ANNEX 1: NASA INTERNATIONAL INTERNSHIP PROGRAME (NASA I^2)
RESEARCH PROJECT AREAS

1. Advanced Life Support

Project Title	Advanced Life Support
Mentor Name	Michael Flynn
Organization Code	Code SC, Bioengineering
Research Area/Field	Water Recycling
Project Description	Advanced life support systems include all systems and technologies required to keep astronauts alive in space: water recycling, air recycling and waste treatment. This Internship is primarily focused on water recycling but is cognizant that an optimized system will include integration with air and waste systems. Our research areas include: • Systems that can recover energy from waste. • In situ resource utilization in spacecraft and on planetary surfaces • Application of space flight systems technologies to sustainable terrestrial development.
Requirements	Innovation a required skill. Our group focuses on training the next generation of NASA scientists on how to innovate and to develop the next generation of water recycling space flight systems that will enable the human exploration and colonization of the Solar System. The ideal candidate is an undergraduate or graduate student in the fields of: Engineering (Chemical, Environmental, Electrical, Industrial, Civil, Computer), Mathematics, Chemistry, Biology, Physics, and Environmental Science and must have at least completed their freshman year of college and a GPA of 3.00 (out of 4). Professional Working Proficiency (ILR level 3) of the English language is the minimum level required. The participant must be a team player and comfortable working with professionals of different cultural and scientific background. At the end of the internship the participant will be required to submit a white paper.
Dates	TBD
Hours	40 hours per week (standard)

2. **Biosensor Development**

Project Title	Biosensor Development
Mentor Name	Jessica Koehne
Participating NASA Center	Ames Research Center
Research Area/Field	Nanotechnology
Project Description	Development of biosensors is an active field due to a wide range of applications in lab-on-a-chip, diagnostics of infectious diseases, cancer diagnostics, environment monitoring, biodetection and others. One of the strategies used for selective identification of a target is to /preselect/ a probe that has a unique affinity for the target or can uniquely interact or hybridize with the target: sort of a "lock and key" approach. In this approach, one then needs a platform to support the probe and a recognizing element that can recognize the said interaction between the probe and the target. The interaction result can manifest optically (by using dyes, quantum dots for example) or electrically. The platform design and configuration may vary depending on whether optical or electrical readout is used and what environment the sensor will be utilized. Electrical readout biosensors have gained much attention because, in principle, they can be made more compact than optical technologies. Advances in microfabrication and related technologies have been aiding the electrical readout based biosensor development to the forefront. A previous NASA Ames innovation involves a nanoelectrode array consisting of an array of carbon nanofibers as individual nanoelectrodes. Each nanofiber, which is a solid nanocylinder, has a probe attached to it. The array size, chip size and wafer size can be controlled. In order to maintain that this device is stable over a wide range of testing conditions, the sensor will placed in various chemical and electrical environments. The project involves pursuing the above or closely related avenues to demonstrate the sensor functionality in a variety of testing conditions. Intended NASA applications include water quality monitoring for ISS and lab-on-a-chip for point of care diagnostics for astronaut health monitoring.
Requirements	Microsoft Word, Excel and PowerPoint
Dates	TBD
Hours	40 hours per week (standard)

3. Computer Science Programmer

Project Title	Computer Science Programmer
Participating NASA Center	Ames Research Center
Research Area/Field	
Project Description	Develop 3D virtual globe technology and applications in Java, C++, iOS and Android We are delighted at the prospect of Inzamam Rahaman working for NASA this summer as part of the Intern Program. We have a lot of challenging things to accomplish with NASA World Wind technology, http://goworldwind.org/ as we port it from Java to JavaScript. http://worldwindserver.net/webworldwind/examples/BasicExample.html http://worldwindserver.net/webworldwind/examples/BingLayers.html http://worldwindserver.net/webworldwind/examples/Shapefiles.html http://worldwindserver.net/webworldwind/examples/MultiWindow.html Source Code: http://worldwind31.arc.nasa.gov/svn/trunk/WebWorldWind/ API documentation: http://worldwindserver.net/webworldwind/api-doc/
Requirements	
Status	
Hours	40 hours per week (standard)
Mentor	Patrick Hogan
Number of Students	
Approved by Export Control	Yes

4. CubeSat Cluster Test-Bed

Project Title	CubeSat Cluster Test-Bed
Mentor Name	BJ Jaroux
Participating NASA Center	Ames Research Center
Research Area/Field	Small Sats
Project Description	Team members will use available off-the-shelf or spare laboratory hardware to develop laboratory test bed of at least two "Cubesats" and one ground station that will be used for on-going software and communications architecture development. The "Cubesats" may be complete units with all subsystems, flat-sats, or development units consisting of just a processor and RF subsystem. The team will develop ground software as necessary to demonstrate operation of the units including simulated intersatellite communications and simulated downlink.
Requirements	Student should have an Aerospace Engineering, Mechanical Engineering or Mechatronics, Electrical Engineering, Systems Engineering or other related engineering major.
Dates	TBD
Hours	40 ours per week (standard)

5. **Data Mining and Analysis for Sustainability Base**

Project Title	Data Mining and Analysis for Sustainability Base
Mentor Name	Rodney Martin
Participating NASA Center	Ames Research Center
Research Area/Field	Data Mining
Project Description	The Intelligent Systems Division at NASA Ames Research Center will be integrating advanced technologies into a new "Green" building known as "Sustainability Base" at the Ames campus. Sustainability Base is high-performance, LEED Platinum certified building that will incorporate NASA innovations and technologies to improve energy efficiency, reduce carbon footprint, and lower operating and maintenance expenses compared to traditional buildings. It will function as a living experimental platform, integrating the latest technologies as they evolve. This internship opportunity will assist in defining and implementing demonstrations of NASA technology in Sustainability Base. In particular, the intern will employ advanced data mining algorithms on data acquired from Sustainability Base to learn how the building operates and then monitor how it is performing over time. This could include measurements of energy use, mechanical system performance, environmental parameters, and other key performance indicators. For example, correlations between environmental control system settings and temperature ranges in workspaces can be established and then monitored to give early indication of performance degradation or unexpected changes to the building configuration. However, basic data analysis and gaining an intuitive understanding of data from various building systems (BACnet data, lighting, shade, photovoltaic sensor data, etc.) will also be an important precursor to any application of the advanced data mining algorithms. In addition to global building performance, the algorithms can also be used to detect changes in individual energy use as well. In either case, the algorithms will provide early indications of off-nominal performance to building operators or occupants, enabling corrective actions to maximize building performance and efficiency. Additional information on Sustainability Base can be found athttp://www.nasa.gov/sustainability-base/. Additional information on data mining algorithms can be found athttp://ti.arc.nasa.gov/tech/dash/intelligent-data-understanding/.
Requirements	The focus of this effort may relate more to automated tracking and consolidation of energy data and plug load management and analysis, so the ideal candidate will have experience in scripting or application development to extract real-time data from APIs and websites for logging into a PostgreSQL database. Experience with MATLAB; Familiarity with Linux OS is preferred; Strong analytical and organizational skills;

	Interest in sustainability; Interest in data mining algorithms for health management. Senior undergraduate at junior/senior level or higher preferred.
Dates	TBD
Hours	40 ours per week (standard)

6. **Explore Impact of Network Delays on Distributed Spacecraft Testing**

Project Title	Explore Impact of Network Delays on Distributed Spacecraft Testing
Participating NASA Center	Ames Research Center
Research Area/Field	Small Sats
Project Description	Team members will use available off-the-shelf or spare laboratory hardware to explore the possibility of using standard network systems and protocols to run mission simulation and closed-loop hardware-in-the-loop tests remotely where significant parts of the system are connected over the internet. For example, a spacecraft bus could be at one location, a payload at a second location and a dynamic simulation environment could be at a third location, all connected over the internet. The team would identify the problems associated with such an arrangement (e.g. latency) and suggest approaches to mitigate them.
Requirements	Student should have an Aerospace Engineering, Mechanical Engineering or Mechatronics, Electrical Engineering, Systems Engineering or other related engineering major.
Status	
Hours	40 hours per week (standard)
Mentor	BJ Jaroux
Number of Students	
Approved by Export Control	Yes

7. **Lunar Topographic Products from Orbital Images** Ames Research Center

Project Title	Lunar Topographic Products from Orbital Images
Participating NASA Center	Ames Research Center
Research Area/Field	Computer Science
Project Description	Digital terrain models are essential for cartography, science analysis, mission planning and operations. The NASA Ames Intelligent Robotics Group (IRG) has developed software to automatically generate high-quality topographic and albedo models from satellite images. Our software, the Ames Stereo Pipeline (ASP), uses stereo vision and photoclinometric techniques to produce 3D models of the Earth, Moon, and Mars with very high accuracy and resolution. The intern will assist IRG to improve the quality of topographic products from lunar orbital images. In particular, the intern will help develop multi-stage stereogrammetric methods to exploit the full potential of multiple, overlapping views of a planetary surface. The intern will work closely with NASA researchers and engineers throughout the internship. Very strong emphasis is placed on incorporating and integrating the intern's research into IRG's on-going projects. Research results may be published in one (or more) technical forums: as a NASA technical report, a conference paper, or journal article.
Requirements	The intern must have a background in Computer Science or Mathematics. Practical experience with computer programming, Linux-based software development and open-source tools (gcc, git, etc) is required. Experience with C++ is strongly encouraged.
Status	
Hours	40 hours per week (standard)
Mentor	Terrence Fong
Number of Students	
Approved by Export Control	Yes

8. Metabolic control for adaptation to spaceflight environment

Project Title	Metabolic control for adaptation to spaceflight environment
Mentor Name	Yuri Griko
Organization Code	Code SC, Division of Space Biosciences
Research Area/Field	Space Biology/Metabolism
Project Description	With the growing interest in long haul flights and the colonization of the solar system, it is becoming important to develop organism self-regulatory control systems which would be able to meet the requirements of extraterrestrial environments rather than requiring an Earthly environment in space. A better mechanistic understanding of metabolism offers a means for sustaining astronauts in long-duration missions beyond the low Earth orbit. Recent data obtained from several research reports have shown that metabolic suppression could protect biological organisms from damaging effects of space radiation and microgravity. The ability to drastically reduce and suspend metabolism appears to be closely tied to the unique survival of bacteria and some invertebrates (e.g., tardigrades) after a prolonged exposure to cosmic vacuum and radiation. It is possible that there is a monophyletic origin for this adaptation at the molecular level among a variety of different organisms. Our ultimate goals are to demonstrate proof-of-principle for metabolic suppression as means to reduce the negative effects of spaceflight environmental issues such as radiation and microgravity. In order to demonstrate the potential application of the metabolic control technology the PI's laboratory at NASA Ames Research Center has engineered a hypo-metabolic chamber with a range of life-monitoring equipment for high-throughput testing of hypo-metabolic parameters and conditions that enable reversible induction of a state of suspended animation in non-hibernating animals. This internship opportunity will assist in defining and implementing demonstrations of the metabolic control technology using different animal models. Objectives of this research are: 1. To characterize the hypometabolic state 2. To develop methodology for real time monitoring of respiratory and other physiological parameters and conditions associated with the hypometabolic stasis. In the proposed experiments, the intern will work in collaboration with molecular biologists and engineers to (1) reproduce induction of the reversible suspended animation-like state in selected animal models, and to (2) establish a comprehensive life support system for monitoring physiological parameters of the hypometabolic state.
Requirements	Student should be willing to work with animals. He/she should have basic knowledge of life support systems (respiratory parameters, ventilation, and core body temperature

	control), have basic laboratory skills and technical knowledge for monitoring physical parameter from telemetric devises, and have software management skills. Strong analytical and organizational skills; interest in biology; interest in data analysis. Senior undergraduate at junior/senior level or higher preferred.
Dates	TBD
Hours	40 hours per week (standard)

9. Monitoring Changes in ASRS Reports using Python and Text Mining

Project Title	Monitoring Changes in ASRS Reports using Python and Text Mining
Participating NASA Center	Ames Research Center
Research Area/Field	Computer Science
Project Description	Students applying for fellowship opportunities will be required to submit a proposal to the mentor. Prior to submitting a proposal, students will create a proposal summary with a description of their idea, and they will submit it to the mentor for their approval. The mentor has 10 business days to respond to each proposal summary. It is anticipated that mentors will only approve a couple proposal summaries, and they will work with those students to create their proposals and to make sure the topic is mutually beneficial to both the mentor and student.
Requirements	We aim to develop tools that can be used to monitor the changes in the aviations safety reports submitted to NASA Aviation Safety Reporting System (ASRS) program. ASRS collects and analysis the voluntarily submitted aviation safety incidents reports in order to reduce the ikelihood of aviation accidents. We need tools that can help ASRS to monitor changes in the narratives of the reports over time and can summarize these reports.
Hours	40 hours per week (standard)
Mentor	Hamed Valizadegan
Approved by Export Control	Yes

10. Nanotechnology in electronics and sensor development

Project Title	Nanotechnology in electronics and sensor development
Mentor Name	Meyya Meyyappan
Organization Code	Code T; co-mentors: Code-TSN
Research Area/Field	Nanotechnology
Project Description	Nanomaterials such as carbon nanotubes (CNTs), graphene and a variety of inorganic nanowires offer tremendous potential for future nanoelectronics, nanosensors and related devices. We have active ongoing programs in these areas. Several examples are given below. Chemical sensors to detect trace amounts of gases and vapors are needed in planetary exploration, crew cabin air quality monitoring and leak detection; there are numerous societal applications as well. We have been working on CNT based sensors amenable for various platforms including smartphones. Flexible electronics on substrates such as textile and paper is of great deal of interest to us. We have fabricated gas/vapor sensors on cotton textile as well as cellulose paper. Other interests in paper electronics and flexible substrates include memory devices, energy storage devices, displays and detectors. Finally, we have also been revisiting vacuum tubes although in the nanoscale, using entirely silicon based technology. These radiation resistant devices offer exceptionally high frequency performance. Our interest here extends to exploring the nano vacuum tubes for THz electronics applications. In all the areas, the projects include material growth, characterization, device fabrication, device testing and evaluation, reliability and lifetime assessment.
Requirements	For device related aspects, majoring in electrical engineering or physics is preferred. For the remaining aspects of the project, majors in material science, chemistry and other engineering disciplines are welcome. PhD candidates and talented undergraduates will get preference.
Dates	TBD
Hours	40 hours per week (standard)

11. **Prognostics and Health Management**

Project Title	Prognostics and Health Management
Participating NASA Center	Ames Research Center
Research Area/Field	
Project Description	Explore prognostic and forecasting concepts in the context of aeronautics vehicles and airspace operations. The task involves literature review, algorithm development (likely in matlab) and realization of some of the concepts in relevant aeronautics simulations. It may also involve some lab experiments during which the candidate would age components relevant in an aeronautics context.
Requirements	The outcome would be one or more of: • algorithms • experimental data • report or publication • poster presentation Matlab required, labview desired.
Status	
Hours	40 hours per week (standard)
Mentor	Kai Goebel
Number of Students	
Approved by Export Control	Yes

12. Studies of the aqueous history of Mars

Project Title	Studies of the aqueous history of Mars
Participating NASA Center	Ames Research Center
Research Area/Field	Computer Science
Project Description	Student will analyze data from a variety of spacecraft to understand the geologic history of sites of interest, in order to better understand the role of water in the history of Mars. This opportunity may include computer modeling, data analysis, and laboratory work. If times allows, preparation of a manuscript. Potentially, the sites will be proposed as landing sites for the 2020 Mars Rover. Student will also develop software for the analysis of CRISM data.
Requirements	Experience in Unix or equivalent fluency in IDL preferred.
Status	
Hours	40 hours per week (standard)
Mentor	Eldar Noe
Number of Students	
Approved by Export Control	Yes

13. **The Influence of Mechanical Unloading on Biological Function Ames Research**

Project Title	The Influence of Mechanical Unloading on Biological Function
Mentor Name	Elizabeth Blaber
Participating NASA Center	Ames Research Center
Research Area/Field	Life sciences, biology
Project Description	The spaceflight environment, including microgravity and space radiation, is known to negatively impact mammalian physiology, including somatic stem cell-based tissue regeneration. The degenerative effects of spaceflight that we understand best include rapid microgravity-adaptive bone and muscle loss, loss of cardiovascular capacity, defects in wound and bone fracture healing and impaired immune function. These implications pose a significant risk for long-term human space exploration. Our work focuses on the influence of mechanical unloading on stem cell proliferation, differentiation and regeneration and how alterations in stem cell function may be the cause of widespread tissue degeneration in space. In this opportunity, the selected student will work with research scientists to analyze the response of mouse bone and bone marrow stem cells to mechanical unloading using both spaceflight samples and mouse hindlimb unloading experiments. The student will investigate stem cell responses to microgravity and mechanical unloading using gene expression and protein analysis and furthermore, will investigate the influence of stem cell function on whole bone tissue properties - including structural and molecular analysis. Furthermore, the student will also work with scientists on optimizing conditions for an upcoming spaceflight experiment where we aim to identify key molecular mechanisms that cause degenerative effects in bone tissue through impaired differentiation of mesenchymal stem cells. The student will conduct cell culture and gene expression/protein assays to characterize wildtype stem cells compared to the transgenic model. The student will then work with research scientists to determine the optimal cell culture parameters to conduct the experiment in spaceflight hardware.
Requirements	Laboratory experience is preferred.
Dates	Spring, Summer, or Fall 2017
Hours	40 hours per week (standard)

14. Upgrading a Space Debris Simulation Software for planetary defense assessments

Project Title	Upgrading a Space Debris Simulation Software for planetary defense assessments
Mentor Name	Chad Frost
Organization Code	RD, Mission Design Division
Research Area/Field	Space Debris Mitigation / Planetary Defense
Project Description	NASA Ames Research Center has developed a simulation software that models the space debris environment in Low Earth Orbit (LEO). The goal of the current software is to assess the efficiency of a concept for collision avoidance between debris and active satellites. The investigated system would use photon pressure from ground based lasers to slightly change orbits to avoid collisions on warning. For the internship, the main task will be to upgrade the simulation software to include the near earth object (NEO) environment (asteroids) and enable the assessment of cubesat based asteroid detection systems. You will change the main body of the previous simulation from the sun to the earth, introduce a population of asteroids into the model and investigate the utility of cubesats to detect those asteroids as they come close to Earth. In addition, you also will help to maintain the original software for space debris modeling.
Requirements	The intern should have a background in the sciences or engineering, and ideally Aerospace Engineering or Physics. The project requires programming skills in C and Matlab and an understanding of orbital dynamics.
Dates	TBD
Hours	40 ours per week (standard)

15. Upgrading a Space Debris Simulation Software for planetary defense assessments Ames Research Center

Project Title	Upgrading a Space Debris Simulation Software for planetary defense assessments
Mentor Name	Chad Frost
Organization Code	RD, Mission Design Division
Research Area/Field	Space Debris Mitigation / Planetary Defense
Project Description	NASA Ames Research Center has developed a simulation software that models the space debris environment in Low Earth Orbit (LEO). The goal of the current software is to assess the efficiency of a concept for collision avoidance between debris and active satellites. The investigated system would use photon pressure from ground based lasers to slightly change orbits to avoid collisions on warning. For the internship, the main task will be to upgrade the simulation software to include the near earth object (NEO) environment (asteroids) and enable the assessment of cubesat based asteroid detection systems. You will change the main body of the previous simulation from the sun to the earth, introduce a population of asteroids into the model and investigate the utility of cubesats to detect those asteroids as they come close to Earth. In addition, you also will help to maintain the original software for space debris modeling.
Requirements	The intern should have a background in the sciences or engineering, and ideally Aerospace Engineering or Physics. The project requires programming skills in C and Matlab and an understanding of orbital dynamics.
Dates	TBD
Hours	40 hours per week (standard)

16. Engineering Student Intern, Experimental Aero-Physics Branch Ames Research Center

Project Title	Engineering Student Intern, Experimental Aero-Physics Branch
Mentor Name	Kurtis Long
Participating NASA Center	Ames Research Center
Research Area/Field	Mathematics, Physics, Engineering
Project Description	The student will help with a variety of experimental projects which investigate the fluid mechanic, aerodynamic, and/or aero-acoustic characteristics of manned and unmanned spacecraft, aircraft, rotorcraft, ground vehicles, ships, structures, sports balls, and other objects. The experimental projects will be conducted in conjunction with on-site research mentors, using NASA Ames wind tunnel, water channel, lab, and/or computer facilities. The student will assist with many different phases of one or more test programs; these phases may include prior data review and test planning, test logistics, experimental design and setup, model construction and installation, instrumentation calibration, installation, and operation, test video/photo documentation, post-test data plotting and analysis, and report development. The student may also assist with the development and execution of various computer programs used to analyze or simulate the results of experimental test programs. The main outcome of this internship will be experience with a variety of disciplines related to fluid mechanics, aerodynamics, and/or aeroacoustics.
Requirements	Physics, Science, Math, Engineering backgrounds preferred
Dates	Spring, Summer, or Fall 2017
Hours	40 hours per week (standard)

17. Rotorcraft Aeromechanics Ames Research Center

Project Title	Rotorcraft Aeromechanics
Mentor Name	William Warmbrodt
Participating NASA Center	Ames Research Center
Research Area/Field	Aeromechanics
Project Description	The Aeromechanics Branch is responsible for aeromechanics research activities that directly support the civil competitiveness of the U.S. helicopter industry and the Department of Defense. Branch programs address all aspects of the rotorcraft which directly influence the vehicle's performance, structural, and dynamic response, external acoustics, vibration, and aeroelastic stability. The span of research also includes unmanned aerial vehicle (UAV) platforms, including quadcopters and other advanced, small remotely piloted vertical takeoff and landing (VTOL) aircraft. The programs are both theoretical and experimental in nature. Advanced computational methodology research using computational fluid dynamics and multidisciplinary comprehensive analyses seeks to understand the complete rotorcraft's operating environment and to develop analytical models to predict rotorcraft aerodynamic, aeroacoustic, and dynamic behavior. Experimental research seeks to obtain accurate data to validate these analyses, investigate phenomena currently beyond predictive capability, and to achieve rapid solutions to flight vehicle problems. Databases from the flight and wind tunnel experimental programs are validated, documented and maintained for the benefit of the U.S. rotorcraft technology base.
Requirements	Broad background in science and math classes typical of an upper division undergraduate in mechanical, aeronautical or aerospace engineering. Knowledge of MatLab, Simulink, CREO ProE/SolidWorks/AutoCad,, VSP, Rhino, C++, python, or other programming/software languages is desired, but not mandatory.
Dates	Spring, Summer, or Fall 2017
Hours	40 hours per week (standard)

Note: The research fields stated in this document are the opportunities presented for the NASA I^2 Summer 2017 Cycle. Any additions and outstanding information will be updated accordingly.