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September 2009 • 2101 NASA Parkway, Houston, Texas 77058
The Undergraduate Student Research Project (USRP, http://usrp.usra.edu) is a NASA Higher Education Program (www.nasa.gov) administered by the Universities Space Research Association (USRA, www.usra.edu), a private, nonprofit corporation founded in 1969 under the auspices of the National Academy of Sciences.
Welcome

The Undergraduate Student Research Project (USRP) provides Science, Technology, Engineering and Mathematics (STEM) undergraduate students with immersive internship opportunities and has become NASA’s largest agency-wide internship project. USRP operates year-round offering internships in the spring, summer, and fall; currently placing well over 300 undergraduates at 12 NASA centers and research facilities each year. Critically positioned in NASA’s STEM workforce development pipeline, the USRP is regarded as a key to ensuring a high-quality future technical STEM workforce for the U.S.

In the last two years, USRP has undergone many changes tied to an innovative new project design and management approach that has resulted in rapid project growth allowing USRP to become both in size and quality NASA’s premier undergraduate internship project. As a result, USRP has generated exemplary results, many of which are highlighted in this report. During this period, USRP grew in size from 130 to 330 internships per year and changed from a highly summer-focused project to a year-round internship project with 201 semester interns in FY 2009. With changes of this scale, came many workload adjustments and management challenges. In all cases, the USRP team has demonstrated a keen ability to predict and minimize difficulties generated by these changes as well as meet those challenges that have arisen — all with an exemplary level of customer-focus.

Perhaps it should come as no surprise that the metrics and outcomes presented here demonstrate such a high level of excellence. All of the programmatic changes implemented over the past 18 months have served to align USRP to better meet the needs of the key customers that make any internship project work — the students and the mentors. By implementing a fully web-based, streamlined and user-friendly student application process, USRP has been able to generate a much larger and more diverse pool of highly-qualified...
and motivated students (over 3,000 qualified applicants representing over 900 academic institutions and including over 500 minority candidates in FY2009). Also, by filling the needs of the NASA technical workforce during fall and spring, USRP has generated a larger number of in-depth, technically challenging internship experiences which are often more directly aligned with the personal career goals of the students selected.

The new metrics presented in this report demonstrate that the USRP team is on the right track in maximizing both the student learning and productivity generated by these internship experiences. These immediate results are a strong indication that the longer-term STEM pipeline outcomes, which are the ultimate goal of NASA higher education projects, will be equally stellar as recent participants in USRP graduate, pursue advanced degrees, and ultimately enter the aerospace workforce.

I congratulate the entire USRP team for a job well done and support their efforts to migrate best practices to other NASA projects as well as maintain and improve on the levels of excellence established in this report in the upcoming years.

Sincerely,

Susan M. White
Education Director, Johnson Space Center Office of External Relations
The United States and NASA are at risk of being strongly impacted by the projected decrease of technical talent in the STEM workforce. NASA expects 50% of its workforce to retire within the next decade. NASA recognizes that the Agency is facing tremendous challenges in maintaining a skilled, qualified, and motivated workforce capable of successfully embarking upon increasingly complex and multi-disciplinary endeavors. Thus, it is vital to both NASA and its industry partners that substantially more U.S. students are exposed and attracted to the science, technology, engineering and mathematics (STEM) fields.

The NASA Undergraduate Student Research Project (USRP) is a critical element in NASA’s STEM Pipeline. USRP enables STEM students to apply their academic knowledge through immersive, hands-on STEM experiences. USRP has demonstrated that it can positively influence the career choices for many of the most promising technical students in the United States, and moreover, enhance the skills, competencies and commitment of those students as they progress towards graduate studies and the STEM workforce.
USRP: Connecting Undergraduate Students With NASA Training Opportunities

# NASA Education Goals

NASA continues to pursue three major education goals:
- Strengthening NASA and the Nation’s future workforce;
- Attracting and retaining students in science, technology, engineering and mathematics, or STEM disciplines;
- Engaging Americans in NASA’s mission.

# USRP Education Goals

- To extend and strengthen NASA’s commitment to educational excellence through immersive undergraduate STEM internships to increase and help retain our nation’s science, technology, engineering, and mathematics (STEM) majors and graduates;
- To build a national program bridge — from the existing NASA K-12 Education Program activities to the NASA Higher Education Program options — that encourage and facilitate student interest in future professional STEM opportunities with NASA and its partner organizations;
- To attract STEM undergraduate students from the widest array of backgrounds who are fully representative of America’s racial, ethnic, and cultural diversity and to provide them with challenging, hands-on research experiences that increase competencies and foster continued interest in the fields and/or disciplines aligned with NASA’s mission.
**USRP AT A GLANCE**

- NASA’s Largest Agency-wide STEM Internship Project
  - 577 STEM undergraduates placed from 1/08 to 8/09
  - All 10 NASA field centers and 2 NASA research facilities participating

- Competitive Application Process Open to STEM Undergraduates
  - Rising sophomores through senior students
  - Applicants must be U.S. citizens with minimum of 3.0 GPA

- Year-round Opportunities with Spring, Summer, and Fall Sessions
  - Spring & Fall internship sessions – 15 weeks
  - Summer internship session – 10 weeks
The USRP applicant pool shows that combined engineering degree-seeking students make up nearly half (51%) of the applicants, with 29% science majors and 20% computer science majors accounting for the other half.

### Academic Major

- **Total Engineering** – 51%
- **Total Physical Sciences** – 18%
- **Total Mathematics/Computer Science** – 20%
- **Total Biological Sciences** – 6%
- **Total Earth/Atmospheric/Oceanic Sciences** – 5%

### Academic Class Standing

- **Senior** – 55%
- **Junior** – 32%
- **Sophomore** – 9%
- **First Year Grad** – 4%

Junior and senior students are the most prevalent applicants (87%) to USRP. Many of the Community College students are in the sophomore category. First year graduates are only eligible for USRP if they have had previous NASA experience.
Outcomes

Program Assessment Rating Tool (PART) Measures and Outcomes

USRP’s innovative database collects metrics on all aspects of the project to aid in the continuous improvement of project processes and provide for efficiencies (e.g., in quick and easy reporting capabilities). USRP provides NASA with an annual report capturing specific required metrics (PART Measures and Outcomes) which are collected from all projects across the entire NASA Higher Education portfolio. During the period covering this report, USRP is reporting data from the 577 placed USRP STEM interns that were placed from January 2008 through August 2009. The statistics below represent the data collected from this combined cohort of USRP participants.

100% of USRP Interns Intend to Finish Their Bachelors Degree in STEM and 85% of USRP Interns Intend to Pursue a Graduate Degree

> STEM Workforce, p. 14

22% of USRP Interns Have Had a Previous NASA Experience

> NASA Pipeline, p. 12

30% of USRP Interns are Female

> Building Gender Equality in STEM Workforce, p. 11

21% of All USRP Interns Were Classified as Minorities

> Building Diversity in STEM Workforce, p.13
30% of USRP Interns are Female

The Undergraduate Student Research Project has placed 182 female interns by the Summer of 2009. Cassie Li and Courtney Dressing are examples of the type of outstanding USRP interns that will help the U.S. STEM workforce move towards a more balanced gender equity. Li worked at the NASA Stennis Space Center in the Summer of 2008 on the Integrated System Health Management Project. Her main responsibility involved work on the development of intelligence technologies for the various elements of rocket engine test-stands. Li came to USRP as a Sophomore from Carnegie Mellon University majoring in Electrical and Computer Engineering.

Courtney Dressing participated as a USRP intern in the Summer of 2009 and worked on the Mars Data Analysis Project. Her primary responsibility focused on the identification of Martian landforms using data returned by a series of Mars spacecraft: Mars Global Surveyor, Mars Odyssey, Mars Reconnaissance Orbiter and the Mars Exploration Rovers. Dressing’s project allowed her to use her knowledge of geology and computational science skills. Courtney attends Princeton University and majors in Astrophysical Science with a certification in Russian Language.
22% of USRP Interns Have Had a Previous NASA Experience

Tyler Kirby embodies the type of USRP student who has successfully navigated through multiple NASA experiences within the “NASA Pipeline.” Kirby obtained valuable hands-on STEM training to help build his professional competencies before he graduates. Kirby came to USRP after working on the NASA Moonbuggy Project, the NASA University Student Launch Initiative Project and working in the NASA Marshall Space Flight Center Propulsion Detailed Design Branch. Kirby became an intern in USRP during the summer of 2009, again at NASA Marshall. During his USRP 10-week internship, Kirby worked on the Valve Actuator Pressurization Program project in support of the development of a cryogenic valve for the Ares 1 rocket. “This is the kind of engineering I want to do when I enter the industry in 2010, and the experience and guidance that I receive at NASA will help me be a better engineer,” said Kirby. Kirby attends the Alabama A&M University and is majoring in mechanical engineering with an emphasis on propulsion.
Runa Lucienne worked on the Orion Cockpit Working Group Mock-ups Project at NASA’s Johnson Space Center in Houston. Her main project responsibility involved refining current concept designs associated with the Orion Spacecraft. Lucienne came to USRP after participating in the Summer High School Apprenticeship Research Program (SHARP) at the University of Michigan during the summer of 2005. Since she has had the opportunity to intern at NASA through USRP, Lucienne is determined to be an influential role model in the community, especially for young women who may also have an interest in STEM (Science, Technology, Engineering, and Math) related fields. “Adding NASA to my life’s resume is far beyond imaginable and has been a stepping-stone to understanding that anything really is possible as long as one has the determination and a positive attitude”, said Lucienne. Lucienne is a Toledo, Ohio native and is attending the City College of New York where she is studying mechanical engineering. She plans to graduate in 2011 and hopes to fulfill her dream of applying her knowledge and skills to help solve global issues like hunger, drought and global warming.

Minorities Selected

- Caucasian Selected – 63%
- Minorities Selected – 21%
- Unknown Selected – 16%
Laila Rahmatian exemplifies the type of focused USRP intern that takes advantage of STEM opportunities to enhance her career pathway. She interned with USRP at the Kennedy Space Center in the Summer of 2008. Rahmatian is currently enrolled at Purdue University and is majoring in Civil Engineering with a focus in Structures. Ms. Rahmatian plans to graduate with her Bachelor of Science in Civil Engineering in December of 2010. After receiving her undergraduate degree, Ms. Rahmatian is planning on pursuing her Ph.D. “Sharing with students my personal journey and experience gives people hope, interest and excitement about pursuing a non-traditional path. It helps fulfill my life long goal of breaking the stereotype. I want to help and be a good role model for students who are interested in working for NASA,” said Rahmatian. Rahmatian has been involved in six different NASA programs and activities including USRP. Other NASA opportunities that Rahmatian has participated include: the NASA Cooperative Education Program, a NASA Reduced Gravity Flight Opportunity Project in Systems Engineering, NASA ISS EarthKAM, the Texas Aerospace Scholars, the NASA Mars Settlement Competition and the International Space Station Design Competition.
COMMUNICATION

USRP Communication Strategy and Recruitment Campaign Design Based on Research

The USRP communication strategy was created as a result of the information collected from relevant age and STEM major student focus groups. USRP also synthesized data collected electronically from the USRP applicants documenting which communication channels they had heard about USRP. The research conducted sought to understand student perceptions towards NASA and the STEM disciplines to better determine the methods that would prove most productive in motivating students to apply for NASA internships. A significant number of students indicated that the various entities within the University (47%) and the Internet (17%) were the most often used resources for learning about USRP internship opportunities. The applicant data is continuously being analyzed to determine the most productive avenues of reaching USRP’s target audience.

USRP Communication Strategy Research

How Students Heard About USRP

- Web Search – 17%
- University – 17%
- Professor – 13%
- Advisor – 8%
- Friend – 8%
- NASA Employee – 6%
- Department Office – 7%
- Former NASA Intern – 5%
- Family Member – 5%
- Previous NASA Internship – 2%
- Conference – 2%
- Career Fair – 3%
- Space Grant – 2%
- Other – 5%
- Career – 2%
- Space Grant – 2%
- Conference – 2%
- Career Fair – 3%
- Other – 5%

Conclusion & Contacts
USRP Recruitment Campaign Creates Lasting Impressions

USRP focuses project recruitment communication efforts to maximize audience exposure. The top communication channels included:

- University Career Center and Co-op Office Web sites
- E-mail Communication Campaigns to Target Audiences
- Virtual Career Fairs to Prospective Applicants and University Officials.
- USRP Web site Enhancements and Developments based on student feedback
- On-site Recruitment through NASA Sponsored Organizations and Education Events

The Results: USRP has seen a record number of 5,626 qualified applicants, and a high level of interest in the program.

USRP initiated a new student recruitment campaign in 2008 entitled “Find Your Vision.” This campaign was developed to engage the nations’ STEM undergraduate students and to communicate the value and benefits of participating in NASA USRP internship opportunities. With record number of students applying to USRP, the elements of the new campaign seem to be successfully reaching the intended audiences.
Recruitment Results: Geographic Diversity of USRP Applicants and Selected Interns

The interactive USRP Web site was developed with enhancements that would allow prospective interns to make informed choices when selecting a NASA Center. This innovative and interactive design also provided project information to target audiences. With the USRP on-line application, students could access their application and update it for another session very easily.
Furthering NASA’s Mission —
Return on NASA’s STEM Investment

USRP mentors were asked to rate the productivity of USRP interns to generate an estimate of the value of the useful work generated by USRP interns. Mentor responses indicated that USRP interns were slightly better than a new hire (USRP Intern = 1.07, New Hire = 1.00) in terms of productivity. These ratings were used to create an equivalent FTE value (ROI) for work generated by USRP interns.

\[
\text{Productivity (\$)} = \text{mentor rating} \times \text{starting salary & benefits} \times \text{total length of USRP internships}
\]

\[
\text{Productivity (\$)} = 1.07 \text{ FTE mentor rating} \times \$70,000 / \text{yr} \times 147.1 \text{ FTE}
\]

\[
\text{USRP Productivity (\$)} = \$11 \text{ Million}
\]

\[
\text{Cost of USRP over same period} = \$6.6 \text{ Million}
\]

\[
\text{Net USRP Return on NASA Investment} = \$4.4 \text{ Million} + \text{STEM Workforce Development}
\]
USRP Success: STEM Interns Hired

Adam Rawlin and Johanna Goforth are examples of USRP interns moving through the “NASA Pipeline” and entering the STEM workforce. These USRP alumni have been hired. Rawlin and Goforth both indicated in their exit surveys that the USRP internship helped them prepare for a full-time STEM job and neither regret the decision to intern during an academic semester to take advantage of this unique immersive opportunity. Rawlin now works at the NASA Johnson Space Center with the Electronic Design and Development Branch. Goforth has been working at the NASA Johnson Space Center with Lockheed Martin since June of 2008.

USRP Return on Investment: Increased Core Competencies

The primary immediate outcome of experiential learning programs is a net increase in the competencies and skills of the students in their core area of study. Academic institutions are required to provide evidence that their engineering graduates demonstrate 13 defined core competencies (ABET a-k criteria). USRP interns were asked to indicate whether their internship experience provided them with significant growth in nine of those core competency areas shown to the right.
USRP Return on Investment:
Increased STEM Retention Rates

Hands-on, immersion STEM workforce training projects such as USRP generate positive outcomes in three general areas:

1. Retention (graduation, advanced degrees, employment)
2. Competency (experiential learning, skill development)
3. Productivity (task completion – furthering NASA’s mission)

USRP Increased Retention Rates

While very important, retention outcomes require years to emerge as students complete their undergraduate degrees, decide whether or not to pursue graduate programs, and finally enter the STEM workforce. USRP has been documenting attitudinal changes through student exit surveys. These types of surveys been shown to be reliable indicators of long-term retention outcomes.

“\[This is an excellent program for highly motivated students to get hands-on experience in a work environment and to get the satisfaction of contributing to a real program.\]\n
– Stephen Waterbury, Fall 2008 USRP Mentor

NASA Goddard Space Flight Center
The USRP Student Exit Survey asked students to determine the overall quality of the internship project. The results below indicate that 67% of the interns strongly agree that the internship was a quality experience while 25% moderately agree that the internship was a quality experience.

Overall I would rate the quality of the USRP internship as...

- Excellent – 67%
- Good – 25%
- Fair – 7%
- Below Average – 1%
- Poor – 0%

92% of USRP Interns Rated Their Experience as Excellent or Good
USRP Mentor Satisfaction Data

USRP Connect software combined with the online student application has helped to provide a much more efficient process of application review and enabled USRP mentors to match students with the specific needs of their technical project.

In the USRP mentor survey, mentors were asked:
- Was this student a good match for your project?
- Overall, I would rate this students’ performance as…?

### Match Quality

- Excellent – 89%
- Above Average – 8%
- Average – 1%
- Below Average – 1%
- Poor – 1%

### Performance Ratings

- Excellent – 83%
- Above Average – 15%
- Average – 1%
- Poor – 1%
USRP Mentor Satisfaction Surveys

The results from the USRP Mentor Survey indicated that 98% of USRP Mentors felt that the intern was Excellent or Above Average in the categories of Performance and Overall Match Quality to their USRP project.

“Paul Bonness was one of our top students to date. He is an extremely hard worker, knowledgeable, resourceful, creative and has been a great asset to our team. Great program and excellent candidate selection.”

– William Warmbrodt, USRP Mentor and Aeromechanics Branch Chief – NASA Ames Research Center

“Lisa Perez was an outstanding intern. She was extremely productive and self-motivated — constantly asking for more work. She completed tasks in several different disciplines, including mechanical design, stress modeling, mechanical assembly, and scripting for data analysis in two different languages, Python and KML, both of which she learned on-the-job.”

– Julie Townsend, USRP Mentor and ATHLETE Testing and Operations Engineer – NASA Jet Propulsion Laboratory

“Brenton Hartung’s performance during the internship was outstanding. He was able to absorb and learn new skills and tools quickly, and apply his knowledge to abstract concepts. The USRP program continues to be a valuable resource for our division, providing quality team-members, not just interns, who are hard working and quick learners.”

– Greg Holt, USRP Mentor and Navigation Engineer Flight Controller, Flight Design and Dynamics – NASA Johnson Space Center
USRP Mentor Satisfaction Benefit:
Interns Contribute to the Team

The USRP Mentor Survey asked USRP mentors to rate the performance, abilities and professionalism of the USRP interns. One particular question asked mentors if the student provided any new ideas to the organization during their internship.

Mentor responses indicated that in addition to their intern contributing to the completion of the project, USRP interns also provided constructive suggestions and excellent new ideas.

The Student Identifies and Suggests New Ideas

![Bar chart showing the distribution of ideas rated by mentors. The categories are Excellent Ideas, Good Ideas, Satisfactory Ideas, Poor Ideas, Unsatisfactory Ideas, and N/A. The bar for Excellent Ideas is the tallest, followed by Good Ideas, and so on.]

The chart shows that most mentors rated the ideas as Excellent or Good, with only a few cases of Poor or Unsatisfactory ideas.
Growth of USRP Reflects Projects Impact on Student Participants and Research Mentors

The Undergraduate Student Research Project has grown exponentially in 2008 and 2009 in multiple areas:

- Increased number of student applications
- Number of undergraduate students placed through USRP internships

USRP interns have become an integral part of NASA’s workforce development success. Growth in the numbers of NASA engineers and scientists willing to mentor USRP interns has been another indicator of the value the mentors see as a return on investment for their time spent. The chart below indicates how the 577 students were distributed among all 12 NASA Centers and Facilities around the country.
Student Technical Report Abstract Example

Project Thinkspace: Using Biocybernetics to Create Adaptive Learning Environments
Luis Santiago – NASA Langley Research Center

Project Thinkspace was conceived to investigate the use of brainwave biofeedback in game-based learning environments to improve the teaching and learning of science, technology, engineering, and mathematics (STEM). The scope of this project was threefold: obtain engagement data, design an educational video game, and finally perform a pilot experiment. The team aimed to develop a system that gathers brainwave data from a subject, transfers the data to a computer, and subsequently processes it to reveal the engagement of the subject. Next, we developed a game that exposes players to NASA initiatives and missions and teaches students about our solar system and the universe.

This game is centered on the concept of integrating collected engagement data, so as to modulate the difficulty of the game and provide incentive for attentiveness. Finally, we designed an experiment to use the new brainwave educational video game as a research tool to test whether attention facilitates short term retention and recall. Next, a ‘space game’ was developed using the Java programming language. The game involves launching off of Earth and exploring the different planets and moons in the solar system. When the player lands on a body in space, multimedia information is presented. During this time, the player’s EEG data is recorded and processed. After the instructional video, a mini game starts, with the difficulty dependent on the engagement score received during the instructional video. Therefore, a player who is attentive during the video will play an easier game, and vice versa. The technology behind this brainwave video game can have many applications in educational environments to improve teaching and learning. An experiment has been designed to test the EEG analyses and measures available to us, from principal component to non-linear or multivariate analyses. Attention and working memory measures will be employed to link the composite of EEG analyses we conduct with rudimentary forms of learning, in order to understand the relationship this game can have with a classroom and learning environment.
Student Technical Report Abstract Example

*Analysis of Ilmenite Dissolution by Iron-Tolerant Cyanobacteria*
Emily E. Foraker – NASA Johnson Space Center

The goal of NASA’s Constellation program is to return to the moon and eventually send humans to Mars. It is extremely expensive and cumbersome to transport all of the resources necessary to support a lunar base. It would be useful to find a way for astronauts on the moon to extract some of the necessary resources (e.g. O, Fe, Al, Si, Mn, Ti, etc.) in-situ. Litholytic cyanobacteria are able to produce a weathering agent that can dissolve minerals found on the moon, in particular ilmenite.

Terrestrial ilmenite is an analog of lunar regolith. Astromaterials Research and Exploration Science (ARES) is currently conducting research on the development of a light-driven bioreactor that uses cyanobacteria to biochemically extract the abovementioned elements from lunar soils. Focus is being placed on determining the rate and extent of ilmenite weathering by the cyanobacteria. A Scanning Electron Microscope (SEM) in conjunction with Energy Dispersive Spectroscopy (EDS) and Vertical Scanning Interferometry (VSI) has revealed a significant dissolution of ilmenite and natural mineral inclusions by the cyanobacteria JSC-12. Rather than eroding the surface evenly, JSC-12 has been shown to create distinctive etch pits in the ilmenite host body of a sample. EDS chemical mapping techniques have also shown that certain elements in ilmenite mineral inclusions, such as Ca, Fe, S, P, Ni and Cu are significantly dissolved by the bioreactor system. In addition, it has been shown that oxygen plasma etching has little to no effect on the chemical composition and topography of terrestrial ilmenite samples.
Student Technical Report Abstract Example

*Fast Engine Response Requirements*
Megan D. Bastian – NASA Glenn Research Center

For the rare times where a transport aircraft enters into an emergency situation (such as when a control surface is damaged or fails, or in the case of a runway or takeoff incursion, etc.), it is critical for the engine to be able to provide faster than nominal thrust response. This will allow the engine to be used as a flight control effector when standard controls are unavailable or insufficient.

This paper will describe a study of how the transport aircraft’s propulsion system can be used to compensate for the deficient control, based on an analysis of historical and simulated scenarios that depict these emergency situations. From these scenarios, requirements for the propulsion system performance capabilities can be developed and understood more thoroughly.

The study will first discuss the issues with Throttles Only Control (TOC) as established from various flight simulations, followed by a discussion of approximate thrust level and/or response time requirements in order to provide a safer flight or landing.
Student Technical Report Abstract Example

*Blade Displacement: Calibration Data Collection and Analysis*

Paul Bonness – NASA Ames Research Center

Advanced rotorcraft CFD/CSD flow models are incorporating mechanical dynamics of rotor blades in their calculations. To validate their predictions, accurate real-world data are needed. Collecting blade displacement data has therefore become a desirable feature of test programs.

For the upcoming Independent Blade Control (IBC) test, blade displacements of two full-scale UH-60 rotor blades will be measured using photogrammetry. Retro-reflective targets placed at vital points on the blades, tunnel ceiling, and Large Rotor Test Assembly (LRTA) are illuminated by strobe lights and then photographed. Analysis of the images locates the target centers in 3-dimensional space. To ensure the accuracy of these measurements, precise calibration data are needed. Target measurement surveys were performed on each component independently. Blade target precision, most critical since these are the elements of interest, was excellent with Root Mean Square (RMS) errors all under 0.001 inch.

Ceiling target precision, critical since these provide a fixed, nonmoving reference frame, resolved less accurately with RMS errors around 0.01 inch. RMS errors of LRTA targets were just over 0.006 inches on average. These values fell within acceptable ranges, with the ceiling targets being the most marginal. The basic conflict between obtaining complete and highly accurate calibration data sets was resolved by including point wise error values in these reference files.
One element of the overall guidance system for the Orion Crew Module (CM) includes an emergency down-mode algorithm intended to provide last resort entry control for the vehicle. This logic initiates a slow, constant bank rate of the vehicle about its longitudinal axis and thereby creates a stable, unguided, entry configuration for the vehicle known as a ‘ballistic entry’. This down-mode provides a survivable contingency between Service Module (SM) separation and drogue chute deployment, for situations where one or more serious system failures have occurred.

Numerical simulation of trajectories for this contingency entry mode have yielded a region of initiation points, along the nominal skip trajectory, where landing site location is highly sensitive to the angle of bank at initiation of the down-mode. This sensitivity results in large down-range error, and overshoots of the targeted landing site. In addition, such an emergency entry exposes the vehicle and its crew to significantly higher decelerations than the nominal entry profile. These pose serious physical boundaries to the use of such an emergency return mode and strategies must be implemented in order to mitigate the risks and ensure crew survival.
CONCLUSION & CONTACTS

Challenges in Managing STEM Student Immersive Experience Programs

USRP has accomplished:

- Generating a large, diverse pool of student candidates;
- Collecting challenging projects and appropriate mentors from NASA Centers;
- Matching the right mentors to the right students for optimal experience;
- Tracking offers, acceptances, and processes for bringing the students on-board;
- Documenting outcomes and Return on Investment “ROI” metrics; and
- Tracking Students’ progress in the STEM pipeline

KEYS to USRP Success: Using Best Practices and Establishing Process Efficiencies
Looking Forward…

The NASA Undergraduate Student Research Project Management Team is proud to announce these outstanding results. USRP will continue to evolve the project by seeking to implement the innovative changes necessary to capture the interest and imagination of STEM students with the ultimate goal of retaining them to become NASA’s future technical workforce. In keeping pace with USRP’s target Gen Y audience, successful changes thus far have included:

- USRP user-friendly on-line application
- USRP Connect for intern selection process
- USRP Connect database for automatic collection of metrics
- USRP on-line professional development sessions
- USRP on-line virtual career fairs and virtual campus forums for recruiting
- Virtual NASA USRP Coordinator meetings
- Targeted strategic communications defined by project research

USRP is a vital step in NASA’s workforce development. USRP strongly supports and encourages connectivity between NASA Education Pipeline projects by promoting USRP as a next “landing spot” for the students starting college and as a launching pad to the next NASA higher education experience after completing USRP.
Contacts

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http://usrp.usra.edu
A Word from the USRA President

Dear Partners in STEM Education,

The first obligation of a leader is to train more leaders. That is why we are so pleased to be working with Johnson Space Center (JSC) on the Undergraduate Student Research Project (USRP). Perhaps no other organization understands the importance of educating the next generation of leaders as well as NASA. JSC, the home of the astronaut corps, embodies the vision of leadership for our next generation of scientists and engineers.

Universities Space Research Association (USRA) is proud to be a part of this NASA Undergraduate Student Research Project Workforce Development Update. Results highlighted throughout this publication show Undergraduate Student Research Project success. USRP is now NASA's largest agency-wide internship activity. It is critically positioned in the STEM workforce development pipeline and a key for ensuring a high-quality technical workforce in the future. USRP operates year-round offering internships in the spring, fall and summer. It currently places undergraduates at 10 NASA centers and 2 NASA research facilities.

In the last two years USRP has had notable success including measurable increases in student learning and professional development. Through strategic IT development, important enhancements have been added to USRP operations resulting in significant project performance improvements. Among the accomplishments are:

• Implementation of an advanced, web-based system streamlining the intern application and selection processes and allowing for sophisticated tracking and reporting by and for both interns and mentors;
• Use of enhanced program recruiting strategies that resulted in an over 200% increase in the number of student applicants overall;
• Focus on applicant quality that has resulted in an applicant pool with an average GPA of over 3.6;
• Focus on program diversity that has resulted in an applicant pool with 31% minority and 30% female applicants;
• Efforts to broaden the program base resulting in a pool of participants representing over 900 educational institutions in all 50 states and Puerto Rico; and
• Focus on improving customer satisfaction that has resulted in a measured increase in satisfaction with the program among both participating students and mentors.

Please join us in congratulating the NASA USRP students as the technical workforce of the future, ready to take on the challenges facing our world.

Thank you,

Dr. Frederick A. Tarantino
CEO & President, Universities Space Research Association

USRA is a private, nonprofit corporation founded in 1969 under the auspices of the National Academy of Sciences. Its current membership consists of 104 universities in the U.S. and abroad that have graduate programs in space-related sciences and/or engineering.

USRA focuses on space-related technical competencies with the goal of expanding knowledge and developing technology for the benefit of the academic community, space-related industries, and NASA’s mission to “pioneer the future in space exploration, scientific discovery, and aeronautics research.”