NASA Swarmathon Project

Sub-award to:
Engineering and Engineering Technology Programs
Southwestern Indian Polytechnic Institute (SIPI)

Project Progress Report
Spring 2016

Grant Co-PI/Project Director:

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“Educating Native American ROSE STEM's to Develop, Steward, Sustain the Human, Energy,
and the Environmental Resources!”

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Darron Tewa, Bradley Kaye, Sasha Benallie, Bryan Bedonie,
INTRODUCTIONS

Southwestern Indian Polytechnic Institute is a federally operated college funded through the U.S. Department of Interior, Bureau of Indian Education (BIE). The College is advised by a national tribally appointed Board of Regents, established to provide technical and higher education at the associate degree and certificate levels for members of federally recognized tribes. The enrollment derives from over 100 different Indian tribes among approximately 500 students. In 1993 the SIPI Board of Regents directed the College to begin offering transfer degrees with an emphasis on science and technology. Southwestern Indian Polytechnic Institute is a National Indian Community College that prepares Native American students to be productive life-long learners as tribal members in an ever-changing global environment. As a land grant institution, SIPI partners with tribes, employers, and other organizations with a stake in Indian education. An enduring commitment to student success is the hallmark of SIPI’s operations.

Nature of Collaboration with NCAT and USTA
Southwestern Indian Polytechnic Institute (SIPI) has created partnerships with two major research universities across the United States, i.e., North Carolina A&T (referred to NCAT hereafter) and The University of Texas in San Antonio (Referred to as UTSA hereafter); NCAT and USTA wish to expand its mission to diversity through partnership with Native American Tribal Colleges; NCAT, USTA, and SIPI have strong commitments to project-based engineering education particularly in the area of sustainable energy; NCAT and USTA and SIPI agree to enter this Agreement of Collaboration with the purpose to promote cooperation and build partnerships among institutions in the areas of science and engineering education, research and technology. Through the implementation of the following four core and capstone courses, in the partnering high schools (concurrent enrollment) and tribal community colleges (11 members of the TCU Engineering Programs Working Group).

Through the development and the curricular integration of the following four courses at all the participating tribal community colleges and three Native American Serving High Schools:

1 - ENGR 105 – Introduction to Engineering and Design (3)
2 - ENGR 280 – Engineering Internship (3)
The venue is created to implement the following outreach activities in the participating tribal community colleges,

Within the framework proposed in this proposal, NCAT, USTA, and SIPI focus on the development of the following activities:

1. Faculty Professional Developments and Exchange,
   a. NCAT and UTSA will develop a Summer Faculty Program for SIPI faculty in order to promote research collaboration among institutions.

2. Student exchange,
   a. NCAT and USTA will provide travel and living support on a semester basis for two MS and Ph.D. students to serve as instructor in SIPI design courses.
   b. NCAT, USTA, and SIPI will develop and support joint educational design projects involving undergraduate student teams from both institutions.
   c. SIPI will provide assistance in identifying and encouraging potential Native American students to apply and enroll in graduate programs at School of Engineering, The University of New Mexico.
   d. NCAT will cover the costs for a Ph.D. student appointed to serve as an instructor/research mentor at SIPI

3. Curricular development
   a. NCAT and USTA will collaborate in developing course curricular development in order to create articulation for transfer of participating tribal community college students to the engineering bachelor degree programs.

4. Accreditation support
   a. NCAT and USTA and SIPI will collaborate in developing program review and course assessment tools for engineering and engineering technology programs.

5. Laboratory development
   a. SIPI will provide the funding for the development of lab equipment that will stay at SIPI. SIPI will share its "I-C-MARS Tested" for student-faculty projects focused on autonomous vehicle Control.
   b. NCAT and USTA Ph.D. students will organize the new lab equipment and will supervise the construction of new equipment for educational purposes

6. Sharing Research and Laboratory Resources
   a. NCAT and USTA and SIPI will collaborate in developing online courses and telepresence course and laboratory facilities.

7. Joint training and Research Programs
   a. NCAT and USTA and SIPI will develop joint proposals in areas of mutual interest.
OVERVIEW and PROJECT TASKS

New Mexico STEM Symposium-workshop for STEM teachers

SIPI-ICMARS project and Bernalillo Public Schools District (Dr. Vadiee, Jonathan West, and Katrina Lake, Brando Ray, and Tomczak Billie) are going to present a workshop for math and science teachers attending the 2016 New Mexico STEM Symposium in June! Please see the email notification below:

Dear Nader:

Thank you for submitting a proposal to present at the 2016 NM STEM Symposium. Your proposal has been accepted. You will receive more information regarding your session as the event approaches.

Please, contact me with any questions you may have.

- Event: 2016 STEM Symposium Presenter Proposal
- Attending: Nader Vadiee
- Number in Party: 5
- Time: 7:45 AM
- Date: Friday, June 3, 2016
- Confirmation Number: DYND5JKKSMX
- Current Registration:

NASA STEM Day on SIPI campus

NASA Glenn Space Center will hold a “NASA STEM Day” on SIPI Campus in September, 2016.

NASA Glen team observation:

SIPI is a Bureau of Indian Education facility, committed to research, promoting, perpetuating and nurturing American Indian culture, and providing outreach workshops and community service.
SIPI was selected to be the site of GRC’s Tribal College Stem Event due to the following:
Tribal College with a strong emphasis on offer a Pre-Engineering Degree
Offers both Certificate and Associate Degree
Offers several Technical Diplomas
Participants represent many different Native American Tribes
NASA Award Recipient
Strong STEM outreach
NASA Academy
SIPI is one of several tribal colleges working to increase STEM instructional and research capacities for indigenous students and the communities the colleges serve

KUNM Radio- SIPI Engineering Program Story

On Monday February 29, 2016, Elaine Baumgartel, KUNM News Director; and Marino Spencer; from New Mexico News Port, visited SIPI, toured the I-C-MARS lab facilities. The KUNM team interviewed several SIPI Pre-engineering students and faculty for a story to be featured on a KUNM morning program
Southwest Indian Polytechnic Institute (SIPI), one of the two post-secondary institutions operated by BIE, was featured on New Mexico public radio station KUNM for its Intelligent Cooperative Multi-Agent Robotic System (I-C-MARS) project. SIPI, home to one of the largest tribal college engineering programs in the United States, received nearly $1 million from the NASA Tribal College and University Experiential Learning Opportunity (TCU-ELO) grant to allow students to work with rovers in a simulated Martian environment called a Mars yard and to expose Native American students to more science and math courses. To learn more about this innovative project listen here:


Please also check out this link on the New Mexico News Port site:
http://www.newmexiconewsport.com/tribal-students-explore-m…/
ESTABLISHMENT OF THE SIPI AUTONOMOUS VEHICLES TESTING AND EVALUATION LAB.

Several students and faculty teams at the pre-engineering program at the Southwestern Indian Polytechnic Institute (SIPI) are currently engaged with several projects focused on modeling, simulation, development, testing and evaluation of un-manned and autonomous vehicles. Some of the projects are as follows:

**SIPI Autonomous Vehicles Research and Development Group:**
- Mars Rovers (SIPI NASA TCU ELO and NCAT-UTSA-SIPI TECHLAV Project)
- Mars Exploration using UAV (NASA TCU ELO – Project)
- Rockets with Science Payloads (NASA New Mexico space Grant Project)
- Swarmies (The University of New Mexico - NASA Swarmathon and Traffic control and transportation management for autonomous automobiles Projects)

**Task 1: Course and Curriculum Development and Students Education**
Brandon Ray and Tomczack Billie, SIPI Pre-engineering program alumni and the I-C-MARS project mentors, regularly visit Bernalillo high school and oversee the students’ progress. The I-C-MARS sponsored class of Ms. Katrina Lake, BHS science teacher and ICMARS project partner, are expanding the SIPI RoadRunner 4.0 ver. platform’s capabilities. They have added onboard LCD screens and line detector sensors.
Team from SIPI Selected for NASA Swarmathon Competition

We like to introduce our three swarmie rovers: Eva, Wall-E, and Chappie! They work together and they play together, therefore they stay together! They are rehearsing their swarming and foraging skills for the upcoming first ever NASA National Swarmathon competitions held on April 20-22 at the NASA Kennedy Space Center!

SIPI NASA Swarmathon team is getting ready for the upcoming national competition held at the NASA Kennedy Space center on April 10-22, 2016. Here is a quick time lapse we recorded today while witnessing the Swarmies being tested. It’s a pretty rough cut; made hastily, but you can get the idea.

https://www.youtube.com/watch?v=DX1wpvw6z0w&feature=youtu.be

Swarmathon Timelapse Final Test #1 - One of the final program tests of the Swarmies before the upload deadline.

The NASA Swarmathon is a competition to develop cooperative robotics to revolutionize space exploration. The First Annual Swarmathon, will occur April 18-22, 2016 at NASA Kennedy Space Center. Students from Minority Serving Universities and Community Colleges will be challenged to develop search algorithms for robotic swarms. This technology promises to more effectively and efficiently locate and collect resources on the Moon or Mars.

12 teams representing 14 schools were selected to compete in the Swarmathon’s Physical Competition and 23 teams for the Virtual Competition. Congratulations to the teams that were selected to compete in the 2016 NASA Swarmathon!
(Universities and Community Colleges interested in applying for the 2017 competition should visit the Swarmathon “Apply Page” to get on the email notification list.)

Swarmathon Physical Competition

Institution Location
California State University, Los Angeles Los Angeles, CA
Central New Mexico Community College Albuquerque, NM
Claflin University Orangeburg, SC
Fayetteville State University Fayetteville, NC
Florida International University Miami, FL
Morehouse College Atlanta, GA
Pasadena City Community College Pasadena, CA
San Jacinto College & University of Houston, Clear Lake Houston, TX
Southwestern Indian Polytechnic Institute Albuquerque, NM
University of District of Columbia & Howard University Washington, DC
University of Houston Houston, TX
York College of The City University of New York Jamaica, NY
Indian Country Today Media Network Story on SIPI Pre-Engineering Program
Darron Tewa, engineering student, is interviewed by Alysa Landry, the Indian Country Today reporter in the SIPI I-C-MARS Research and Development Lab. Mr. Jonathan West, the SIPI NASA Swarmathon team faculty advisor, is describing the rules for the upcoming NASA Swarmathon Physical competition.
SIPI Engineering Programs home-made educational mobile robot platforms: RoadRunner 4.0 series!

SIPI team has developed and fabricated several educational mobile robot platforms. The RoadRunner 4.0 platforms are used by the partner schools.
Introduction to Coding Course – Cyber Code Talkers

SIPI Community, students, advisors and faculty,

SIPI staff, faculty, and students (including incoming freshman students), who are interested in learning to code, computer programming and designing embedded control systems are welcome!

ENGR 290 - Special Topics in Engineering
Cyber Code Talkers
Let Us Code!
Summer 2016
3 Credit Hours
TTH 01:00 – 02:25 pm

Sponsored and Presented by:
Advanced Technical Education Department (ATE)
Pre-engineering and CADD Programs
SPI I-C-MARS (NASA TCU ELO) Project
SIPI DOD TECHLAV Project

The pre-req. is Math 120 and basic computer skills. Please share and post.

SIPI advanced Manufacturing Lab.

The SIPI Engineering Programs (Associate of Science degree in Pre-engineering and Certificate in CADD programs) enjoys having a state of the art, Computer Aided Design and Drafting computer Lab., manufacturing lab. and shop equipped with laser printers, CNC machines, lathe and mill, 3-D scanners, and 3-
D printers. The facility is one the best among tribal colleges. These lab and shop facilities are extensively used by the students, faculty and staff to design and develop their hands-on projects. The SIPI NASA I-C-MARS, New Mexico space grant Student Launch program, and DoD TECHLAV project teams are using the facility to design, 3-D print, and test and evaluate parts that are needed for building the I-C-Mars rovers, autonomous vehicles, and their attached manipulators. In this photo, Dr. Ahghar is teaching students the proper use of the new 3-D printer.

**SIPI Alumni Share their transfer challenges and experiences**

Stratlin Ellsworth, Brandon Ray, and Tomczak Billie, SIPI Engineering Programs alumni and current UNM engineering students and the SIPI I-C-MARS Project teaching assistants, held an information session for the summer 2016 graduating class. They talked about their challenges and shared their experience in overcoming those challenges in transferring to the school of engineering programs, the University of New Mexico. SIPI pre-engineering program has a 2016 graduating class of 12 students. This brings the number of graduates and transferee’s to the four-year engineering and engineering technology programs to 35 since 2006. SIPI engineering program hires the program graduates who are currently UNM engineering students, as part-time mentors and tutors
Task 2: Outreach

High School Outreach
SIPI TECHLAV Program has expanded its outreach to the Bernalillo high school, Bernalillo middle school and Pueblo of Jemez Education region:
Program Outline for Partner High Schools (and Lower Grades)
• To develop creative and demonstrate effective ways to engage students in STEM subjects.
• To develop and deliver curricula to meet this objective.
• To engage student interest in STEM subjects by having them build Mars Rovers and learn to program and operate Mars Rovers in Mars-yards that we have constructed and are constructing on the SIPI campus.
• To teach students the math and physics required to build and operate the rovers.
• To enable students to program and operate the Mars Rovers from their current classrooms.
Project Phases
• Phase 1 – teach students to build and operate simple RoadRunner Rovers on the SIPI Mini-Mars-yard.
RoadRunner Rovers are operated through the Mini-Mars-yard control system, accessible by any computer.

- Phase 2 – teach students to program “large” Mars Rovers for complete missions on the SIPI Large Mars-yard.

Early Program Impact
- External evaluation indicates that students are more engaged and enthusiastic about learning STEM subjects and more motivated to attend class (December, 2015).

Features of the Program
- The program is fully funded through the NASA TCU-ELO Grant.
- The program includes curricula, Mechanism Guidebooks (teacher and student editions), and Lesson Outlines culminating in Challenges for each unit (Grades 9-12).
  - Compliant with NM Common Core and NextGen Standards.
- Includes funding for our partner schools for technology and supplies.
- SIPI graduates and students available to work with your teachers and students as they implement the program.

Jobs for America’s Graduates Program visits SIPI campus

Groups from Zuni High School, who are enrolled in the JAG program (Jobs for America’s Graduates), visited SIPI Engineering Programs laboratory facilities and met with SIPI ICMARS project students and faculty.

Dr. Vadiee,

Thank you for giving the Zuni JAG students a tour of your facilities at SIPI. It really brings math and science alive for the students. I’ll send information to the superintendent and principals in Zuni and encourage them to contact you for more details.

Kay Provolt
State Director
Jobs for America’s Graduates- New Mexico
M: 505.239.9270
www.jag.org
AISES National Vists SIPI

AISES national filmed Mr. John Herrington, first Native American astronaut, for a STEM Education promotional video, using SIPI’s Engineering I-C-MARS Laboratory venues, located in the SIPI's Science and Technology building, on the morning of February 4, 2016. A team of high school students from the Bernalillo High School also joined us for this event and as well as attending a training on the SIPI home-made Educational RoadRunner Mobile Robot Platform., RoadRunner 4.0. Ms. Sarah EchoHawk, AISES CEO, and Mr. Joe Connolly, an aerospace engineer at NASA, were also present for students to meet and greet. In another note we have received our three NASA Swarmies ! fully Autonomous Mobile Robot platforms.
SIPI Outreach and Student Education website.
The posted course modules are developed, by the SIPI ICMARS Project team, for our high school partners to be integrated into their science, technology, engineering and mathematics courses. Please visit the following URL for more information.
https://sites.google.com/site/sipimodules/home

TECHLAV summer Internships;

In the following, you will find the list of the I-C-MARS groups and plans for the summer internships:

Group A:
- Mars Rovers (NASA TCU ELO and TECHLAV)
- Mars UAV (NASA TCU ELO)
- Rockets with Science Payloads (NASA Space Grant)
- Swarmies (NASA Swarmathon and TECHLAV)
- Space Biology and Astrobiology

Group B:
I-C-MARS Research Laboratory Facility Development Group: (Dr. Nader Vadiee, Jasamaine Martinez, Darron Tewa, Bradley Kaye, Audrina West, Jerrile Jones, Leo, and Cody Yazzie)

Group C:
Outreach and Education: (Alexander Mcmahon, Katrina Lake, Alicia Montoya, Brandon Ray, Tomzack Billie, Stratlin Ellsworth, Zack Nez, Bobby Lynch)

Group D:
Documentation, Assessment, Evaluation, Information Dissemination, and Public Relations: (Dr. Nader Vadiee, Alexander Mcmahon, Dr. Gavin Clarkson, Janet Gordon, Priscilla Martin, Stanton Lance, Rebeca Price, Amber Martin)

TRAVEL:

For your information, (I am planning to

1 – Send two students (Daron Tewa, Bradley Kaye), myself, and Jonathan West to the national NASA Swarmathon competition in Cape Canaveral Florida, Kennedy Space Center, and April 19-23, 2016. PAID by NMSGC

2 – Send three students (Sam Smith, Bernadette Quintana and Rebeca Price) and Jonathan West to the NASA Wallops Islands Rock on Event on June 22-27th, 2016. Paid by NMSGC

3- Send two SIPI students, Sasha Benallie and Brian Bedonie, for an eight-week internship (June 6 – July 30, 2016) at University of Texas in San Antonio/TECHLAV paid by TECHLAV

4 - Send two SIPI students (two) for two one-week internship (June 6 – August 12, 2016) at NASA JSC in Houston Texas. All expenses paid by SIPI-BOR-TCU ELO grant.

5 – Send three students (Audy West, Jerrile Jones, and Jasamaine Martinez) to North Carolina A&T, for one week (July 25-July 29, 2016). Paid by the North Carolina A&T University.

The following students are selected to attend a 10-week summer internship at the University of Texas in San Antonio:
Sasha Benallie
Bryan Bedonie

Both students are attending an intense C and ROS programming course.

PROJECT EVALUATION

All proposed tasks were successfully developed and implemented. Three teams of students, a total of 20 students have participated in the supplemental grant. Two course curriculum and a laboratory on Autonomous Vehicles Testing and Evaluation Test-bed Collocated with an indoor Mars Yard of the SIPI Science and Technology building (SIPI building 125).

FINANCIAL STATUS AND REPORT

All work performed by Dr. Joshua Hecker and Fei Hann related to the SIPI TECHLAV grant, has been the result of synergistic activities involving NASA TCU- ELO and NASA Swarmathon in building an Autonomous Vehicles Testing and Evaluation Test-bed Collocated with an indoors Mars Yard of the SIPI Science and Technology building (SIPI building 125).