

NTC Program Progress Performance Report (PPPR) Information Form

For P.I.'s Use

On a semi-annual basis the NTC sponsored P.I. must report Program Progress Performance Report (PPPR) using the format specified in this PPPR Information Form. The form must be submitted electronically to the corresponding NTC Associate Director by **9/15/2014**.

Cover Period: 4/1/2014 – 9/15/2014

NTC Funded Project Information (Round/Year 1, 2013-2014)	
University Name	Arizona State University
Project Title	Congestion Mitigation Potential of Autonomous (Driverless) Vehicles: A Scenario-Based Approach
Principal Investigator	Xuesong Zhou
PI Contact Information	Email: xzhou74@asu.edu Phone: 480-965-5827

The form includes the following six parts:

- Part I – Performance Indicators
- Part II – Accomplishments: What was done? What was learned?
- Part III – Products: What has the program produced?
- Part IV – Participants & Collaborating Organizations: Who has been involved?
- Part V – Impact: What is the impact of the program? How has it contributed to transportation education, research and technology transfer?
- Part VI – Changes/Problems

Supplementary documents/materials can be attached to this form with the submission.

Part I – Performance Indicators	
Reporting Period	4/1/2014 – 9/15/2014
1. Transportation-related courses offered during the reporting period that were taught by faculty and/or teaching assistants who are associated with the UTC	N/A
Undergraduate courses	
Graduate courses	CEE 598 Transportation Simulation and Modeling
2. Students supported by this grant	N/A
Undergraduate students	
Masters students	
Doctoral students	
3. Students participating in transportation research projects funded by this grant (but not supported by this grant)	N/A
Undergraduate students	
Graduate students	Monirehalsadat Mahmoudi Supervisor: Xuesong Zhou
4. Students supported by this grant who received degrees	N/A
Undergraduate degrees	
Masters degrees	
Doctoral degrees	

Part II – Accomplishments: What was done? What was learned?	
The information provided in this section allows the OST-R grants official to assess whether satisfactory progress has been made during the reporting period.	
Reporting Period	4/1/2014 – 9/15/2014
1. What are the major goals of the program?	<p>The National UTC aims to promote strategic transportation policies, investment, and decisions that bring lasting and equitable economic benefits to the U.S. and its citizens. The Center is concerned with the integrated operations and planning of all modes serving the nation’s passenger and freight transportation system, including the institutional issues associated with their management and investments. A balanced multi-modal approach will be used that considers freight and passenger travel mobility, reliability, and sustainability, as well as system operations during periods of both recurring and non-recurring incidents, including response to major emergencies. The modes in this theme include highway, transit, rail, and inter-modal interfaces including ports, terminals and airports. In particular, the center focuses on research, education, and technology transfer activities that can lead to (1) Freight efficiency for domestic shipping and for our international land, air, and sea ports; (2) Highway congestion mitigation with multi-modal strategies; and (3) Smart investments in intercity passenger travel facilities such as high speed rail. Major center activities are as following:</p> <ul style="list-style-type: none"> • Advanced & Applied Research Promoting Economic Competitiveness: Our research activities are multimodal/intermodal and multidisciplinary in scope, with the aims of addressing nationally and regionally significant transportation issues pertinent to economic competitiveness and providing practice-ready solutions. • Education, Workforce Development, Technology Transfer, & Diversity The consortium is committed to providing high-quality transportation education and workforce development programs for a broad and diverse audience. Center’s efforts will support the development of a critical transportation knowledge base and a transportation workforce that is prepared to design, deploy, operate, and maintain the complex transportation systems of the future.
2. What was	In this research, Dr. Xuesong Zhou from Arizona State University

<p>accomplished under these goals?</p>	<p>has worked closely with Dr. Ram M. Pendyala from ASU and currently at Georgia Institute of Technology. Based on a simplified car following model for individual self-driving cars with linear safety spacing rules, we have extensively studied the macroscopic flow-density relationship under microscopic self-driving behavior models. This connection helps to form a flow prediction mechanism to first predict bottleneck evolution along a corridor, through the an extension of Newell’s 3 detector model, and further manage the performance of independently operated self-driving cars under normal and irregular conditions. We have worked on a few medium-scale examples are used to show the potential of a system-wide dynamic programming-based vehicle trajectory optimization method that can coordinate the use of self-driving cars in real time, with various goals of maximizing flow capacity and minimizing energy use.</p>
<p>3. How have the results been disseminated?</p>	<p>The research results are selected for presentation titled “Minimum number of cars a city needs in a fully coordinated vehicle sharing system”, to be presented in November 2014, in San Francisco, Institute for Operations Research and the Management Sciences (INFORMS) annual meeting.</p>
<p>4. What do you plan to do during the next reporting period to accomplish the goals? (10/1/2014 – 3/31/2015)</p>	<p>By introducing the concept of shared autonomous vehicles and ride sharing, we will address the following key questions: How many cars a city should use to support the overall transportation activity demand/desires, at different levels of coordination and pre-trip scheduling? How many parking lots and road infrastructure are required? We plan to develop a holistic optimization approach for synchronizing travel activity schedules, transportation services, and infrastructure on urban networks.</p>

Part III – Products: What has the program produced?

Publications are the characteristic product of research projects funded by the UTC Program. OST-R may evaluate what the publications demonstrate about the excellence and significance of the research and the efficacy with which the results are being communicated to colleagues, potential users, and the public, not the number of publications. Many research projects (though not all) develop significant products other than publications. OST-R may assess and report both publications and other products to Congress, communities of interest, and the public.

Reporting Period	4/1/2014 – 9/15/2014
1. Journal publications:	
2. Books or other non-periodical, one-time publications	
3. Other publications, conference papers and presentations	
4. Website(s) or other Internet site(s)	To help students understand the impact of traffic propagation under different scenarios, we have prepared a learning document about using simulation based traffic impact analysis as training material and user guides for undergraduate and graduate students interested in this subject. The document is Lesson 6.1 Understand Traffic Congestion Propagation, available at www.learning-transportation.org .
5. Technologies or techniques	
6. Outreach activities	

7. Courses and workshops	
8. Inventions, patent applications, and/or licenses	
9. Other products	We have incorporated and tested agent-based calculation module in our open-source package Agent+ available at https://code.google.com/p/agent-plus/

Part IV – Participants & Collaborating Organizations: Who has been involved?

OST-R needs to know who has worked on the project to gauge and report performance in promoting partnerships and collaborations.

Reporting Period	4/1/2014 – 9/15/2014
1. What organizations have been involved as partners?	
2. Have other collaborators or contacts been involved?	

Part V – Impact: What is the impact of the program? How has it contributed to transportation education, research and technology transfer?

DOT uses this information to assess how the research and education programs:

- increase the body of knowledge and techniques;
- enlarge the pool of people trained to develop that knowledge and techniques or
- put it to use; and,
- improve the physical, institutional, and information resources that enable those people to get their training and perform their functions.

Reporting Period

4/1/2014 – 9/15/2014

1. What is the impact on the development of the principal discipline(s) of the program?

The advent of new vehicular technologies has raised considerable debate about the potential impacts of such disruptive technologies on traveler behavior, demand for transportation services and infrastructure, and transportation network performance. There are a number of disruptive technologies that are being considered with various levels of automation, control, and communication protocols.

The US Department of Transportation has ongoing initiatives related to the deployment of connected vehicle systems, and the development of analysis, modeling, and simulation tools that would facilitate the analysis of the impacts and potential congestion benefits that such connected vehicle infrastructure systems may provide.

The challenge facing the profession is that there is very little information, analysis, modeling, or behavioral studies that provide a rigorous prediction of the potential impacts of these technologies on human activity-travel behavior, freight systems, public transit and taxi systems, and household and firm location choices (land use).

2. What is the impact on other disciplines?

<p>3. What is the impact on the development of transportation workforce development?</p>	<p>The open-source learning package which is currently developed and enhanced within this research project, will provide a clean open-source code base to enable transportation researchers and software developers to continue to build upon and expand its range of capabilities to other simulation/optimization packages.</p> <p>The research result of this project will help to develop a rigorous framework that is founded on sound behavioral constructs and analytical methods that would allow the accurate estimation of the impacts of autonomous, driverless, connected, and other advanced vehicular technologies under a variety of scenarios</p>
<p>4. What is the impact on physical, institutional, and information resources at the university or other partner institutions?</p>	
<p>5. What is the impact on technology transfer?</p>	
<p>6. What is the impact on society beyond science and technology?</p>	
<p>7. Additional impacts</p>	

Part VI – Changes/Problems	
If not previously reported in writing to OST-R through other mechanisms, provide the following additional information or state, “Nothing to Report, if applicable:	
Reporting Period	4/1/2014 – 9/15/2014
1. Changes in approach and reasons for change	PI of this project has changed from Dr. Ram M. Pendyala to Dr. Xuesong Zhou, as Dr. Pendyala has moved to Georgia Institute of Technology on August 1 st , 2014.
2. Actual or anticipated problems or delays and actions or plans to resolve them	Nothing to Report.
3. Changes that have a significant impact on expenditures	Nothing to Report.
4. Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards	Nothing to Report.
5. Change of primary performance site location from that originally proposed	Nothing to Report.