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## Program Progress Performance Report #1

Missouri University of Science and Technology. INSPIRE - University Transportation Center

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# PROGRAM PROGRESS PERFORMANCE REPORT #1

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GRANT PERIOD: 11/30/16 – 09/30/22  
REPORTING PERIOD: 11/30/16 - 5/31/17

## Inspecting and Preserving Infrastructure through Robotic Exploration (INSPIRE)

Tier-1 University Transportation Center Sponsored by the Office of the Assistant Secretary for Research and Technology (OST-R)



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## 1. ACCOMPLISHMENTS

### 1.A – What Are the Major Goals and Objectives of the Program?

#### ***Center's Mission and Goal***

The mission of the INSPIRE center is to make an impactful contribution to the overall University Transportation Center Program authorized under the Fixing America's Surface Transportation (FAST) Act by providing leadership in research, education, workforce development, and technology transfer aimed at infrastructure inspection and preservation solutions with advanced sensing and robotic technologies for a sustainable and resilient transportation system. This mission becomes increasingly important in addressing greater needs for condition assessment and maintenance of bridges as natural disaster risks increase and approximately 50% of bridges in the National Bridge Inventory approach their design life.

The overarching goals of the center in five years are to transform in at least two demonstration cases from manual to automated inspection and preservation of bridges with sensors, nondestructive evaluation (NDE) devices, multi-modal unmanned vehicles, and data logistics, thus providing cost-effective, consistent, and reliable solutions in bridge condition assessment and maintenance, and to develop diverse transportation workforces mastering the advanced technologies.

#### ***Research Objectives***

To meet the above goals, three research objectives of the center are set:

1. To explore, develop, validate, and demonstrate standardized-integrated measurement technologies, decision-making tools, data logistics, and autonomous systems to facilitate the field inspection and maintenance of bridges;
2. To develop, validate, and demonstrate methods of robot-enabled resilience analysis and intervention technologies (retrofit and repair) of bridges; and
3. To develop innovative tools and methods for the next-generation transportation workforce training and the general public education.

#### ***Education Objectives***

To achieve the center's goals, three education objectives are set and achieved through degree-granting programs with transportation components, transportation non-degree programs, and seminars/workshops/short courses:

1. To develop new education materials related to advanced sensing and robotic technologies, such as real-world examples and cases that can reinforce the learning objectives of current curriculums, and interdisciplinary topics for senior design/capstone projects that can promote cooperative learning among students from various disciplines;
2. To create new opportunities for knowledge expansion and skill training on non-traditional civil engineering subjects, such as sensing, NDE, and bridge inspection and maintenance with robotics, which can enrich existing civil engineering programs or non-degree certificate programs; and

3. To connect students with transportation industries and professionals through center meetings, annual transportation research board (TRB) meetings, an international conference, and the external advisory committee.

### ***Workforce Development Objectives***

To achieve the center's goals, two workforce development objectives are set and achieved through various outreach activities and close collaborations with professional organizations such as the Missouri Local Technical Assistance Program (LTAP) and the Center for Worker Education (CWE), Manhattan, New York:

1. To raise the public awareness of changes from adopting advanced technologies and attract new entrants from varying pipelines into transportation-related majors; and
2. To apply the robot simulator and video games developed as part of the research portfolio for a rapid and innovative workforce training of both current and prospective transportation workforces.

### ***Technology Transfer Objectives***

To achieve the center's goals, three technology transfer objectives are set:

1. To work in partnership with end users to facilitate technology transfer, including state and local governments, non-profit entities, and private enterprises, and assist them in mastering and implementing the developed technologies such as sensors, robots, and image analysis tools;
2. To protect intellectual properties with patent applications through the technology transfer and economic development offices and actively seek their licensing with small businesses such as InnovBot LLC; and
3. To disseminate research results through high quality peer-reviewed journals, conference proceedings, and exhibitions at TRB annual meetings and other national/international conferences.

### ***Diversity Objectives***

To achieve the center's goals, two diversity objectives are set:

1. To broaden underrepresented minority participation through direct involvement of two minority institutions; and
2. To recruit and retain female and traditionally underrepresented minority students in close collaboration with special programs such as the activities of the Student Diversity, Outreach and Women's Programs office at Missouri S&T.

### **1.B - What Was Accomplished Under These Goals?**

Nothing to Report.

### **1.C - What Opportunities for Training and Professional Development Has the Program Provided?**

Nothing to Report.

### **1.D - How Have the Results Been Disseminated?**

Nothing to Report.

## **1. E - What Do You Plan to Do During the Next Reporting Period to Accomplish the Goals and Objectives?**

Research projects will start in June of 2017 in five research topics: (1) workforce development (WD), (2) sensing and nondestructive evaluation (SN), (3) autonomous system (AS), (4) inspection and maintenance (IM), and (5) retrofit and resilience (RR).

Students who are involved with various research projects will be documented with their disciplines, genders, and ethnic backgrounds.

The INSPIRE center will host a Missouri Transportation Camp on July 18, 2017. The camp will engage approximately 30 high school students and, through various hands-on activities, attract them into transportation related majors in the Department of Civil, Architectural, and Environmental Engineering at Missouri S&T.

The INSPIRE UTC will launch its first presentation of the seminar series in August of 2017.

The 9<sup>th</sup> International Conference on Structural Health Monitoring of Intelligent Infrastructure, St. Louis, 2019, will serve as a venue for the INSPIRE UTC to reach out and disseminate results to the international community. The planning and organization of the conference will begin in July of 2017.

## **2. PRODUCTS**

### **2.A - Publications, Conference Papers, and Presentations**

Nothing to Report.

### **2.B - Website(s) or Other Internet Site(s)**

A website was created for the INSPIRE center at <http://inspire-utc.mst.edu>. This website will serve as an information clearinghouse for all activities related to the grant and a gateway to transportation agencies, end users, technical communities, and the general public. In this reporting period, the following webpages were added to the site and populated with limited information:

- Home
- Research Projects
- Directory
- PPPRs
- PIRs

PPPRs and PIRs will be posted to the site as they are submitted and approved.

In addition to the main website, INSPIRE will create social media pages. Those links will be provided in the next reporting period.

### **2.C - Technologies or Techniques**

Nothing to Report.

## **2.D - Inventions, Patent Applications, and/or Licenses**

Nothing to Report.

## **2.E - Other Products, Such as Data or Databases, Physical Collections, Audio or Video Products, Software or Netware, Models, Educational Aids or Curricula, Instruments, or Equipment.**

Nothing to Report.

## **3. PARTICIPANTS & COLLABORATING ORGANIZATIONS**

### **3.A - What Organizations Have Been Involved as Partners?**

The consortium members of this University Transportation Center remain the same as proposed originally, including:

- Missouri University of Science and Technology - Rolla, MO (lead institution)
- City College of New York - New York, NY
- Georgia Institute of Technology - Atlanta, GA
- University of Colorado at Boulder - Boulder, CO
- University of Nevada-Las Vegas - Las Vegas, NV
- University of Nevada at Reno - Reno, NV
- East Central College - Union, MO
- Lincoln University - Jefferson City, MO
- Ozarks Technical College - Springfield, MO
- St. Louis Community College - St. Louis, MO

Several state governments and industrial partners are in the process of partnering with the INSPIRE center to provide financial and/or in-kind support to the research program. Those agencies include:

- Georgia Department of Transportation, Atlanta, Cash and/or In-kind
- Missouri Department of Transportation, Jefferson City, MO, Cash and/or In-kind

### **3.B - Have Other Collaborators Or Contacts Been Involved?**

An External Advisory Committee (EAC) has been established to guide the center for the development and validation of advanced and applied technologies targeted to practical solutions for existing bridges. The committee consists of:

- Hoda Azari, Ph.D., NDE Research Program Manager, Federal Highway Administration
- Bojidar Yanev, Eng. Sci. D., P.E., Executive Director, Bridge Inspection and Management, New York City Department of Transportation
- David Jared, P.E., Assistant State Research Engineer, Georgia Department of Transportation
- Michael Collins, P.E., State Bridge Asset Management Engineer, Colorado Department of Transportation
- Bill Stone, P.E., Research Administrator, Missouri Department of Transportation

- Nancy Kennedy, P.E., Assistant Chief Structures Engineer, Nevada Department of Transportation
- Paul Thompson, Consultant, Paul D. Thompson
- Kevin Hicks, P.E., AVP Engineering – Design, Union Pacific Railroad

## **4. IMPACT**

### **4.A - What Is the Impact on the Development of the Principal Discipline(s) of the Program?**

Nothing to Report.

### **4.B - What Is the Impact on Other Disciplines?**

Nothing to Report.

### **4.C - What Is the Impact on the Development of Transportation Workforce Development?**

Nothing to Report.

### **4.E - What Is the Impact on Physical, Institutional, and Information Resources at The University or Other Partner Institutions?**

Nothing to Report.

### **4.F - What Is the Impact on Technology Transfer?**

Nothing to Report.

### **4.G - What Is the Impact on Society Beyond Science and Technology?**

Nothing to Report.

## **5. CHANGES/PROBLEMS**

### **5.A - Changes in Approach and Reasons for Change**

No Change to Report.

### **5.B - Actual or Anticipated Problems or Delays and Actions or Plans to Resolve Them**

Nothing to Report.

### **5.C - Changes That Have a Significant Impact on Expenditures**

No Change to Report.

### **5.D - Significant Changes in Use or Care of Animals, Human Subjects, And/or Biohazards**

Nothing to Report.

### **5.E - Change of Primary Performance Site Location from That Originally Proposed**

No Change to Report.





## 6. SPECIAL REPORTING REQUIREMENTS

Nothing to Report.