)	Spacecraft	Determination of the Chemical Composition of Nanomaterials for Aerospace Applications	This project involves the characterization of the chemical composition of nanomaterials for aerospace applications using energy (or wavelength) dispersive spectroscopy, x-ray diffraction, atomic absorption (or emission) spectroscopy, mass spectrometry, and/or nuclear magnetic resonance spectroscopy. The materials will be provided to the project team by the NASA POC. The overarching purpose of this and related projects is to understand the morphology and mechanical, electrical, magnetic, and chemical properties of the fabricated materials and then attempt to correlate those results to the modeled and observed nanoscale structures.
LARC4-21-SD	Langley Research Center (LaRC)	Spacecraft	Determination of the Surface Conductivity of Nanomaterials for Aerospace Applications	This project involves the characterization of the surface conductivity of nanomaterials for aerospace applications using a four-point probe for mapping. The materials will be provided to the project team by the NASA POC. The overarching purpose of this and related projects is to understand the morphology and mechanical, electrical, magnetic, and chemical properties of the fabricated materials and then attempt to correlate those results to the modeled and observed nanoscale structures.
LARC4-22-SD	Langley Research Center (LaRC)	Spacecraft	Determination of the Surface Energy of Nanomaterials for Aerospace Applications	This project involves the characterization of the surface energy of nanomaterials for aerospace applications using contact-angle goniometery. The materials will be provided to the project team by the NASA POC. The overarching purpose of this and related projects is to understand the morphology and mechanical, electrical, magnetic, and chemical properties of the fabricated materials and then attempt to correlate those results to the modeled and observed nanoscale structures.
LARC4-23-SD	Langley Research Center (LaRC)	Spacecraft	Determination of the Surface Chemistry of Nanomaterials for Aerospace Applications	This project involves the characterization of the surface chemistry of nanomaterials for aerospace applications using x-ray photoelectron spectroscopy. The materials will be provided to the project team by the NASA POC. The overarching purpose of this and related projects is to understand the morphology and mechanical, electrical, magnetic, and chemical properties of the fabricated materials and then attempt to correlate those results to the modeled and observed nanoscale structures.
LARC4-24-SD	Langley Research Center (LaRC)	Spacecraft	Determination of the Surface Roughness of Nanomaterials for Aerospace Applications	This project involves the characterization of the surface roughness of nanomaterials for aerospace applications using an atomic force microscope. The materials will be provided to the project team by the NASA POC. The overarching purpose of this and related projects is to understand the morphology and mechanical, electrical, magnetic, and chemical properties of the fabricated materials and then attempt to correlate those results to the modeled and observed nanoscale structures.