



# OHIO TRANSPORTATION CONSORTIUM



## Annual Report 2006-2007 2007-2008

## Our Member Universities

The Ohio Transportation Consortium is a tier II University Transportation Center involving eight major universities in Ohio. The University of Akron is the lead institution for the Ohio Transportation Consortium.



# OTC Annual Report 2007-2008

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## *Director's Message*

I am pleased to report on the activities of the Ohio Transportation Consortium for the biannual period from 2006-2008. OTC is a Tier II center led by The University of Akron and involving several other universities in Ohio. This is a dynamic program because some universities do not have a transportation engineering program, or even an engineering program at all, but are still interested in transportation research from a long engineering perspective. Given limited funding, it is a true challenge to involve many universities in the center's activities while providing necessary research focus to enhance the center's theme.

Since the center was established and its strategic plan approved in the spring of 2007, we launched a number of activities in the areas of research, education, and technology transfer. We solicited project ideas and funded five research projects and three education projects to be conducted by eight different universities. Because of the seed money, several universities have reported an increase in transportation course offering, the number of students involved in transportation research, number of graduate students, or the number of conference presentations and publications.

We have also actively engaged in collaborations with the engineering community and transportation industry in Ohio by jointly sponsoring meetings and seminars by engineering student organizations and professional societies and by inviting guest speakers from other transportation programs. Our effort to work with the Defense Metals Technology Center has produced conference proceedings to disseminate knowledge and experience of well known experts on the application of titanium in civil structures.

I look forward to another productive and exciting year for OTC.



Ping Yi  
Director, OTC

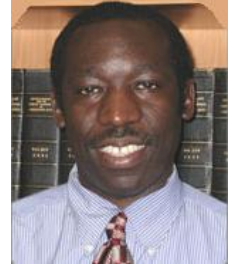
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## *Board of Directors*



**Dr. Ping Yi**  
Director, OTC  
Associate Professor,  
Civil Engineering  
The University of Akron

**Dr. Deogratias Eustace**  
Assistant Professor,  
Civil Engineering  
University of Dayton



**Dr. Dave Kaplan**  
Professor,  
Geography  
Kent State University

**Dr. Mark McCord**  
Professor,  
Civil & Environmental  
Engineering & Geodetic  
Science  
The Ohio State University



**Dr. Gayle Mitchell**  
Professor & Department Chair,  
Civil Engineering  
Ohio University

**Dr. Robert Mullen**  
Frank Neff Professor &  
Department Chair,  
Civil Engineering  
Case Western Reserve  
University



**Dr. O.M. Salem**  
Associate Professor,  
Construction Engineering &  
Management,  
Director of Infrastructure Systems  
& Management,  
Department of Civil &  
Environmental Engineering  
University of Cincinnati

**Dr. Subramania Sritharan**  
Professor,  
Water Resources  
Management  
Central State University



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## *Management and Operation*

The Center Director, Dr. Ping Yi, is responsible for implementing the Center's Strategic Plan, ensuring compliance with all UTC program requirements, serving as liaison with USDOT, sponsors and other groups and convening technical and managerial meetings as well as attending UTC business meetings and annual meetings as required by USDOT RITA. As Chief Executive Officer, the Director is responsible for conducting all programs, managing the Center's funds and personnel, keeping records of all activities and action, providing administrative management of all projects, setting agendas for all meetings, ensuring budget compliance, developing new initiatives and public presentation of the Center's business and accomplishments, and assuring day to day operations and compliance with the collective requirements of USDOT RITA and other co-sponsors to research activities.

Two part-time staff members are employed to assist in the Center's operation. The Grant and Budget Manager, Melinda White, coordinates grants management with The University of Akron Office of Research and Development and Office of Controllers, and serves as the point of contact for external coordination with the diversity of participating universities for funds awarded either directly or as subcontracts from the lead university. This individual assists the Director in financial dealings, coordinates complex book-keeping, ensures that budget reports and budget projections are updated to maintain long-term financial sustainability of the Center, and ensures that budget management at the Center is consistent with budget reporting at The University of Akron and other participating universities. The Program Assistant, Angela Brodie, aids the Director in activity planning and management and provides general support to all aspects of the Center. This individual initiates and coordinates activities to ensure Center newsletters, webpage, on-site conferences and meetings, outreach events, and other programs are professionally prepared and conducted.

A representative from each OTC member university has a seat on the OTC Board of Directors. All members are encouraged to take part in the Center's activities and all initiatives in research, education, and technology transfer will be conducted according to the strategic plan under RITA's supervision. The Center has established legal and contract guidelines for research and education program partnerships and subcontracting of project awards with other participating universities in coordination with the Office of Research and Development at The University of Akron.

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## Center Theme

The Ohio Transportation Consortium theme is *Transportation Mobility and Infrastructure Management*. This theme addresses the challenges facing the transportation systems in Ohio, summarizes the strengths in research and education existing in the OTC universities, and presents opportunities embracing OTC for future development.

## OTC Strengths

The research and education concentrations of OTC universities include:

- traffic detection and surveillance systems, data mining and fusion
  - adaptive traffic signals and optimization
  - location based information system
  - parking management and traffic calming
  - crash data analysis
  - work zone planning and safety
  - environmental impacts of transportation systems
  - geotechnical assets and risk management
  - Pavement/highway materials and design, pavement monitoring
  - monitoring and rehabilitation of bridge systems, nondestructive testing of bridge systems and performance evaluation.
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## *Education*

The OTC is dedicated to supporting activities that encourage student interest and continued education in transportation fields. During the 2007-2008 grant year, the OTC sponsored three education initiatives: "Undergraduate Research Internships to Support Exploratory Research in Transportation Engineering" by Dr. Aaron Jennings, Case Western Reserve University; "Thematic Enhancements for the Summer Transportation Institute" by Dr. Subramania Sritharan, Central State University; and "Development of a Problem-Based Learning (PBL) and Cooperative Learning (CL) Transportation Engineering Course for Undergraduate Students" by Dr. Deogratias Eustace, University of Dayton.

Case Western Reserve University (CWRU) is in the process of expanding its teaching and research activities in the areas of Transportation Engineering as part of its initiative in the overall area of Infrastructure Performance and Reliability. Their current project, "Undergraduate Research Internships to Support Exploratory Research in Transportation Engineering", led by Dr. Jennings, established a Research Internships in Transportation (RIT) program at CWRU. This program was modeled after the National Science Foundation Research Experience for Undergraduates (REU) which has proven success in recruiting students into the department's Environmental and Geotechnical Engineering programs. As part of this new program, students participate in ongoing or exploratory research projects in one of three areas: Improving the Design and Performance of Bridge-Mounted Structures; Reducing Heavy Metal Loading from Urban Pavements; and Improving the Application of Geotechnical Engineering and Advanced Instrumentation to Transportation Infrastructure. This experience exposes students to transportation engineering research while helping CWRU explore new opportunities for managing infrastructure. The lessons learned in these projects will be used to improve the quality of RIT experiences and ultimately increase the number of engineers pursuing advanced degrees in transportation engineering in the state of Ohio. Additionally, information gathered in this project will lead to a series of research proposals designed to help CWRU partner with other Ohio universities and professional organizations to conduct innovative transportation research.

Professors at Central State University recognize the need to develop an interest in and understanding of transportation fields and the science and mathematics involved in them in order to re-

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main competitive with other advanced industrialized countries. As a result, Dr. Sritharan led the project, "Thematic Enhancements for the Summer Transportation Institute" to improve their existing Summer Transportation Institute (STI) program. The STI, implemented in 2000, is a four-week program that teaches students in grades 9-11 the basics of physics and mathematics. STI, supported by the Federal Highway Authority and the Ohio Department of Transportation,



*Introduction to GPS Classroom Instruction at Central State University*

was looking to improve the summer program through the incorporation of Geographic Position Systems (GPS) education. Through OTC funding, 23 GPS units, along with three laptop computers and two SMART boards, were purchased for use during the program. Students were taught theory behind the GPS as well as how to use them and then were divided into groups to perform a field exercise designed to test their knowledge. The exercise allowed the students to gain valuable hands-on experience while further emphasizing the need for increased education and understanding of transportation engineering. Future STI programs will continue to incorporate GPS education in the hopes of peaking student interest while increasing knowledge in the field of transportation engineering. The final report for this project can be found on the OTC website at [www.otc.uakron.edu](http://www.otc.uakron.edu).

The University of Dayton implemented a new format for its junior-level Transportation Engineering course during the 2007-2008 academic year. The project, led by Dr. Eustace, replaced the traditional lecture format course with a problem-based format incorporating cooperative learning. Students learned how to collect, measure, interpret and analyze data through a combination of field work, research and classroom exercises. Students were then placed in groups where they worked on a design project. The revised course improved student-instructor interaction through active learning, ultimately improving the student learning process and material retention. Go to the OTC website to view the final report for this project.

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# Research

The OTC promotes transportation research that attempts to solve local as well as regional transportation problems. During the 2007-2008 grant year, the OTC sponsored the following research initiatives: "Planning for Multi-University Educational Activities Based on OSU Campus Smart Transit System and Administrative Activities in Support of OTC" by Drs. Mark McCord and Rabi Mishalani, The Ohio State University; "Kent State University's Sustainable Transportation Initiative" by Dr. David Kaplan, Kent State University; "Feasibility of Using Cone Penetrometer Truck (CPT) to Install Time Domain Reflectometry (TDR) and Fiber Optic Slope Failure Detectors in Pavement Structures" by Dr. Shad Sargand, Ohio University; "Characterize Dynamic Dilemma Zone and Minimize its Effect at Signalized Intersections" by Dr. Heng Wei, University of Cincinnati, and "Development and Testing of an Automated Turning Movement Identification System" by Dr. Ping Yi, The University of Akron.

Drs. McCord and Michalani have been monitoring Ohio State University (OSU) campus buses for years with a "homemade" GPS-based automatic vehicle location communication and information system. Recently, alternative funding has allowed OSU to equip their buses with a commercial-grade GPS system. OSU researchers are now, through OTC funding, taking these unique data sets produced by this new system and using them to plan for educational activities among the OTC partner universities. Currently, coursework is being discussed with relevant faculty members at OTC universities to assess the potential for integrating data collected from the smart bus system into existing classes and for designing other future educational activities such as short courses, site visits, or web-based projects. This project offers the potential for experimentation and student activities

while fostering collaboration among the OTC partners. Visit the OTC website to view the final report for this project.

Slope stability is a major issue affecting the performance of pavement structures, particularly in hilly areas. Time Domain Reflectometry (TDR) cables can be used to determine slope movement but the time and cost involved with drilling the hole to install the cable, as well as the vulnerability of that cable to damage by moisture, are significant concerns. Dr. Sargand, Ohio University, is



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leading an investigation to determine the feasibility of using a cone penetrometer truck (CPT) as an alternative means for creating holes for the TDR probes. He is also comparing the performance of fiber optic to traditional TDR cable systems to determine which is more durable and resistant to damage, particularly from moisture. The use of a CPT to create holes along with the use of fiber optic cables for TDRs will significantly reduce the cost of TDR installations and improve reliability of the systems which will lead to increased monitoring of sensitive spots at a reduced cost to the Department of Transportation.

Kent State University (KSU), the third largest university in the state of Ohio with a population equaling that of the city of Kent in which it resides, was looking for a way to reduce traffic congestion while improving alternative modes of transportation. To do so, an inventory of the entire infrastructure and facilities that may either encourage or hinder non-automotive traffic was taken and a variety of traffic usage data such as traffic count data around KSU, parking lot data, records of public transportation system usage, non-vehicular data, and safety data were all gathered. The research, led by Dr. Kaplan, resulted in a better understanding of some of the barriers to non-automotive transportation, a sense of how to achieve a better modal mix across campus, and tools to establish a master transportation plan for KSU, in collaboration with the City of Kent. Currently, students are being lined up to participate in a series of focus groups. Soon an interactive map of the campus and surrounding areas as well as a website highlighting the potential for engaging in non-automotive transportation across campus will be developed.



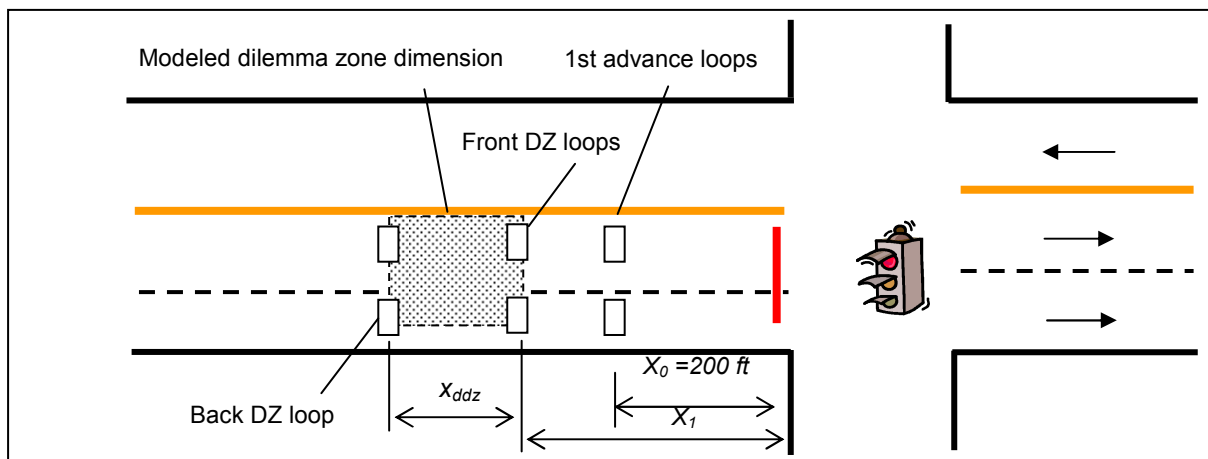
Accurate vehicle trajectory data plays a significant role in measuring dynamics of signal dilemma zones and their relationships with travel behaviors such as speed and reaction to yellow signal as well as the potential of signal-related crashes at high-speed signalized intersections. Dr. Wei, University of Cincinnati, led a research project aimed at extracting accurate vehicle trajectory data

# Research

Continued from page 11

while successfully obtaining data samples featuring travel behaviors at dilemma zones. Initial results revealed that the physical ranges of the dilemma zones are distributed at varied dimensions with diversity of the observed speeds. More observations and further statistical analyses are being performed to further disclose dynamic features of dilemma zones with different speed distributions. Potential countermeasures to minimize/eliminate dynamic dilemma zones' (DDZ) affect on safety and mobility will be investigated. The final goal is to provide a basis and support for traffic engineers in the development of effective strategies and tools to reduce dilemma zone in the design and implementation of signalized intersections. It helps develop a framework for studying DDZ issues related to layout of detection systems when applying advanced signal control systems and/or Intelligent Transportation Systems (ITS) measures. In the future, research will be expanded to more sites to get more data for modeling improvement. Future research will also be focused on the placement of loop detectors to balance the operation efficiency and dilemma zone protection. Since actual dimension of a dilemma zone is critical for optimally placing the loop detectors, research result from this project would provide preliminary study for loop placement problem. As shown below, back DZ and front DZ loops may be determined based on the actual location and length of

Illustration of relations between modeled dilemma zone and loop placement



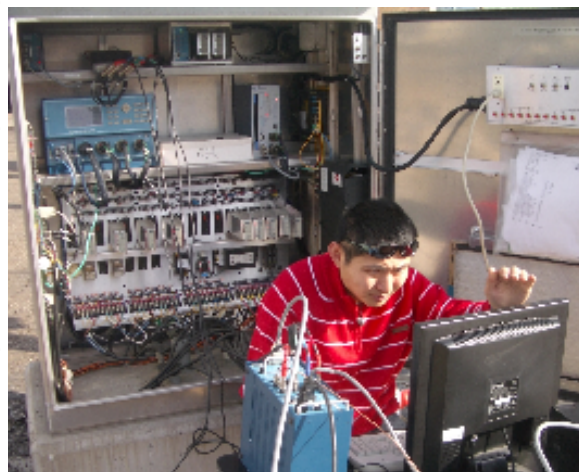
the dilemma zone under prevailing speeds detected at the loop detectors. Vehicles passing the Back DZ loop would be provided adequate passage time to clear the dilemma zone before the yellow in-



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interval starts. With the accurate dimension of the dilemma zone, vehicles will be ensured to clear the dilemma zone. However, the balance between the operational efficiency and the Dilemma zone protection performance need to be clarified in our future research.

It is important for many applications, such as real-time adaptive signal control, dynamic traffic assignment and traffic demand estimation, to obtain the vehicle turning movement information in all approaches at signalized intersections, however, it is tedious and time consuming to collect it manually. Previous efforts were focused on solving the problem in an O-D matrix but the result is not accurate



and reliable. Identifying vehicle turning movements from detector information were also studied, but the shared lane problem prevented it from being applied in most intersections. Driven by the need to identify vehicle turning movements automatically at signalized intersections regardless of the intersection geometry, The University of Akron, led by Dr. Ping Yi, decided to develop an Automatic Turning Movement Identification System (ATMIS) and test it in the field. This work serves to contribute as part of an adaptive signal control system called Genetic Algorithm Based Real-time Intersection Coordination Algorithm (GABRICA) being developed at the University of Akron.



*Above: University of Akron graduate student Chun Shao tests ATMIS.*

*Left: Researchers from the University of Akron monitor ATMIS,*

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# Technology Transfer

The OTC has participated in a variety of technology transfer programs during the 2007-2008 grant year such as co-sponsoring a conference on titanium use in civil structures, sponsoring an ASCE meeting, holding a joint ITE/OTC and participating in the OTEC meeting. Member universities have been involved with a variety of technology transfer programs such as community meetings and conference presentations.


On April 22, 2008 the OTC co-sponsored a titanium conference in conjunction with the Defense Metals Technology Center (DMTC) aimed at increasing awareness of titanium and its many applications. Experts from a variety of backgrounds presented their research and views on the past, present and potential future uses of titanium in civil and mechanical structures to individuals from industry and academia. The goal was to advance discussion between titanium product manufacturers and titanium researchers in regard to the production and use of titanium in place of other more commonly used metals. The collaborative approach of this conference provided for increased insight into the potential for future research and unique usage of titanium which could increase demand and ultimately production of titanium resulting in lower costs and increased use in civil structures. The complete conference proceedings can be found at [www.otc.uakron.edu](http://www.otc.uakron.edu).



*Ohio Senator Kevin Coughlin speaks at ASCE meeting*

The December 2008 meeting of the Akron-Canton chapter of the ASCE was sponsored by the OTC and held on The University of Akron campus. Over sixty area engineering professionals, professors, and students gathered to listen to Ohio Senator Kevin Coughlin, who serves on the Senate Highways and Transportation Committee, speak at this event. The event was a great opportunity for the OTC to collaborate with area professionals and government representatives while furthering the OTC mission of optimizing transportation mobility and infrastructure management.

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In April 2008, the OTC co-sponsored a joint meeting of the Ohio Section and Lake Erie Chapter of the Institute of Transportation Engineers held on The University of Akron campus. Individuals from area engineering firms, the city of Akron, and The University of Akron attended the meeting that featured four guest speakers. The speakers included Dave Gasper, Chief Traffic Engineer for the City of Akron, as the key-note speaker and several University of Akron graduate students working on transportation engineering projects. The event enabled area engineering professionals to gain insight into the latest technology used by the City of Akron furthering understanding and discussion of traffic-related issues in the city. It also allowed the graduate students to share their research while gaining insight from area professionals.

The OTC was pleased to host two Ohio UTC Directors meetings at their University of Akron facility. The meetings, which brought together directors from Youngstown State University, Cleveland State University, and the University of Toledo, provided an opportunity to discuss potential future collaborations and also share insight. A future meeting of Ohio UTC Directors is planned for September 2008.

On February 7th and 8th, 2008, Kent State University (KSU) and the City of Kent invited Dr. Spenser Havlick, an expert on sustainable transportation planning, to speak. Dr. Havlick toured the city and campus, spoke with local and university officials, spoke at an open forum on “Foundations of a Joint Transportation Master Plan”, and provided KSU and the City of Kent with a set of suggestions at the conclusion of his visit. Dr. Havlick’s visit was well received with not only top officials at KSU attending but with most of the Kent city council and city administration in attendance as well.

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## *Outstanding Accomplishments*


Dr. Ping Yi worked closely with CUTC to broaden membership to include international memberships. Dr. Yi was responsible for contacting a number of Chinese universities and programs engaged in transportation education and research. His recent trip to China to visit several of those organizations and their campuses and discuss related subjects proved to be productive. At the time of publication, one member, Wuhan University of Technology, has become a formal international member of CUTC and several others have expressed interest in joining CUTC in the near future.

OTC member universities and researchers have been involved in the following transportation related projects:

### **National level presentations**

- Eustace, Deogratias; Indupuru, Vamsi, "Drivers' Behavior and Knowledge Regarding Right-Of-Way at Freeway On-Ramp Merging Area", presented at the 87<sup>th</sup> Transportation Research Board Annual Meeting, Washington, D.C., January, 2008.
- Fitzpatrick, Kay; Park, Eun Sug; Schneider, William, "Potential Driveway Density Accident Modification Factors for Rural Highways Using Texas Data", presented at the 87<sup>th</sup> Transportation Research Board Annual Meeting, Washington, D.C., January, 2008.
- Kaplan, Dave, "Measuring and Facilitating Sustainable Transportation around University Campuses" presented at the Association of American Geographers Annual Meeting, Boston, MA., April 2008.
- McCord, Mark, "Freight flow modeling at border crossings for congestion mitigation", presented at the 87<sup>th</sup> Transportation Research Board Annual Meeting, Washington, D.C., January, 2008.
- Wei, H., Pavithran, M., Yi, P., and Yang, Q.Y. "Simulation Trials on an Unconventional Alternative to Congestion Mitigation and Traffic Control at Highway Work-Zone Bottlenecks using Advanced Technologies," CD-ROM, presented at the 87th Transportation Research Board Annual Meeting, Washington, D.C., January, 2008.
- Yang, Q.Y., and Wei, H. "Data Archiving Testing and Initial Analysis in Supporting GLITS I-75 Integrated Corridor Project," CD-ROM, presented at the 87th Transportation Research Board Annual Meeting, Washington, D.C., January, 2008.
- Zhang, G.H., Wang, Y.H., Wei, H., and Yi, P. "A Feedback-Based Dynamic Tolling Algorithm for High

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Occupancy Toll (HOT) Lane Operations,” CD-ROM, presented at the 87th Transportation Research Board Annual Meeting, Washington, D.C., January, 2008.

### **Publications**

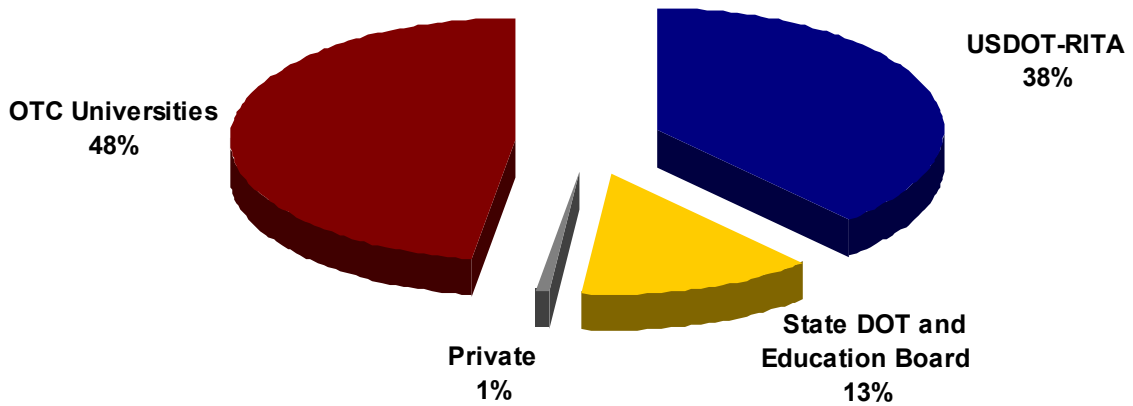
- Ohio Transportation Consortium, *Enhancing the Use of Titanium for Novel Areas Spanning the Domains of Structural, Performance Critical and Innovative Applications in Engineering*, The University of Akron, Akron, OH (2008).
- Wei, H.; Zeng, Q.A.; Hu, H.; Wang, X.H.; and Kukreti, A.R. “Integrated Urban Evacuation Planning Framework for Responding to Human-Caused Disasters over Surface Transportation Network,” *Transportation Research Record (Journal of Transportation Research Board)*, No. 2041 (2008), pp 29-37.
- Xu, T.Z.; Wei, H.; and Anastasios, M. I. “Modeling Capacity Reliability of Minor Roads at At-grade Unsignalized Intersection for Potential Performance Evaluation,” *Journal of Transportation Planning and Technology*, Vol. 31, Issue 4 (2008), pp 417-433.
- Yi, Ping; Shao, Chun; Wang, Yinhai, “Piecewise Optimum Delay Estimation for Improved Signal Control”, to appear in the *Journal of Transportation Research Records*, (2008).
- Zhang, Guohui; Wang, Yinhai; Wei, Heng; Yi, Ping, “Feedback-Based Dynamic Tolling Algorithm for High-Occupancy-Toll Lane Operations”, to appear in the *Journal of Transportation Research Records*, (2008).

In addition to the above presentations and publications, OTC partner universities have added several transportation-related courses and involved undergraduate and graduate students in a variety of transportation-related research projects in the last year. To date, five undergraduate and/or graduate courses have been implemented at OTC universities. Additionally, nineteen undergraduate and graduate students were involved in transportation research projects. Due to the fact that the OTC is a small center with many members, some of which do not have engineering programs at this time, the efforts of its members to increase research and knowledge in transportation engineering are applauded.

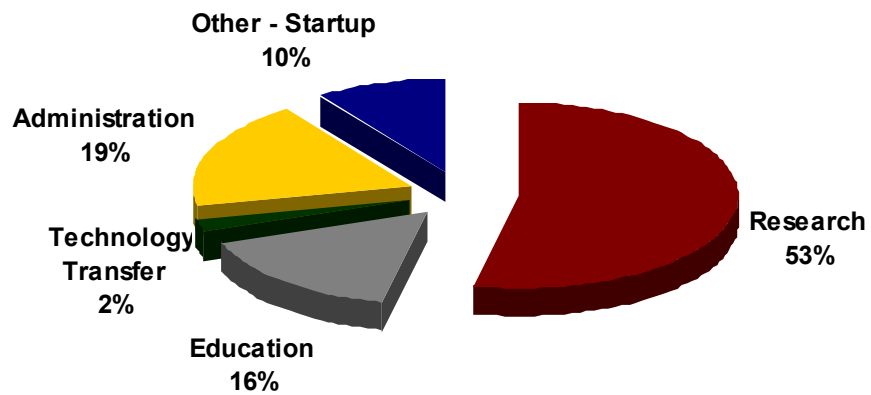
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# Financial Report

## Funding Sources



## Expenditures





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Any questions or comments regarding this publication should be directed to:

The Ohio Transportation Consortium

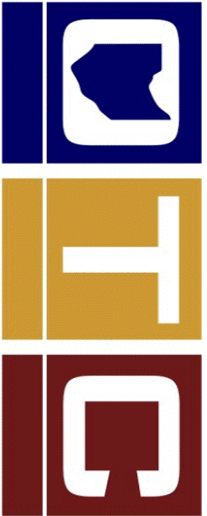
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