|  |  |  |
| --- | --- | --- |
| Sponsor | Nominations must be submitted by an AASHTO member DOT willing to help promote the technology | 1. Sponsoring DOT (State): Florida
 |
| 1. Name and Title: Bouzid Choubane, State Pavement Materials Engineer
 |
| Organization: Florida Department of Transportation  |
| Street Address: 5007 NE 39th avenue |
| City: Gainesville      | State: FL | Zipcode: 32609 |
| E-mail: Bouzid.choubane@dot.state.fl.us | Phone: (352) 955-6302 | Fax: (352) 955-6345 |
| 3. Is the sponsoring State DOT willing to promote this technology to other states by participating on a Lead States Team supported by the AASHTO Innovation Initiative? Yes or No: Y |
| **Technology Description (10 points)** | The term “technology” may include processes, products, techniques, procedures, and practices. | 1. Name of Technology:

Automated and Mobile Retroreflectometer commonly referred to as the Mobile Retroreflectivity Unit (MRU) |
| 1. Please describe the technology.

Retroreflectivity is created by reflecting light from the vehicle’s headlamps directly back to the driver’s eyes. It is quantified as the ratio of the luminance (or brightness detected by a human eye) of an object to the illuminance of the object by a light source (amount of light illuminating the object) and is expressed in units of millicandelas per meter squared per lux (mcd/m2/lux). Pavement markings typically provide retroreflectivity through the application of small glass spheres that are partially embedded into the pavement marking material. The Florida Department of Transportation’s (FDOT) mobile retroreflectometer measures the retroreflectivity by applying the “30 meter geometry” described in ASTM E 1710. The 30 meter geometry consists of the following assumptions: a typical passenger vehicle headlamp height of 0.65 m (2.1 ft.), a driver eye height of 1.2 m (3.9 ft.), and a distance of 30 m (98 ft.) between the headlamps and the ground-based retroreflective target. In order to reduce the size of the measuring device, the MRU uses a 1/3rd scale of the 30 meter geometry. This equipment measures pavement marking retroreflectivity continuously at highway speeds. |
| 1. If appropriate, please attach photographs, diagrams, or other images illustrating the appearance or functionality of the technology. (If electronic, please provide a separate file.) Please list your attachments here.

  |
| **State of Development** **(30 points)** | Technologies must be successfully deployed in at least one State DOT. The AII selection process will favor technologies that have advanced beyond the research stage, at least to the pilot deployment stage, and preferably into routine use. | 1. Briefly describe the history of its development.

Historically, visibility or retroreflectivity of in-service pavement markings has been measured with handheld devices and visual inspections. However, visual surveys are considered subjective and the handheld measurements are tedious and potentially hazardous. In addition, FDOT has always searched for more innovative ways to monitor the performance, condition, and safety of its roadway infrastructure. It has carried out a number of initiatives focusing on the appropriate implementation of faster and safer testing methods and technologies to minimize maintenance of traffic, expedite projects acceptance, and minimize impact to the traveling public. It has particularly focused on the use of non-contact sensor-based technology capable of assessing pavement markings continuously at highway speeds as it provides for versatility, ease and speed of use. Inventorying pavement marking retroreflectivity using this mobile technology eliminates the need for maintenance of traffic and provides improved safety and efficiency over the traditional site-specific handheld reflectometers. FDOT initiated then a program to evaluate, optimize, and subsequently develop a comprehensive implementation plan for MRU as an alternative for measuring pavement marking retroreflectivity. The plan included the use of MRU to identify pavement markings that are reaching the minimum allowable retroreflectivity, monitor retroreflective characteristics of various materials/applications of pavement markings, and provide inventory for maintenance to assess restriping strategies. This technology has also provided FDOT for an opportunity to develop and, subsequently, implement a Pavement Marking Management System.  |
| 1. For how long and in approximately how many applications has your State DOT used this technology?

This technology has been used since 2013 to identify pavement markings that are reaching the minimum allowable retroreflectivity, monitor retroreflective characteristics of various materials/applications of pavement markings, and provide inventory for maintenance to assess restriping strategies. As such, a total of 25,000 lane-miles of pavement markings are evaluated each year with primary emphasis on yellow center lines and white line (edge and skip) markings. This has also provided FDOT for an opportunity to develop and, subsequently, implement a Pavement Marking Management System.  |
| 1. What additional development is necessary to enable routine deployment of the technology?

Standardized procedures for calibration and verification of retroreflectivity measurements as well as data format. FDOT has submitted a standard method of AASHTO (AASHTO TP 111 – Standard Method of Test for Measuring Retroreflectivity of Pavement Marking Materials Using a Mobile Retroreflectivity Unit). |
| 1. Have other organizations used this technology? Yes or No: Y If so, please list organization names and contacts.
 |
| Organization | Name | Phone | E-mail |
| Texas Transportation Institute | Adam M. Pike | 979-862-4591 | a-pike@tamu.edu |
| Minnesota DOT |       |       |       |
| Washington State DOT |       |       |       |
| **Potential Payoff****(30 points)** | Payoff is defined as the combination of broad applicability and significant benefit or advantage over other currently available technologies. | 1. How does the technology meet customer or stakeholder needs in your State DOT or other organizations that have used it?

A key component of a highway agency’s mission is to provide a safe transportation system. As such, the visibility of pavement markings is an important aspect of a safe transportation system since it conveys vital roadway warnings and guidance information to the traveling public. There are many pavement marking materials available, including paints, thermoplastics and tapes, with many utilizing glass beads to enhance retroreflectivity. However, the intended retroreflectivity level is not always achieved given the inherent non-uniformity of the material, such as that created by the random dispersion of glass beads. In addition, the environmental conditions such as rain, fog, snow, ultraviolet light and heat as well as the constant action of tires, debris, and dirt can all affect retroreflective properties. Thus, to ensure the intended in-service visibility level is adequately maintained, the retroreflectivity must be monitored, measured and quantified accordingly. This technology assesses pavement markings continuously at highway speeds and provides for versatility, ease and speed of use. Inventorying the stripe reflectivity using this mobile technology eliminates the need for maintenance of traffic and provides improved safety and efficiency over the traditional site-specific handheld reflectometers. Implementation of the Pavement Marking Management System will result in a more effective/strategic use of state funds through informed decision-making process while ensuring the safety of the traveling public. |
| 1. What type and scale of benefits has your DOT realized from using this technology? Include cost savings, safety improvements, transportation efficiency or effectiveness, environmental benefits, or any other advantages over other existing technologies.

Based on the MRU technology, a Pavement Marking Management System has been implemented to more effectively evaluate Florida’s pavement marking condition in order to better allocate funding and maximize resources. In addition, safety and efficiency have been improved by eliminating manual handheld type testing and traffic control operations on active roadways. Florida TaxWatch organization has recently honored this development with a Productivity Award and highlighted this work as “significantly and measurably increases productivity and promotes innovation to improve the delivery of state services and save money for Florida taxpayers and businesses”. It is estimated that over $1.7 million are saved each year. |
| 1. Please describe the potential extent of implementation in terms of geography, organization type (including other branches of government and private industry) and size, or other relevant factors. How broadly might the technology be deployed?

This technology can be implemented by any public and private agency in any state and region that has the responsibility to monitor its roadway system for nighttime visibility and pavement marking performance. |
| **Market Readiness (30 points)** | The AII selection process will favor technologies that can be adopted with a reasonable amount of effort and cost, commensurate with the payoff potential. | 1. What actions would another organization need to take to adopt this technology?
2. Develop a business plan to include needs, data requirement and use, funding allocation and program support as well as implementation plans.
3. Evaluate the benefits and costs of implementing the system in-house versus outsourcing.
4. Develop a process to assure data quality including calibration procedures.
5. Capitalize on the experience of other states.
 |
| 1. What is the estimated cost, effort, and length of time required to deploy the technology in another organization?
* The cost of the equipment alone ranges from $100 to $120K not including the database development for data storage and the cost related to equipment operation and data analyses.
* Perform a cost analysis of implementing the program in-house versus outsourcing.
 |
| 1. What resources—such as technical specifications, training materials, and user guides—are already available to assist deployment?

The following documents are available:1. Florida Test Method 5-600 - Measuring Retroreflectivity of Pavement Marking Materials Using a Mobile Retroreflectivity Unit (link below)

<http://infonet.dot.state.fl.us/materials/administration/resources/library/publications/fstm/Methods/fm5-600.pdf>1. FDOT MRU Worksheet (Standard Reporting Form).
2. FDOT Quality Assurance for MRU Testing.
3. FDOT Operations Manual for MRU Testing.
 |
| 1. What organizations currently supply and provide technical support for the technology?

     Vendors, Industry, Certification Facility, and TRB Standing Committee on Signing and Marking Materials (AHD55) |
| 1. Please describe any legal, environmental, social, intellectual property, or other barriers that might affect ease of implementation.

The MRU technology is relatively young, market is relatively small, and there is room for technology improvement. In addition, alternate factors such as autonomous vehicles may impact how we collect pavement marking data in terms of required data, needs, and analysis methods. This area is unchartered but is expected to become more of a national level discussion. |
| ***Submit Completed form to*** | [***http://web.transportation.org/tig\_solicitation/Submit.aspx***](http://transportation1.org/tig_solicitation/Submit.aspx) |