2009-10 ESMD Senior Design Project List
Updated: June 29, 2009

Project ID	NASA Center	ESMD Related Area	Title	Description
ARC1-01-SD	Ames Research Center (ARC)	Lunar and Planetary Surface Systems	REAL-TIME VISION FOR VEHICLE NAVIGATION	REAL-TIME VISION FOR VEHICLE NAVIGATION .The goal of this project is to develop a real-time computer vision library to support vehicle navigation (mobile robots, lunar transport rovers, etc). The library will allow vehicle control system developers to quickly assess the nearby environment, e.g., to determine if a particular arc is collision-free over a specified distance. This library will take advantage of real-time performance provided by a hardware-based stereo vision system (Tyzx G2 camera) and include methods for processing 3D point clouds, generating grid-based occupancy/obstacle maps, and evaluating drive arcs. This project will involve computer vision theory, cross-platform software development, and testing on a mobile robot.
ARC1-02-SD	Ames Research Center (ARC)	Lunar and Planetary Surface Systems	NON-PREHENSILE MOBILE MANIPULATION	NON-PREHENSILE MOBILE MANIPULATION The goal of this project is to design non-prehensile robot manipulation devices for lunar site operations, such as cable running, leveling/grading, and rock clearing. A variety of approaches are possible including pushing, tapping, or rolling. These modes of manipulation require the robot to have some understanding of the physics of interacting with a part, particularly friction and contact. In addition, robotic systems should take advantage of different strategies for manipulation, such as picking up a part by pushing it against a fixed obstacle. This project involves electrical and mechanical engineering and some embedded system (e.g., microcontroller) programming.
ARC1-03-SD	Ames Research Center (ARC)	Lunar and Planetary Surface Systems	GEOCAM: A LOW-COST CAMERA FOR RAPID GEO-REFERENCED AERIAL MAPPING	GEOCAM: A LOW-COST CAMERA FOR RAPID GEO-REFERENCED AERIAL MAPPING The goal of this project is to develop the ?GeoCam?, a camera system that can be used to rapidly map local areas from low-flying vehicles (small planes, lunar hoppers, etc). High-resolution digital imagery acquired from low-altitude flight can supplement wide-area coverage provided by orbiting cameras, particularly when surface features are best viewed up close or satellite task time is limited. The GeoCam will be designed to: attach easily/rapidly (while respecting operational regulations), provide high-precision pose estimates (position and pointing) for each captured image, and be as low-cost as possible. This project will involve trade studies (capture device, storage medium, etc.), mechatronic system engineering, and development of position estimation software.
ARC1-04-SD	Ames Research Center (ARC)	Spacecraft	Small Spacecraft	Small spacecraft show great promise for future NASA missions. Because of their nature, these spacecraft typically have very low margins in mass, power, and propulsion. In order to make these systems viable, NASA needs evaluate what is possible with innovative concepts for microspacecraft landers, rovers, and communications relays that could be used for very low cost robotic lunar precursor missions.
ARC4-09-SD	Ames Research Center (ARC)	Spacecraft	Photonic or Electronic Hit Indicator: MMOD impact detector for Orion	Further advance a detector to determine the extent of MMOD damage to the Orion vehicle for its ISS and Lunar missions. The detector has a low false positive rate, uses minimial spacecraft resources and is based on a DoE system used to determine strikes on ballistic missile targets.
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.
ARC2-05-SD	Ames Research Center (ARC)	Ground Operations	NASA Technology Database	Assist researchers in the determination of technology that affect ESMD mission using next generation of NASA Technology Database and explore approaches for improving NASA Technology Transfer meeting OMB Requirements. Senior design team will help model aspects of the technology descriptions and maturity control and collect and analyze data as needed.
ARC2-06-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, ?)
ARC2-07-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.
DFRC1-15-SD	Dryden Flight Research Center (DFRC)	Lunar and Planetary Surface Systems	Lunar Landing Training Vehicle	This projects seeks senior design concepts for Lunar Landing Training Vehicles. The concepts must account for reduced lunar gravity, and allow the terminal stage of lunar descent to be flown either by remote pilot or autonomously. Platform should allow for both sensor evaluation and pilot training.
DFRC1-17-SD	Dryden Flight Research Center (DFRC)	Lunar and Planetary Surface Systems	Aero-Assist Options for Mars Surface Sensor Deployment	This projects seeks senior design concepts for using aero-assist to deliver a constellation of small sensors to the surface of Mars. In this study the surface delivery of pico-sat sized sensors using ONLY aerodynamic deceleration will be addressed. Study should identify aero-shell geometry, required L/D ratios, mass fractions, launch options, and number and size of sensors deliverable to the Mars surface. Class of allowable ballistic coefficients for sensor packages, and required parachute/decelerator systems should be described.
DFRC3-16-SD	Dryden Flight Research Center (DFRC)	Propulsion	Propulsions Systems for Planetary Gravitational Simulator	This projects seeks senior design concepts for propulsion or lift-system concepts for gravity offset for a Lunar Landing Training Vehicle (LLTV). Project should perform trades to evaluate the most effective and reliable methods for gravity offset. Potential methods include roto-craft, jet engines, small rocket systems, and cold-jet lift concepts. Issues to be addressed include scalable lift mass, reliability, onboard propellant mass fractions, and vehicle stability/handling qualities.
DFRC4-07-SD	Dryden Flight Research Center (DFRC)	Spacecraft	Dynamic soaring/Autonomous autopilot	Develop aerial platforms that exhibit autonomy and dynamic soaring capabilities
GRC1-07-SD	Glenn Research Center (GRC)	Lunar and Planetary Surface Systems	Extreme Environment Lander Design	The goal of this project is to develop a conceptual lander design capable of long-term operation under extreme environmental conditions. The design must provide sufficient power and environmental protection for a pre-selected set of scientific instruments. A 3D CAD model of the lander is required to provide thermal and stress analysis, as well as to determine packaging and overall system mass.
GRC1-08-SD	Glenn Research Center (GRC)	Lunar and Planetary Surface Systems	Lunar Surface Mobility	NASA is currently developing the technology for long-range exploration of the lunar surface. This includes the development of a mobile landing platform and a lunar truck. In both cases, it's critical that their tires envelop the rocky surface of the Moon. The enveloping action isolates motion, which improves astronaut ride quality and power efficiency. The objective of this senior design project is to create a scale-model manned lunar vehicle tire (of unspecified radius and weight) for long range use. The functional characteristics must include: • Operation for 1million cycles. (E, N) • Envelopment of a 90 degree wedge, with at least 15% of the tire's radius, under the nominal load. (P) The limitations imposed on the design are: • Unloaded radius/width ratio of 1.3 or more. (P) • Average footprint pressure of 40 kPa or less, under the nominal load. (P) Besides meeting the objective, the goodness of the design will be judged by: • Robustness to lunar conditions. E.g. Hard vacuum, temperature variations between 40 and 400K, direct solar radiation, un-weathered regolith and dust. (E) • Severity of the primary failure mode. The less risk to the mission the better. (E) • Level of redundancy: The number and efficacy of the backup operation modes. (E) • Manufacturability / scalability: Ability to be manufactured at the full scale radius of 40.64 cm and support the nominal ground load of 2.7kN. (E) • Development risk / cost: Likelihood of success and cost of creating the full scale prototype. (E) • Design versatility: Ability to tune the stiffness properties in all directions. (E) • Tire handing: Responsiveness to footprint forces (longitudinal, lateral, aligning torque). (E) • Low power number: Input energy required, per unit ground load, per unit distance traveled when the tire is pulling 40% of the nominal ground load over sandy terrain. (E,N) • High load number: Nominal ground load per unit tire weight. (P) Key: E: Student must estimate this, P: Student must prove this, N: NASA will evaluate this.
GRC3-06-SD	Glenn Research Center (GRC)	Propulsion	Mechanical Components for Cryogenic Tank	Cryogenic propellant tanks, such as those used for the Lunar Lander, are rather complex systems with many electro-mechanical components for fuel supply, thermal control, pressure control, and low gravity propellant gauging. The objective of this senior design project opportunity is to consider the operability and reliability of those mechanisms inside or connected to the tank where the operating temperature range is extremely large. Thermal expansion of mechanical components, materials to withstand thermal cycles, sizes and weights of the mechanisms are some of important considerations.
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. Another importance tool in selecting landing sites will be accurately compute slopes and surface roughness parameters, from laser altimeter or stereo data, taking into account appropriate solar illumination models. Specifically, the work will focus on terrain classification and SAR data hazard analysis. Classification with methods such as shape analysis, textural analysis, mathematical morphology, & shading analysis, as well as both unsupervised clustering & supervised

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GSFC1-10-SD	Goddard Space Flight Center (GSFC)	Lunar and Planetary Surface Systems	Thermal Ctrl Sys (TCS) for Lunar (or Mars) Rovers	For future rovers a robust, simple, lightweight thermal control system will be required. The conventional thermal architecture uses a pumped fluid loop and was used on Mars Pathfinder and Mars Exploration Rover (MER). An alternative system using a miniature loop heat pipe (LHP) system has been proposed, which is an order of magnitude lighter, less costly and has no moving parts. The students will be asked to perform trade studies on this and other possible solutions, taking into account weight, reliability, cost ease of integration etc, as part of their approach. They will be asked to determine the environment and perform thermal analysis to show that temperature limits have not been exceeded during 1) interplanetary cruise 2) descent and landing 3) surface operations. Mechanical or CAD drawings will be developed to show how the system will be integrated into a typical rover concept, such as Pathfinder or MER as well as how the TCS interfaces with other supporting sub-systems such as Power and C&DH.
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.
GSFC1-12-SD	Goddard Space Flight Center (GSFC)	Lunar and Planetary Surface Systems	Lunar Transverse Map Contest	Next year more than 3 billion dollars of new lunar data will start to flow in a torrent. We would like to design an educational outreach effort setting up a competitive mission design by students for the most basic types of lunar robots.
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.
GSFC2-05-SD	Goddard Space Flight Center (GSFC)	Ground Operations	Use of a Fabry-Perot interferometer for precise column carbon dioxide measurements and monitoring.	Use existing Fabry-Perot Interferometer to make daily-long term measurements of CO2 column; check calibration/stability of instrument and evaluate data.
GSFC2-06-SD	Goddard Space Flight Center (GSFC)	Ground Operations	Embedded science data processing applications using high-performance hybrid platforms	Work on a robotic path planning demonstration; R&D involving SAR and Hyper-spectral data processing; and robust software architecture that will help fly commercial processors reliably in a space-radiation environment. Students need to have C and/or VHDL experience, and combined hardware/software experience.
GSFC2-13-SD	Goddard Space Flight Center (GSFC)	Ground Operations	Use of a Fabry-Perot Interferometer for precise column carbon dioxide measurements and monitoring	Use existing Fabry-Perot Interferometer to make daily-long term measurements of CO2 column; check calibration/stability of instrument and evaluate data.
JPL2-01-SD	Jet Propulsion Lab	Ground Operations	Spacecraft Flight Project and Design Practices Software for Mission Operations Assurance	The proposed project includes a high level software design that will implement the JPL FPPs (Flight Project Practices) and DPs (Design Practices) as a function of the various parameters of the mission in flight (phase E)
JSC1-01-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Remote Image System Acquisition (RISA) - Space Environment Monitoring	The RISA multispectral imager has been shown to be able to detect and monitor space radiation. Further study is required to determine the usefulness and potential of employing the RISA imager in this way. The ability to have a single instrument provide multiple functions is of interest to NASA given limit stowage and power available in the spacecraft environment. In addition, temperature monitoring, and other environmental characteristics shall be included in the RISA design to serve to both indicate the ambient environment and for sensor calibration.
JSC1-02-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Remote Image System Acquisition (RISA) - Space Camera 4 (SC4) Development	The purpose of the RISA SC4 project is to produce a high quality / high reliability wireless multispectral imager designed specifically for the space environment. The imager will be used to monitor the health and status of the crew and vehicle while in space as well as on Lunar and Martian surfaces. The SC4 design will be based on the existing SC3 and SC2 imagers. The project includes the: *development of required functions in VHDL, * electronic circuit development, * testing of alternate sensors, * characterizing the performance of the system, and * design and build of proof-of-concept prototypes using flight equivalent parts.
JSC1-04-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Remote Image System Acquisition (RISA) - Multispectral Imaging, Optical System Development	The purpose of the RISA Multispectral Imaging project is to develop methods to use multispectral imaging for materials identification, locating vegetation, locating evidence of life, locating environments that will sustain life, atmospheric penetration, biomedical applications, astronomical imaging, and improving methods to identify properties of interest to the NASA mission to meet exploration objectives. Both optical and electrically tunable filters shall be employed for the multispectral imaging objectives. The optical design objectives will explore the use of liquid lenses and other methods to mitigate the effects of the space environment. Proof of concept prototypes will be designed and built. [Disciplines: Optical Engineering, Physics, Astronomy, Biomedical Engineering, Remote Sensing, Electrical Engineering, Software Engineering, Mechanical Engineering]
JSC1-06-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Advanced Lunar Pressurized Rover (EC Priority #2)	Design of a 2-4 person rover for lunar exploration with both robotic manipulator capability and EVA capability. Rover would include minimum gas loss and low power EVA airlock and dust mitigation capabilities. CHALLENGE GOALS AND OBJECTIVES: The task would be to design a future lunar pressurized rover that can accommodate 2-4 crew members. This rover would be an element of a future planetary lander.The goal would be to perform surface exploration by creatively designing the layout and the operation of the pressurized rover. The Advanced EVA Technology Group will provide information on concepts from previous studies. Small models of advanced airlocks for rovers that have been proposed could also be provided. High level design requirements for rovers and airlocks from NASA design standards would also be provided.
JSC1-08-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Lunar Lander EVA Crew and Small Cargo Lifting System (EC Pr #4)	Design of a system for routinely and safely transporting the EVA crew and small cargo up and down from the airlock to the surface and back, including innovative ladder designs and lifts. CHALLENGE GOALS AND OBJECTIVES: The task would be to design a future lunar lander EVA crew and small cargo lifting system. This EVA crew and small cargo lifting system would be an element of a future planetary lander. The goal would be to minimize the overall, mass and weight of a lunar lander crew and small cargo lifting system. The Advanced EVA Technology Group will provide information on the previous designs of crew ladders and some concepts from previous studies.
JSC1-09-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Hand-held magnetic lunar dust removal brush.	Since most of the lunar dust is magnetic, a brush with magnetic bristles could be designed to brush the space suit or any other items and the dust would be attracted to it. If the brush was electromagnetic or mechanical where the polarity could be changed, then the poles could be reversed and the dust would be repelled and dropped to the surface after use.
JSC1-10-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Peel-off space suit visor protective film	Since the space suit visor will be scratched and get dust after each EVA, design a peel-off film or coating that can periodically be removed so the astronaut can clearly see and not have scratches, especially during long duration missions.
JSC1-11-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Dust tolerant hand tools	Standard tools, such as ratchets, folding handles on tools, and extendable devices, such as tripods will be used during lunar assembly, maintenance, and science tasks. Design some typical tools, such as a folding handle or ratchet, that has mechanisms that are extremely robust and dust tolerant.
JSC1-12-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Lunar lander dust mat	Since there will much walking and preparation at the base of the lander/habitat ladder or stairs after an EVA, and prior to entering the airlock, design a lunar mat or surface so the astronauts are not walking constantly in the lunar dust. This may sound simple, but the requirements are: * light weight, * low volume when stowed, * easily deployed, * dust can be removed or falls between mesh. The crewmembers would prepare sample boxes, repair equipment, dust off on this mat or surface prior to entering the airlock.
JSC1-15-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Design of a Wireless Sensor Scavenging Network	Design a wireless sensor energy scavenging network that provides communications to a base station (mobile or stationary) from an array of intelligent sensors nodes comprised of various transducers , sensors ,RF transmitters/receivers and controllers with their own power source that does not require batteries to operate. The wireless network sensors obtain power from the environment (power harvesting) and would respond to an interrogation command from the base station to send their data acquisition data to the base station. The wireless sensor scavenging network is programmable for sending data on demand or periodically. In addition, the sensor network can be reconfigured to acquire different types of data from each sensor by the base station. This has applicability for the lunar and beyond outposts. Design includes what trades were made to arrive at the design and concept of operations.
JSC1-17-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Dust Tolerant EVA Compatible Connectors	In the dusty lunar environment, astronauts will be making and breaking various electrical and fluid connectors with their gloved hands. A goal is keep out dust when the electrical or fluid connector is exposed. Design an electrical or fluid connector for lunar exploration with EVA capability. The connector should include dust mitigation capabilities. CHALLENGE GOALS AND OBJECTIVES: The task would be to design an electrical or fluid connector for lunar exploration with EVA capability and keeps dust out. These connectors could be on the space suit for recharging the portable life support system or on lunar surface systems for assembly or maintenance. The goal would be to creatively design a connector that is easy to operate with a gloved hand while keeping dust out with minimum crew operations and complexity. The Advanced EVA Technology Group will provide information on concepts from previous studies.
JSC1-18-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Advanced EVA Airlock with Pressure Assisted Airlock Hatches and Dust Mitigation	Due to the expected large number of space walks that will be performed on the lunar surface, innovative designs for an airlock will be needed. Both the internal and external hatches shall be pressure assisted. The EVA airlock should also include minimum gas loss, low power, and dust mitigation capabilities. CHALLENGE GOALS AND OBJECTIVES: The task would be to design a minimum gas loss airlock with pressure assisted hatches that accommodate 2 astronauts. This airlock would be an element of a future planetary lander, habitat, or pressurized rover. The Advanced EVA Technology Group will provide information on concepts from previous studies. Small models of advanced airlocks that have been proposed could also be provided. High level design requirements for airlocks from NASA design standards would also be provided.

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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.
JSC1-21-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Electric Propulsion Systems	In this project you will: * Investigate new forms of electric propulsion that can be used for future exploration objectives. Build prototypes of existing methods of electric propulsion and compare them to alternate methods developed under this effort. * Research recent breakthroughs in propulsion and develop quantitative results documenting their characteristics. * Develop new theories of advanced propulsions systems and build prototypes to test concepts.
JSC1-22-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Velcro Inprovement or Replacement for Use on Space Suits and other Equipment in Dusty Lunar Environment	Velcro is currently used routinely to attach and removal thermal blankets, close flaps on soft goods containers, and attach and close various components on the space suit, such as the Thermal Micrometeorite Garment (TMG). In this dusty lunar environment, Velcro will allow fine lunar dust to migrate through the Velcro connection and adversely affect equipment. The design challenge would be to improve the current Velcro such as to not degrade its performance and to not allow dust to migrate through it or to design a totally new technology to replace Velcro, but its performance is just like Velcro. This Velcro -like attachment system would have the same requirements as Velcro, such as easily attaches and removes, is flexible and can be sewed to textiles, meets lunar temperature limits, attaches while misaligned, and does not allow dust to migrate through it.
JSC1-23-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Wall Surfaces that Allow Condensation and Low-Energy Evaporation	One problem with enclosed living spaces is that sometimes surfaces will collect condensation due to a cold surface behind the wall. This water could promote the growth of plant or animal life (mold and bugs!). For this project, you are to investigate how you can design a ?wall system? that will trap any condensation that forms, then evaporate it periodically (e.g.. every six hours) actively using very little energy or passively when the adjacent air warms above dewpoint. The solution could be a new material, a sensor/heater system, or any other viable design that can be demonstrated on a small scale.
JSC1-24-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Freeze Back Radiator	How would you cool a lunar outpost on the rim of Shackleton Crater? There will be high heat loads when the outpost is occupied plus unoccupied periods of low activity and heat load. One heat rejection system option is a freeze-back radiator of reflux boilers. For this project you will investigate reflux boilers, assess scaling laws for the reduced lunar gravity, build a scaled reflux boiler using commonly available materials, and test its performance.
JSC1-28-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Vacuum Cleaner for Spacecraft Cabin Housekeeping for Lunar Surface Missions	Dust and particulate matter contamination of spacecraft cabin atmosphere and surfaces are challenges that must be overcome for lunar surface exploration. Particulate contamination originating from the external surface environment or from internal sources are both of concern. Development of process technologies and equipment to minimize the impacts of surface dust on crew health and equipment inside the habitable volume are sought. This project focuses on development of an advanced vacuum cleaner for removal of particulates from internal cabin surfaces and equipment, including space suit components, and for additional use as a portable atmospheric dust filter. This tool will have particular challenges based on the affects of gravity and the physical properties of lunar dust. Particulates may range from several millimeters into the sub-micron range, and operation of the vacuum must not contribute to atmospheric particulates. Atmospheric requirements include maintaining particulates in the range 0.5 microns to 100 microns below 0.2 mg/m3 and lunar dust contaminants of less than 10 micron size below 0.05 mg/m3. Candidate technology solutions should provide high efficiency, long-lived removal capacity, low noise, and minimized use of power and consumables. Novel methods for particulate removal and filter regeneration are encouraged, including electrostatic, magnetic, inertial and/or cyclonic separation and/or backwashing processes. Technologies must be tolerant to the abrasive effects of dust
JSC1-29-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Low Energy/Low Water Laundry Equipment for Space	For long-duration human exploration missions including a Lunar Outpost, the clothing system will be a large factor in mission cost. Currently clothing used in space is discarded and is a major source of trash. Clothes washing and drying is expected to be cost effective for mission durations of the order of three months or longer. Aqueous-based systems with extremely efficient water-use are desirable. Initial use will be for lunar surface missions, thus operation in a fractional gravity environment and ability to remove lunar dust will be required. Systems engineering approaches, including synergy with clothing made from advanced fabrics, use of novel detergents or alternative cleaning agents, and compatibility with physicochemical and/or biological regenerative water recovery systems must be considered. This project will involve the design and prototyping of a washing and drying system for re-use of clothing that minimizes requirements for mass, volume, energy, heat rejection, consumable supplies and crew involvement, while meeting toxicity, flammability, out gassing, and human factors requirements.
JSC1-30-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Advanced Clothing for Long Duration Human Exploration Missions	Currently clothing is not re-used in space. It is a bulky consumable of considerable mass that must be re-supplied, and once soiled, becomes a solid waste problem. Significant benefit may be realized from improvements to space clothing systems. Advancements in textiles, including high performance fibers, fabrics and materials treatments may benefit clothing systems for future human space exploration missions. Benefits may include reduced mass and volume for stowage of clean and used clothing, increased use life, safety for use in enriched oxygen atmospheres, and compatibility with low water and low energy laundering and drying systems, while meeting requirements for crew comfort. Properties of interest include mass, thickness, durability, strength, thermal conductivity, wicking, flammability, linting, off-gassing and antimicrobial characteristics. This project includes the investigation or new materials of changes to existing materials.
JSC1-31-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Active Response Gravity Offload System Control Algorithm Development	In preparation for returning to the moon, a means must be developed to allow astronauts to practice performing tasks in a reduced gravity environment, and engineers to evaluate systems, such as space suits, used in the performance of these tasks. To these ends, the Active Response Gravity Offload System (ARGOS) is being developed. ARGOS will use electro-mechanical devices and sensors to compensate for the difference between earth and lunar gravity, while keeping the actuation point above the center of gravity during translations. Of interest to NASA is a control algorithm that will command the motors in response to the astronaut?s movements with negligible lag time.
JSC1-32-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Active Response Gravity Offload System Gimbal Development	In preparation for returning to the moon, a means must be developed to allow astronauts to practice performing tasks in a reduced gravity environment, and engineers to evaluate systems, such as space suits, used in the performance of these tasks. To these ends, the Active Response Gravity Offload System (ARGOS) is being developed. ARGOS will use electro-mechanical devices and sensors to compensate for the difference between earth and lunar gravity, while keeping the actuation point above the center of gravity during translations. A key component of the system is the gimbal, which allows the astronaut to bend and turn while suspended from above. Of interest to NASA is a system that will remain aligned with the astronaut's center of gravity when bending forward or leaning both backwards and to the side.
JSC1-33-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Active Response Gravity Offload System Advanced Control Algorithm Development	In preparation for returning to the moon, a means must be developed to allow astronauts to practice performing tasks in a reduced gravity environment, and engineers to evaluate systems, such as space suits, used in the performance of these tasks. To these ends, the Active Response Gravity Offload System (ARGOS) is being developed. ARGOS will use electro-mechanical devices and sensors to compensate for the difference between earth and lunar gravity, while keeping the actuation point above the center of gravity during translations. Since mass constraints could result in lunar transport vehicle suspension systems that do not function in earth's gravity, it would be beneficial if ARGOS, or a similar system, could be used to perform "test drives" of development hardware. Of interest to NASA is a control algorithm that would allow multiple gravity compensation devices to work in tandem to support a large mobile system.
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 and compounds, including Fe, Ti, Al, Si, Mn, and O. We propose that this process will require less mass and energy for the extraction of elements and will work as a beneficial component of both ISRU and a life support system with lower environmental risk. The most critical feature of our project is to make extraterrestrial mining more compatible with oxygen, propellant and food production, and waste
JSC1-39-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Lunar and Martian Gravity Simulator Development for Long Duration Bed Rest Studies	The Flight Analogs / Bed Rest Research Project at the Johnson Space Center provides NASA with a ground based research platform to complement space research. By mimicking the conditions of weightlessness in the human body here on Earth, NASA can test and refine scientific theories and procedures on the ground before using these in space. Future space exploration will challenge NASA to answer many critical questions about how humans can live and work for extended missions away from Earth. The Flight Analogs Bed Rest Research Project is one way NASA will answer these questions and devise ways to ensure astronaut safety and productivity on extended missions. Looking forward to support the Vision of Space Exploration, the FAP has developed a Lunar Gravity Simulator which will add to the complement of ground analogs a device to simulate the forces encountered by astronauts on the lunar surface at the FAP facility. The LGS, which reclines a subject at 9.5 degrees of head up tilt, will be the primary method for studying the effects of Lunar Gravity on the human body here on Earth. The LGS will be used by subjects for 16 hours a day for up to 90 days in duration during the long term bed rest studies. The objective of this project will be to develop new and novel approaches for simulating Lunar and Martian gravity for the Flight Analogs Project. The simulators must be designed so that human test subjects are exposed to the forces encountered in Lunar and Martian gravity in the long axis of the body for 16
JSC1-44-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Lightweight Electric Vehicle Transmission	Vehicles used on the lunar surface will need electric motors. Since the lunar surface will have variable grades and variable masses (due to different payloads in the vehicle), a drive system with a transmission will be needed. A transmission made from steel will be too heavy, so a lightweight, yet reliable transmission is planned. This project includes the design and prototyping of such a transmission. It must be able to operate in the extreme lunar temperature conditions as well.
JSC1-45-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	High Voltage, High Current 3-Phase Motor Control with PID Control	Vehicles used on the lunar surface will need electric motors. Since the lunar surface will have variable grades and variable masses (due to different payloads in the vehicle), a drive system with a transmission will be needed. The center of this drive system is a 3-phase brushless DC motor. The motor is expected to use 350 volts and be driven with 30 Amps. The control of this motor (PID or similar closed-loop system) will need to ensure constant torque is delivered and constant velocity is maintained. The design challenges include using such a high voltage, circuit board design that support high currents, and maintaining control stability when the vehicle is decelerating. This project includes the design and prototyping of such a motor control system, including the motor and motor control board. It must be able to operate in the extreme lunar temperature conditions as well.

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JSC1-46-SD	Johnson Space Center (JSC)	Lunar and Planetary Surface Systems	Cryogenic Component Checkout and Problem Resolution	In order for NASA to return to the moon there will be a reliance on cryogenic technologies for use with descent propulsion systems, crew breathing air, and fuel cell reactant storage. As part of it?s initial development efforts of these systems NASA is interested in determining whether current off the shelf fluid components, not currently rated for use with cryogens, can be used in these extreme conditions and if not, what design changes need to be made in order to make them function in a cryogenic environment. The intent of this project will be to receive selected components from NASA?s Johnson Space Center for testing with liquid nitrogen and or helium fluids and perform a number of checkout tests. If the component fails checkout testing NASA is interested in understanding what design changes should be made to improve its performance at cryogenic conditions. A comparison with current cryogenic-rated components would be useful.
JSC3-16-SD	Johnson Space Center (JSC)	Propulsion	Electric Propulsion Systems	The RISA multispectral imager has been shown to be able to detect and monitor space radiation. Further study is required to determine the usefulness and potential of employing the RISA imager in this way. The ability to have a single instrument provide multiple functions is of interest to NASA given limit stowage and power available in the spacecraft environment. In addition, temperature monitoring, and other environmental characteristics shall be included in the RISA design to serve to both indicate the ambient environment and for sensor calibration.
JSC4-13-SD	Johnson Space Center (JSC)	Spacecraft	Microphone beamforming array estimation model	Develop a beamforming microphone array model and compare against an actual microphone array measured data. This model would help predict microphone array configuration performance. The model would be developed in MatLab that would help determine the theoretical lower bound of performance using the Cramer-Rao lower bound method. An actual microphone array is built and data gathered and compared against the theoretical model. This project has potential applicability in the Constellation program CEV, lunar lander, and EVA spacesuit where a crew-worn headset is not necessary.
JSC4-14-SD	Johnson Space Center (JSC)	Spacecraft	A Field Programmable Analog Array (FPAA) Voice Activated Switch (VOX)	Develop a VOX device through the use of FPAA devices. Investigate the feasibility of using FPAA for simplifying the attack and decay time adjustments of the VOX through the use of digital techniques. This has applicability in the constellation program for not only for the audio systems but also understanding FPAA technology in use for other constellation systems. A circuit will be developed and data gathered to understand the performance of the VOX circuit. A process for implementing FPAA circuits will also be written.
JSC4-25-SD	Johnson Space Center (JSC)	Spacecraft	Splash-down Space Capsule Cooling	How do you effectively cool the confined inside enclosure of a just-returned space capsule that is bobbing in the Pacific Ocean? One problem is that there is insufficient energy available in the capsule to run a vapor compression cycle to chill the environment. Can you use the ocean water to cool the air in the capsule? Remember, the temperature of the ocean water at the surface varies, since the capsule can land anywhere between 56 degrees North and 56 degrees South latitude. For this project you will need to investigate the typical ocean temperature, and then design an energy efficient system to use this ocean water to effectively cool the capsule air.
JSC4-26-SD	Johnson Space Center (JSC)	Spacecraft	Space Vehicle Transfer Tunnel Automated Mating Design	In the design of the next generation vehicles to be used during NASA?s return to the Moon, there is a need to allow crew transfer between vehicles / modules in a pressurized, shirt sleeve environment. This type of transfer is called ?IVA (Inter-Vehicle Activity) Transfer?. Generically, this type of transfer is performed between any two connected or docked vehicles. The specific case under consideration in this project is the IVA transfer between a Lander Ascent Module (AM) and Airlock (AL). The current lander concept has the IVA transfer tunnel between the AM and the AL pre-mated at Earth launch. The AL remains behind on the Moon and the AM ascends to rendezvous with a vehicle in lunar orbit. The tunnel is pyrotechnically separated and retracted to allow for AM ascent without contact. During a nominal mission, this separation between the AM and AL can be easily managed, as timing is not highly critical. However, in the event of an abort, the tunnel must separate and provide clearance (via retraction) so that the AM does not contact any portion of the tunnel or AL. This retraction must happen very quickly to improve abort reliability. One way to avoid this complication is to fly the mission with the tunnel disconnected. This may provide for increased safety, but adds a serious complication that the tunnel must be mated and sealed in an automated manner once the vehicle lands on the moon. The tradeoff becomes added complexity for automated connection / sealing versus improved safety. This project focuses on the design and
JSC4-27-SD	Johnson Space Center (JSC)	Spacecraft	Hydrogen Detection in a 100% Humidity Environment for Oxygen Generation Technologies	Key to any exploration effort will be generating oxygen for the crew. For example, the Oxygen Generator Assembly (OGA) on the International Space Station (ISS) generates oxygen by electrolysis of water. A current problem of this process is that the oxygen exits the OGA at ambient temperature and pressure, but at 100% relative humidity (RH) due to un-reacted water vapor. The by-product of the electrolysis process is hydrogen, which is very flammable. Normally, hydrogen is vented from the cabin environment, but there are several hydrogen sensors located in and around the OGA to check for hydrogen leaks. If the hydrogen sensor indicates anything other than nominal, the entire OGA is shut down. ?Other than nominal? has, in the past, meant moisture has condensed on the sensor, rather than hydrogen being detected. The design project would be to make this system halt from occurring. The recommended approach is three-fold: 1) attempt to heat the sensor slightly and/or thermally insulate it; 2) create a cold spot upstream of the sensor so that water vapor will deliberately condense away from the sensor and then the condensed water would need to be continuously wick away the water vapor (no gravity available!); and 3) then heat the air back to ambient temperature, resulting in a less-than-100% relative humidity exit stream. This will require applying fluid mechanics of two phase flow in zero gravity, steam thermodynamics, and heat transfer techniques and design. This project and resulting prototype would not need to involve
JSC4-34-SD	Johnson Space Center (JSC)	Spacecraft	Robust Miniature Lightweight Multifunction General Purpose Measurement Tool	In current and future space travel, electronics will play an important part. These electronics are increasingly complex. Occasionally, an electrical or electronics system will fail. In order to troubleshoot the problem, a single handheld instrument is needed. It should have the combined capabilities of a multi-meter, oscilloscope, protocol analyzer, network analyzer, spectrum analyzer, hand held computer, and technical reference database in a rugged, radiation tolerant, easy to use unit. This tool would be the Swiss Army Knife of the International Space Station, Crew Exploration Vehicle and Lunar Habitat Electrical and Electronics Installation and Test. Some capabilities include: ? Unit should be easily used by an astronaut, with a user interface that can be used in bright sunlight, or dimly lit environment. ? Use of high reliability universal front end electronics and virtual instrument interface coupled with field programmable analog arrays, and FPGA to maximize universality.
JSC4-35-SD	Johnson Space Center (JSC)	Spacecraft	Telemetry in Audio Compression CODEC	The Constellation Vehicle Orion will utilize the Internet Protocol (IP) for voice and data communications via the radio frequency links to the Mission Control Center (MCC) routing through Tracking and Data Relay Satellite (TDRSS). For redundancy and safety a ?dissimilar? audio link will communicate simultaneously with the ground via line-of-sight, during critical mission phases, i.e. launch and landing. This communications link will not be IP but will be digital with compressed audio. The audio speech compressor (Vocoder) will be Conjugate Structured Algebraic Code Excited Linear Predictor (CS-ACELP) as defined by ITU-T G.729. The IP data will be delayed due to the difference in path from the ground to the vehicle, i.e. one is line-of-sight the other via the TDRSS. This project will be to create the algorithms and prototype the system for this redundant audio link. It is the intent to deliver both audio communications simultaneously to the headsets of the onboard astronauts, without degradation in intelligibility cause by time delay echo. It is desired to encode a short duration, 10-20ms, sync. signal at the beginning of a ground based voice transmission allowing the line-of-sight speech data to be synchronized with the IP voice data, thus presenting the audio to the astronauts headsets simultaneously. A method of reliably encoding sync. data in the G.729 encoder needs to be developed.
JSC4-36-SD	Johnson Space Center (JSC)	Spacecraft	Implement Codecs on FPGAs	This project will be to implement ITU standard G.729 (CS-ACELP) and G.722.2 (AMR-WB) speech compression codecs on FPGA target. These codecs are typically implemented on Digital Signal Processors (DSP). Constellation wants to implement the codecs on an FPGA so that redundant data-bus audio packet management, speech signal extraction and compression can happen on a single chip, minimizing mass, power and size requirements.
JSC4-37-SD	Johnson Space Center (JSC)	Spacecraft	Development of a Multi-Functional Internal Configuration for a Lunar Lander	Given the pressurized volumetrics of a lunar lander module, develop the internal configuration for a human crew of four astronauts for 7 days. This module must provide for the habitability of the crew as well as the support functions necessary to accomplish the mission objectives. This project will have applicability to the Constellation Program. The project objective is to design this lunar lander module's functional areas (types required will be provided) in such a way that allows for singular or multi-task activities to occur. Constraints will also be provided (e.g., mass allotments).
JSC4-40-SD	Johnson Space Center (JSC)	Spacecraft	Verification Analyses in Support of the Second ISS Treadmill	NOTE: This is a one semester project that must be done in the Fall semester 2008. The International Space Station Program is planning to begin six man operations in mid 2009. The Treadmill is a critical countermeasure device required to maintain crew health while on-orbit and prepare them for return to Earth. To augment the needs of a six member crew, a second treadmill is required. The overall approach for the T2 project is to utilize as much existing NASA Program Hardware as possible and couple it with an existing, commercially available high reliability treadmill. The Treadmill and supporting subsystems (power, cooling, etc.) will be housed in an International Standard Payloads Rack (ISPR) and the vibration isolation system will be a modified Passive Rack Isolation System (PaRIS). The entire assembly is planned to be housed in the Node 2, and will then be moved to Node 3 upon its arrival to ISS. The targeted launch of the T2 system is currently ULF-2. Senior Design Project Description: Verification Analyses in Support of the Second ISS Treadmill The senior design project will consist of a grouping of 3 to 6 analyses (depending on complexity) required to verify the Second ISS Treadmill (T2) design meets the Engineering Specifications and/ or Environmental Compliance Requirements for the International Space Station. Treadmill Project will provide: 1. Description of the problems/analyses to be performed 2. All relevant data needed for analysis including: Relevant Treadmill Design Data and applicable test data results
JSC4-41-SD	Johnson Space Center (JSC)	Spacecraft	Materials Science of Manned Spacecraft Radiation Shielding	This project will involve examining crew dose, materials dose, and avionics single event effects (SEE) environments and how it is affected by manned spacecraft radiation shielding. The project team will use the FLUKA (http://www.fluka.org/) ionizing radiation transport code to explore the effectiveness of various materials and materials combinations in attenuation of galactic cosmic ray and solar cosmic ray dose to the interior of relatively massive (compared to robotic vehicles) manned spacecraft. The objective here is to compare different materials in simple geometries so that materials effects on secondary particle production and stopping power can be determined and visualized directly with no complications from specific spacecraft configuration effects. Validation of the FLUKA tool against available space flight data and ground based accelerator data is an essential part of the project. Participants in this project should strongly consider a similar internship available at JSC during the Summer of 2009.
JSC4-42-SD	Johnson Space Center (JSC)	Spacecraft	Geomagnetic Storms, Traveling Ionospheric Disturbances (TIDs), and Solar Cycle Effects on Neutral Atmosphere	The objective of this project is to evaluate existing (albeit cutting edge) tools used to predict the scale of the ISS attitude control or satellite drag anomalies expected as a result of geomagnetic storm events or as the upper atmosphere become immediately denser during geomagnetic storms and gradually denser as we approach the upcoming solar maximum, the magnitude and character of which is proving more difficult to predict than was the case for the last several solar maxima. Participants in this project should strongly consider a similar internship available at JSC during the Summer of 2009.
JSC4-43-SD	Johnson Space Center (JSC)	Spacecraft	International Space Station as a Nano/Micro Satellite Base	This project is an evolution of the sounding rocket base (Wallops, White Sands, Poker Flats etc.) idea as suggested by the free launch services provided for micro satellite and nano satellites by ESA on the Arianne launcher and used extensively by Surrey Satellite customers. Specifically, the project team will need to provide a report with the following information: a) Feasibility - assessment of earth-to-orbit transportation opportunities to ISS in the post Shuttle era. b) Concept - multi-satellite carrier to attach to ISS externally and provide controlled mechanical deployment/launch over some range of vectors compatible with ISS safety (collision avoidance). c) Launch opportunities for satellite carrier assembly - Progress, Soyuz, ESA/ATV, JAXA/HTV, Commercial Carriers (COTS Program), Orion. d) Matching the concept to the agency road maps and science objectives/needs of, for example, the National Science Foundation, NASA Science Mission Directorate, and the National Oceanics and Atmospherics Administration. Participants in this project should strongly consider a similar internship available at JSC during the Summer of 2009.

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KSC1-02-SD	Kennedy Space Center (KSC)	Lunar and Planetary Surface Systems	Senior Biological Engineer	The goal of this senior design project is the design, integration, and evaluation of components, subsystems, and systems of a prototype habitat module. NASA could then validate and test concepts for the ultimate design of a ?Surface Habitat Module? to be used on the Moon or Mars. The focus will be on the design of components, subsystems, and systems to reduce resupply of life support elements (i.e., air, water, and food), and incrementally evolve and integrate current resupply methods and physical-chemical technologies with bioregenerative technologies. This project should emphasize the critical system selection criteria of minimum launch mass, efficient utilization of volume and power, and minimization of crew labor time and lifecycle costs. Depending on the desired scope of the senior design project, a sub-set of the design elements and requirements may be selected to reduce the scope of the project so that it would be suitable for a senior design project related to this topic. The POC for this project has agreed to be contacted prior to the start of the project for more specifics concerning current priority focus areas and recommendations concerning elements to include for a reduction of the project to a desired scope. This project is recommended for majors including mechanical engineering, biology, microbiology/bacteriology, agricultural engineering, and chemical engineering. The design elements to be considered include: structures, automation and mechanization (robotic manipulators), sensors
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.
KSC2-01-SD	Kennedy Space Center (KSC)	Ground Operations	Packetized Telemetry Converter	Utilizing reconfigurable logic devices, develop a system that accepts packetized telemetry (reference CCSDS 702.1-R-1, 714.0-B-1, 727.0-B-3 and 732.0.B-2) and outputs a PCM stream compatible with IRIG-106-05 Ch.4 for input to existing ground based telemetry processors. The intent of this project is to determine whether existing KSC telemetry processing devices can be utilized in the Constellation packet telemetry environment or if all the PCM based devices need to be replaced. The use of FPGA type devices provides the flexibility to update the translation routines without requiring hardware change-out.
KSC2-04-SD	Kennedy Space Center (KSC)	Ground Operations	Habitat Design	The goal of this senior design project is the design, integration, and evaluation of components, subsystems, and systems of a prototype habitat module. NASA could then validate and test concepts for the ultimate design of a "Surface Habitat Module" to be used on the Moon or Mars. The focus will be on the design of components, subsystems, and systems to reduce resupply of life support elements (i.e., air, water, and food), and incrementally evolve and integrate current resupply methods and physical-chemical technologies with bioregenerative technologies. This project should emphasize the critical system selection criteria of minimum launch mass, efficient utilization of volume and power, human factors, habitation, cultural interaction, minimization of crew labor time, and lifecycle costs. This project is appropriate for human factors, any engineering major, anthropology, or psychology majors.
KSC2-08-SD	Kennedy Space Center (KSC)	Ground Operations	Innovative uses of ESMD's Distributed Observer Network (DON) for education & other NASA purposes	Form a multidisplinary team to interface with KSC intern to test and evaluate other uses of DON and provide results in oral and written form. Various aspects of simulation usage including communication and teaming, human factors, use of simulation for educational purposes (k-12 through professional), and distributed teaming will be addressed. This project is appropriate for human factors, computer science, any engineering major, anthropology, psychology, graphical arts, or education majors.
KSC2-09-SD	Kennedy Space Center (KSC)	Ground Operations	Simulation that Supports Synthesis	Analyze existing simulation tools and recommend tools and techniques to improve the usability of simulation tools. Various aspects of simulation usage including communication and teaming, human factors, and distributed teaming will be evaluated. This project is appropriate for human factors, computer science, any engineering major, anthropology, psychology, or graphical arts majors.
KSC2-11-SD	Kennedy Space Center (KSC)	Ground Operations	Universal Wireless Sensor	Recent developments in the availability of low cost, low power microcontrollers have underscored the amazing things one can do in integrated silicon in today's market. In particular, there is an ever increasing trend to integrate more peripheral's into modern microcontrollers including additional A/D channels, digital I/O, serial communication interfaces, analog comparators, and Pulse width modulation channels for analog outputs with prices starting at under $0.48 and averaging less than $5.00. As an example consider the device from ATMEL semi, the 8-bit RISC processor, ATMEGA168, with a single unit price of ~$4.00 Device: Flash (Kbytes) EEPROM (Kbytes) SRAM (Bytes) F.max (MHz) Vcc (V) 16-bit Timers 8-bit Timer PWM (channels) RTC SPI UART TWI ISP 10-bit A/D (Channels) Analog Comparator ATmega168 16 0.5 1024 20 1.8-5.5 1 2 6 Yes 1+USART 1 Yes Yes 8 Yes This unit has (8) 10bit A-D channels, 6 analog output channels (PWM), has serial communication interface built in, and can operate from off the self alkaline batteries for weeks. This is in contrast to a typical programmable logic controller deployment with KSC's ground power system which involves over $10K in controller hardware for a very similar IO count. More recently, microcontroller vendors have begun to offer wireless communication chipsets that are designed for integration with their controller lines. While many of the products that will emerge have not made it to market yet, the simplicity of the hardware all but guarantees they will. However, the time constants in the R&D cycle as well as UL listing often delay products to market. This makes for an excellent opportunity to develop ahead of the private sector a wireless device suitable for KSC use that costs under $20.00 in materials and is fully functional in KSC ground applications. Proposed Requirements: I/O Capability: (1) Support Analog input with 10 bit or better resolution AND (1) digital sensor using I2C, TWI or other standard serial interfaces Sample Rate: Variable based in battery life requirements but be configurable from 1 sample/minute to 100kSamples/sec Power Requirements: Make use of controller sleep and standby modes to extend battery life to fullest extent Size: Limited to one 2"x4" single layer PCB Connectivity: Transmit wirelessly over Zigbee IEEE 802.15.4 and via USB to a laptop Data Storage: Support onboard data storage or remote poll via Zigbee. Cost: Under $20.00 BOM for 10k units Project Program: Microcontroller specific C Code Deliverables: (1.) (3) Demo units configured to demonstrate Zigbee's mesh networking capabilities with both digital and analog sensor inputs (2.) C code for entire project (3.) Development tools if not freeware (ATMEL development environment is totally free) (4.) PCB layout files so that the government can produce at its leisure from PCB express or other online builders.
LARC1-12-SD	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.
LARC1-14-SD	Langley Research Center (LaRC)	Lunar and Planetary Surface Systems	Design of a Robot Operator/Controller	This project involves the design of an operator/controller for a robot arm. The user would define a visual image using a video camera and guide the end-effecter to the location of an object. A student team would undertake a feasibility study and design the controller interface and algorithms.
LARC1-15-SD	Langley Research Center (LaRC)	Lunar and Planetary Surface Systems	Design of an End-Effecter for a Robot Arm	This project involves the design of an end-effecter for a robot arm. Tasks to be performed by the robot arm include: deployment of a science instrument/sensor, scooping, and gripping/moving material/items. Constraints include power, mass, and space considerations. The project also involves the determination of additional potential lunar functions for the end-effecter.
LARC1-16-SD	Langley Research Center (LaRC)	Lunar and Planetary Surface Systems	Algorithm Development for Robot Guidance and Control	This project involves the development of algorithms which use various types of input data to accomplish autonomous robot guidance and control. The students will develop algorithms which process and merge data from various sources - video, laser range finders, gyro, GPS, etc. - in order to control a robotic device. An appropriate user interface will also be developed.
LARC1-17-SD	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-SD	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.)
LARC4-11-SD	Langley Research Center (LaRC)	Spacecraft	Development of Gravitational Acceleration Educational Display	The primary objective for this project is to develop an educational display and/or software comparing the gravitational acceleration of the ARES 1 rocket, including the Launch Abort System, to roller coasters, games of the winter Olympics, skate boards, and other games and sports that youth can relate to. The display could be a kiosk that would be used at museums, science centers, educational activities, and outreach events.
LARC4-13-SD	Langley Research Center (LaRC)	Spacecraft	Development of Mars Lander Educational Display	The primary objective for this project is to develop an educational display and/or software emphasizing the challenges of entry, descent, and landing on Mars. The user would become the "engineer" and solve problems related to landing on a planet that has an atmosphere.
LARC4-19-SD	Langley Research Center (LaRC)	Spacecraft	Design of Scaled Spacecraft and Test Apparatus to Enable Assessment of Water Landing for Orion-Type Vehicles	This work is important in the context of the development of the Orion Landing System and has potential for future spacecraft design. The focus of the undergraduate engineering design team will be the design and fabrication of a scaled capsule and testing apparatus for landing in water. The model of the Orion spacecraft should land in water with various combinations of horizontal and vertical velocities and impact attitudes in a parametric study. Measurements of interest will be tri-axial accelerations at the center of gravity and pressure variation on the heatshield.

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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.
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.
MSFC1-09-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Integration of Surface Mobility Systems through Systems Engineering	Designing and building surface mobility mechatronics systems by multi-disciplinary teams. Not only the design of such systems but also the process of developing the entire system will be emphasized.
MSFC1-13-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Using Lunar materials and solar energy for Lunar Base self-reliance	Design a self-supporting system for the Lunar outpost using lunar materials and solar energy. The system can supply any necessity for the astronauts (water, oxygen, spair parts, food etc.)
MSFC1-14-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Planetary Instrument Sample Collection Device	Marshall Space Flight Center has been developing a miniaturized Scanning Electron Microscope for in situ imaging and chemical mapping of samples for use on the Moon (as well as other planetary bodies.) This project would require the mechanical design and prototyping of a sample collection scheme that would take samples from the lunar surface and introduce them into a sample chamber for analysis. A fully automated sample collection device would allow for the instrument to be operated remotely from a rover. Some key considerations instrumental to this design are dust mitigation, selectable sample size, temperature fluctuations on the lunar surface, and compactness of design.
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.
MSFC1-23-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Development of lunar composting capability	Composting of human food and other waste on the moon will be desirable, both from the standpoint of reuse of biochemicals (in support of longterm habitation) and in order to protect human health. While composting in lunar soil may desirable, it not be feasible. Lunar soil is, in contrast with most earth soils, completely mineral. More importantly, it is believed to be mechanically, and possibly chemically, hazardous to biological systems. Semester 1: Assess existing literature; identify sources of unpublished data and evaluate publication of recovered information. Characterize the risks and benefits of use of lunar soils for composting foodwastes, paper and cardboard, and sewage. Address each type of waste separately and in combination, as well as microbiological culture required. Develop design concepts for a composting system. Plan testing that addresses regolith simulators and effects of gravity; document in a test plan. Semester 2: Execute complete design based on concepts. Fabricate and assemble. Conduct testing defined in test plan and execute report.
MSFC1-24-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Lunar habitat situational awareness	In order to provide radiation shielding, thermal insulation, and impact protection, the covering of the lunar habitat will be very thick, likely including regolith. Physical windows in the habitat hull will be limited at best. Suggest schema and technologies to allow the crew to be kept informed (without constant human monitoring of the hemisphere around the habitat. System requirements would include, but not be limited to, planning and coordination of multiple ExtraVehicular Activities (EVA); habitat integrity monitoring; and recording of environmental events, such as meteoroid strikes or passages, and solar energetic events. The system should consist of internal controls and displays in the habitat and the external means to gather information. Multispectral data collected simultaneously (visible, IR, UV, and high energy) may be useful. Consider methods such as ?difference modeling? to extract crew-useful information from the collected data. Semester 1: Develop the concepts for the situational awareness system. Address cost, mass, and volume, as well as where the system components would be located both inside and outside the module. Describe the technologies to be used and note which are commercially available and which need further development. Semester 2: Prototype the system and demonstrate its capabilities. Propose further work.
MSFC1-25-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Design of Lunar Garage	NASA will need a garage facility to repair & maintain Lunar Roving Vehicles (LRVs) once we return to the moon. The garage could be pressurized for a shirt sleeve environment or unpressurized for a space suit environment or perhaps both (unpressurized for minimal maintenance, pressurized for more extensive repairs). Semester 1: Using the size of the Apollo LRV as a guide to the vehicle size to be accommodated, propose concepts for the garage using minimal launched mass as a major constraint. This might lead to an inflatable design, or one built from regolith in sand bags for example. Consider what tasks might need to be done on the LRV, based on the Apollo experience, and provide clearance in the garage for the work to be done by two crew. Plan evaluation activities and document in test plan. Semester 2: Construct & test the garage based on the overall design constraints formulated during the first semester.
MSFC1-26-SD	Marshall Space Flight Center (MSFC)	Lunar and Planetary Surface Systems	Partial Gravity Crew Interface Design	The microgravity experience has illustrated the need to accommodate the differences in human performance due to different gravity fields. NASA?s short term interest is in 1/6 g for Lunar habitats, but is also in 1/3 g for Mars. Appropriate architectural design for habitats requires establishing partial Gravity Crew interface design principles such as the transition angles between ramps, stairs, stair ladders, and stairs. These are well established for 1 g, but are still unknown for 1/6 & 1/3 g. Semester 1: Propose methods to determine the transition angles for Lunar habitats. Document in test plan. Semester 2: Carry out the experiments and determine the transition angles for 1/6 g, and (time permitting) 1/3 g.
MSFC2-28-SD	Marshall Space Flight Center (MSFC)	Ground Operations	Simulation of Propellant loading in Launch Vehicle	MSFC has developed a Generalized Fluid System Simulation Program (GFSSP) for modeling and simulation of propulsion systems. GFSSP is a finite volume based network flow analysis code that can model cryogenic propulsion systems. MSFC is currently working on a project to develop numerical modeling techniques for simulating propellant loading of Ares I Launch Vehicle. The objective of this computational project is to develop a methodology to estimate the time required to chilldown the ground system, amount of propellant used to chilldown and to ensure that during loading operation, the propulsion system does not violate any design criterion.
MSFC3-06-SD	Marshall Space Flight Center (MSFC)	Propulsion	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.
MSFC3-12-SD	Marshall Space Flight Center (MSFC)	Propulsion	Liquid engine system performance modeling and Predictions	To further develop PSTAR, the first order modeling tool, by providing the capability to perform off-design analysis of liquid rocket engines ,while improving performance, weight and cost predictions. There are up to 4 senior design projects available -- off design capability, performance improvements, weight model improvements and cost model improvements.
MSFC3-16-SD	Marshall Space Flight Center (MSFC)	Propulsion	Diagnostics for plasma propulsion systems	Plasma-based systems are typically applied to situations where very high gas velocities are required. As a space thruster, plasma-based devices expel their propellant at a much greater velocity than chemical rockets. Consequently, they require less propellant to complete a given mission, leaving more room on a spacecraft for hardware/consumables/instruments. Plasma based devices also find use in studies where the fast plasma can be used to accelerate small particles up to the speeds typical of in-space micrometeorites impacting a spacecraft or habitat. There is a need to have diagnostics that can measure the time-varying plasma properties in such devices to validate the present theoretical understanding and to serve as experimental benchmarks that can support the development of models. Senior project opportunities are available in designing and constructing robust, stand-alone diagnostic packages with plug-n-play capability for use with many pulsed plasma sources and in designing and fabricating experiments for evaluation of new diagnostic techniques.

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Updated: June 29, 2009

Project ID	NASA Center	ESMD Related Area	Title	Description
MSFC3-17-SD	Marshall Space Flight Center (MSFC)	Propulsion	Liquid metal system components for nuclear surface power	There is presently an effort underway at MSFC to evaluate components that might be included in the design and eventual deployment of space and lunar-based nuclear reactor systems. The evaluation effort involves the use of a simulated nuclear reactor core (comprised of resistive heating elements) where pumped NaK (sodium-potassium eutectic) is used as the heat-transfer medium. In these systems there is significant need for improvement over present state-of-the-art component technology. This includes the need for lighter-weight, more efficient liquid metal pumps, more accurate flow rate measurement techniques, and capabilities to monitor the state of the liquid metal (liquid level, temperature, etc), especially in locations that are not easily accessible. Senior projects would aim at evaluating different strategies to improve technology over the present state-of-the-art through a combination of literature research, theoretical and numerical modeling, performance analysis, fabrication and testing.
MSFC3-18-SD	Marshall Space Flight Center (MSFC)	Propulsion	ROCETS (Rocket Engine Transient Simulation) Improvements	RTo improve the Rocket Engine Transient Simulation (ROCETS) tool by making the optimization scheme more robust, adding new design modules and improving existing modules
MSFC3-19-SD	Marshall Space Flight Center (MSFC)	Propulsion	Main Propulsion System and Turbomachinery Analysis by GFSSP (Generalized Fluid System Simulation Program)	GFSSP (Generalized Fluid System Simulation Program) is a finite volume based network analysis code developed at MSFC for analyzing chilldown, loading, stratification, pressurization, feed system, recirculation and fluid transients. It has also been extensively used for secondary flow analysis in turbo-pumps and many other applications that require coupled thermo-fluid analysis involving conjugate heat transfer. GFSSP has an user-friendly visual pre and post processor and a modular code structure with extensive documentation with example problems that make it ideally suitable for Senior Design Project.
MSFC3-27-SD	Marshall Space Flight Center (MSFC)	Spacecraft	Analyze, Build, and Flight-test Rockets	Analyze, build, and flight-test rockets to develop systems engineering skills. Each team will build a rocket and predict and then measure acceleration, altitude and two other variables: such as tank pressure and chamber pressure, Pitot pressure and temperature, vibration, magnetic orientation in two axes, sun sensor, gyro position, etc.
MSFC4-01-SD	Marshall Space Flight Center (MSFC)	Spacecraft	Design for Reliability and Safety	Safety and Reliability is a top priority for NASA in the development of new launch systems. There is a need to define and develop a process that describes how to "design for reliability and safety". This is a system engineering design project that addresses all what needs to be done throughout all the phase of a program (quantitative and qualitative) to design highly reliable and safe launch systems. This includes identification of products, tools, approaches, etc.. by program phase.
MSFC4-23-SD	Marshall Space Flight Center (MSFC)	Spacecraft	Optimized De-Orbit Propulsion Systems for Various Mass-Class Payloads	NASA classifies satellites as standard (>500 kg range), small (100-500 kg range), mini (10-100 kg range), and nano (less than 10 kg). Each size satellite has associated volume constraints which together define the launch mass and volume of the payload. All spacecraft programs are required to have a de-orbit plan for all satellites in Low Earth Orbit. This study will focus on determining the optimum de-orbit system for each of the satellite sizes. The de-orbit systems to be considered are: 1. solar sail, 2. chemical /liquid fuel thruster, 3. natural decay, 4. electro-dynamic tethers, 5. other. To normalize the study, start by considering all satellites at an altitude of 1000 km, in a circular orbit, and 28.5˚ inclination. To start the study, assume the following masses: Standard = 500 kg Small = 250 kg Mini = 50 kg Nano = 5 kg The study should evolve into optimization over available trade space.
MSFC4-24-SD	Marshall Space Flight Center (MSFC)	Spacecraft	Remediation of environmental pollutants and contaminants through non-mechanical technologies	Current technologies for removal of toxic and hazardous materials from life-contact fluids (air, wastewater) include filters and chemical exchangers that must be discarded after use. The limitations on mass that can be carried on long-term missions to the moon and Mars will demand that regenerative capabilities be developed to remove biological materials, outgassed abiological compounds, and lunar dust from water and air. Semester 1: Develop concepts for remediation technologies that could be achieved within 15 years. Address regenerative abiological chemistries, nanotechnology, and biological or biochemical systems. Develop proposal for construction of one or more systems, including test plan. Semester 2: Develop system and conduct appropriate tests, based on test plan. Report results.
SSC3-01-SD	Stennis Space Center (SSC)	Propulsion	Stratification Rates of Nitrogen Contamination in Hydrogen	Determination of the diffusion rate constant and buoyancy force balance at small concentrations for nitrogen contamination in hydrogen. The project would be the experimental determination of the rate of stratification of gaseous nitrogen in a container of hydrogen by introducing a small fixed amount of nitrogen in into a volume of hydrogen (or possibly helium for safety) and monitoring the stratification process.
SSC3-02-SD	Stennis Space Center (SSC)	Propulsion	Determination of Circumferential Temperature Distribution	Determination of the circumferential heat leak through a vacuum jacketed pipe carrying cryogenic fluid. The project would be the experimental determination of the circumferential temperature distribution and heat leak under cryogenic conditions for a vacuum-jacketed pipe in a horizontal orientation. One of the primary goals of the investigation would be the separation of the external radiation component from the convective component of heat transfer producing the circumferential temperature variation with a partially filled inner tube.
SSC3-03-SD	Stennis Space Center (SSC)	Propulsion	Design of A Shell Tube Heat Exchanger	When discussing space travel (including satellite launches), there is and always has been a desire to lift as much payload as possible at the lowest cost possible. In fact, SSC has been asked to deliver 162 degree Rankine Liquid Oxygen (LOX) to support testing of X-33, J-2X Powerpack and recently SSME. This was accomplished by "bubbling" gaseous helium through the LOX storage vessel until the desired temperature was achieved. This "denser" propellant enabled the rockets to achieve better engine performance . Recently, a customer approached SSC with a desire to test with 150 degree Rankine LOX, which is outside of the capability of "bubbling". The customer described a shell tube heat exchanger type apparatus used in conjunction with Liquid Nitrogen to achieve temperatures as low as 145 degree Rankine in a previous project. This heat exchanger would not be available for our testing series. We need to design a shell tube heat exchanger (and associated piping) which uses Liquid Nitrogen to achieve 145 degree Rankine LOX. The actual storage vessel to be used is an 11,000 gallon Liquid Oxygen tank and the required time to decrease LOX temperature is 12 hours maximum. Proof of concept can be done on a much smaller scale to demonstrate proper operation.
SSC3-04-SD	Stennis Space Center (SSC)	Propulsion	Thermocouple Analysis For Cryogenics Temperature Measurement in Testing of Rocket Engines	In the testing of rocket engines for space exploration, it is important to understand temperature measurement in cryogenic fluids. Temperature measurement helps characterize the rocket engine's operating conditions and performance. Accurately determing the temperature requires a good fundamental background in sensor characteristics of numerous temperature devices and the reason for using each in specific situations. All devices have one common performance indicator called a "time constant". Determing the time constant of termperature sensors that are suddenly submerged in a cryogenic fluid can be a challenge. Rapid boiling ensues once a room temperature probe is dipped into the cryogenic fluid. Therefore, NASA has a need to determine the time constant of different types of thermocouples (T/Cs) and Resistance Thermal Devices (RTDs) in cryogenics (normally LN2 will be used). There are many different types of thermocouples and RTDs available for rocket engine testing . Analysis is needed for determining the best overall thermocouple and RTD. This project seeks to analyze and record the characteristics of various types of thermocouples and RTDs in order to accomplish that task . The thermocouples and RTDs will undergo a cryogenic dip test and a specialized oil dip test. Variables of the thermocouple include type, probe diameter, length, depth of dip, grounded or ungrounded, open tip or closed tip, orientation, output mv, and body materials compatibilty with certain cryogenics. In addition, T/Cs
SSC3-05-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.