Southeastern Transportation Center
Proposal Cover Page
O/E Grant 2016-2017

UNIVERSITY:	University of Central Florida	
TITLE OF PROJECT:	Evaluating the Potential of Connected Vehicles in Combating Wrong-Way Driving	
FEDERAL FUNDS:		
Requested Amount	**Proposed Duration:**	**Desired Start Date:**
$49,999	18 months	April 1, 2016
MATCHING FUNDS:		
Source 1: Central Florida Expressway Authority	**Source 2:**	
$49,999		
DEPARTMENT SUBMITTING PROPOSAL: Department of Civil, Environmental, & Construction Eng.		
PI Name/Title: : Haitham Al-Deek, Ph.D., P.E./Professor of Civil, Environmental, & Construction Eng.		
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Phone: 407-823-2988		
Fax: 407-823-3315		
Email: Haitham.Al-Deek@ucf.edu		
Signature: Ft Haitham M. Al-Deek		**Date:2/4/2016**
SUBCONTRACTING INSTITUTION:		
ADMINISTRATIVE REPRESENTATIVE AUTHORIZED TO CONDUCT NEGOTIATIONS:		
Name/Title: Julia Capoverdi, Contract Manager		
Address: 12201 Research Parkway, Suite 501, Orlando FL 32826-3246		
Phone: 407-823-3332		
Fax: 407-823-3299		
Email: Julia.Capoverdi@ucf.edu		
Signature: Not Required		**Date:**
ADMINISTRATIVE ORGANIZATION'S REPRESENTATIVE:		
Name/Title: Erica Spaulding, Proposal Manager		
Address: 12201 Research Parkway, Suite 501, Orlando FL 32826-3246		
Phone: 407-883-2806		
Fax: 407-823-3299		
Email: Erica.Spaulding@ucf.edu		
Signature: Spaulding		**Date:** 2/5/16
OTHER REQUIRED SIGNATURES:		
Name/Title: Arlisia Potter		
Address: 12201 Research Parkway, Suite 501, Orlando FL 32826-3246		
Phone: 407-882-2018		
Fax: 407-823-3299		
Email: ~~aportter@ucf.edu~~ apotter@ucf.edu		
Signature:		**Date:** 2/5/16

Problem Statement

Wrong-way driving (WWD) is a significant problem in Florida. The research team lead by Professor Al-Deek at the University of Central Florida (UCF) has been working through several research contracts with the Central Florida Expressway Authority (CFX), the Florida's Turnpike Enterprise (FTE), and the Texas Transportation Institute (TTI) and NCHRP to combat this problem since 2012. Through extensive data collection, data analysis, and implementation of WWD detection and countermeasure devices, UCF has helped CFX and FTE proactively combat the WWD problem (*1-7*). CFX installed Rapid Rectangular Flashing Beacons (RRFBs) at five sites on their system in Central Florida during the first half of 2015 and will be installing improved versions of this RRFB technology at additional 32 sites during 2016. FTE installed BlinkerSigns at 16 locations on their pilot test in south Florida in 2014 and plan to install additional WWD countermeasures on their portion of SR417 in central Florida in the near future.

The next step in this research area is to determine the most effective ways to notify right-way drivers of a reported wrong-way driver and to prevent wrong-way drivers who do not notice or ignore the WWD countermeasures from entering the highway mainline. This proposed research study will investigate technologies, including connected vehicle and infrastructure communications, to address these topics.

The proposed research study fits well within the STC's main theme of *comprehensive transportation safety* and it has significant linkage to at least two of the main STC research areas: connected vehicle and connected infrastructure. The proposal's main focus is on traffic safety and how to prevent severe injuries and fatalities due to WWD crashes on high-speed toll roads. The study will also focus significantly on communications between connected vehicles and connected infrastructure and how these communications can be used to reduce WWD crashes. More specifically, this proposal covers the following STC topic areas:

- Traffic Safety – Since WWD crashes on toll roads often have severe consequences, reducing the potential for these crashes increases safety for all toll road travelers.
- Connected Infrastructure – The WWD detection devices that are currently being used by CFX and FTE communicate directly to the traffic management center (TMC) when a wrong-way vehicle is detected. This research will expand on this connectivity by having the devices communicate with other technologies, such as dynamic message signs (DMS), to warn right-way drivers of reported WWD events.
- Connected Vehicles – This research will also study the use of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications to reduce WWD. The use of V2I communications to warn detected wrong-way drivers that they are going the wrong way and to potentially disable a wrong-way vehicle before it enters the mainline will be investigated. V2V and V2I communications can also be useful to alert right-way drivers of the presence and location of a wrong-way vehicle.

Research Objectives

The goal of this research is to examine the potential application of connected vehicles and infrastructure communication in warning right-way drivers of a WWD event and/or preventing

a wrong-way driver from entering the highway mainline. To achieve this goal, the following research objectives need to be accomplished:

1) Evaluate various methods of warning right-way drivers about WWD events to determine the most appropriate methods for the CFX roadway network. These methods can include DMS, radio, and in-vehicle alerts using V2I and V2V communications.
2) Investigate the use of V2I communications to alert wrong-way drivers of their mistake and prevent them from entering the mainline if they do not turn around on their own by disabling or taking over control of the wrong-way vehicle.
3) Analyze the WWD detection data collected from the RRFBs installed at select CFX ramps to understand how drivers react to these devices (correct themselves or keep driving the wrong way) and determine where to test any potential warning or preventative technologies developed during this study.
4) Prepare a proof of concept for WWD warning and preventative technologies that show potential for implementation. This proof of concept will consider operational needs of the technologies and can be used for testing in a future phase of this study.

Research Approach

To achieve the above objectives of this proposed project, the UCF research team members under the guidance of Professor Haitham Al-Deek, Ph.D., P.E. (UCF Principal Investigator, PI) will perform the proposed project tasks listed in this section. The aim of these tasks is to better understand the technologies available to notify drivers of WWD events and determine the feasibility and effectiveness of these technologies. Since the source of funding match is CFX's current phase 3 project awarded to UCF (August 2015-August 2017), the proposed STC project will only focus on CFX system. The following is a list of these tasks:

1. *Literature and Research Review on WWD Warning Methods and Preventative Measures.* Any methods currently being used by other roadway agencies throughout the United States to notify right-way drivers of reported WWD events will be reviewed. Additionally, research on V2V and V2I communications will be studied to understand how these communications could be adapted to WWD notification and prevention.

2. *Customer Survey on WWD Notification Methods*. A customer survey will also be developed by UCF to obtain the opinions of CFX's customers regarding WWD notifications and countermeasures. This survey will most likely be implemented online and will ask CFX travelers about their preferences concerning WWD notification methods and messages, as well as WWD countermeasures. The results of this survey will aid UCF and CFX in deciding the most appropriate notification methods for right-way drivers.

3. *Evaluation of V2I Communications to Warn and Disable Wrong-Way Vehicles*. The ability for WWD countermeasures to communicate with a wrong-way vehicle, alert the driver, and disable the vehicle if the driver does not stop or turn around will be examined in this task. Input from CFX, TAPCO, in-vehicle device manufacturers, and other parties will be needed to determine the feasibility and appropriate application of V2I communications for this purpose.

4. *Collection and Analysis of WWD Data.* The UCF research team will collect and analyze WWD crash, citation, 911 call, and detection data for the CFX roadway network to determine how the RRFBs are performing. Sites where wrong-way driving is more prevalent will be considered as future test sites for any warning or preventative technologies decided on from the previous tasks.

5. *Development of a Proof of Concept for Testing of WWD Warning and Preventative Technologies*. Based on the data collected in Tasks 1-4, an operational proof of concept will be developed for any WWD warning and preventative technologies chosen for potential implementation. This proof of concept can be used for testing in a future phase of this research study.

6. *Quarterly Progress Reports* - Five progress reports will be submitted to the STC, at the end of each 3-month period during the first 15 months of the project. These progress reports will be in electronic PDF format.

7. *Final Report Submitted to STC.* A final report detailing the results of this study will be submitted to the STC at the end of this 18-month project period. The final report will be in PDF format (with no hard copies) to save cost of printing and binding. Also, as part of the technology transfer plan, any technical presentations that get accepted and presented at conferences such as TRB (and/or STC) will be sent to STC for documentation.

Research Duration and Costs

The proposed research duration is 18 months and this detail is shown in the Schedule Section on page 6. The total cost is $49,999 with details shown in the budget form.

Qualifications of Research Team

Professor Haitham Al-Deek, Ph.D., P.E., has **30 years** of experience in transportation engineering, planning, and operations. He is nationally recognized in the field of freeway operations and wrong-way driving. He received the 2015 best paper award by the TRB freeway operations committee in January 2016. His 2015 award winning paper developed a new risk model for wrong-way driving on freeways and toll roads. He also received the best TRB paper award in Regional Transportation Management and Operations in January 2016 (for the 2015 review cycle) and January 2014 (for the 2013 review cycle), and received the best paper award in freeway operations again in 2010 and 2004 (for the 2009 and 2003 review cycles respectively). Professor Al-Deek was well recognized by being awarded two Chairman Awards from the Transportation Research Board (TRB) for his significant contributions to the fields of *Freeway Operations*, and *Regional Transportation Systems Management and Operations* in January 2012. He had numerous media interviews on wrong-way driving, e.g., Channel 9 news interviewed him in 2015 and 2014 featuring the innovative countermeasure he and his research team came up with, which was later implemented for the first time in central Florida. He was featured as a distinguished researcher by the UCF College of Engineering in 2003. He received the UCF Researcher of the Year 1999 Award. He graduated from the University of California at Berkeley in 1991. Professor Al-Deek was the principal investigator of about **70+** applied research projects at UCF; several of them on toll roads**.** Since joining UCF in 1992, he attracted

about $7.5 million of research projects, published about 320 papers and technical reports in peer-reviewed journals and conferences, and chaired 11 Ph.D. dissertations and 26 MS theses to completion. He has been the Chair of TRB's paper review for two key TRB committees for the past 15 years: *Freeway Operations*, and the *Regional Transportation Systems Management and Operations*. Professor Al-Deek has been an associate editor of the Journal of Intelligent Transportation Systems (J-ITS) since 2007.

Adrian Sandt, *UCF Ph.D. Student Researcher*, is a graduate research assistant at the University of Central Florida under the supervision of Professor Al-Deek. He obtained his B.S. in Civil Engineering, with a Math Minor, in May 2014 from UCF and was immediately admitted to the civil engineering Ph.D. program at UCF. Mr. Sandt is a recipient of the prestigious UCF Trustees Fellowship. Mr. Sandt has extensive experience working on UCF wrong-way driving projects.

Md Imrul Kayes, *UCF Ph.D. Student Researcher*, is a graduate research assistant at the University of Central Florida under the supervision of Professor Al-Deek. He obtained his B.Sc. in Civil Engineering, in July 2014 from Bangladesh University of Engineering and Technology (BUET) and was admitted to the Civil Engineering Ph.D. program at UCF in Fall 2015. He has been working on the UCF wrong-way driving projects.

Omar Al-Sahili, *UCF MS Student Researcher*, is a graduate research assistant at the University of Central Florida under the supervision of Professor Al-Deek. He obtained his B.S. in Civil Engineering, in December 2014 from An-Najah University (NNU), and he worked in the professional consulting field for 1 year before getting admitted to the Masters of Science in Transportation Engineering Systems (MSTS) program at UCF in spring 2016. Omar is currently working on wrong-way driving projects at UCF.

Andres Velasquez, *UCF Undergraduate Student Researcher*, is an undergraduate research assistant at the University of Central Florida under the supervision of Professor Al-Deek. He is set to obtain his B.S. in Civil Engineering, in May 2017 from UCF and plans on apply to graduate school in transportation engineering in summer of 2016. Andres has been working on wrong-way driving projects at UCF.

Antony Shamma, *UCF Undergraduate Student Researcher*, is working on his Bachelor of Science Degree in Civil Engineering with a focus in Transportation at UCF, and is also a research assistant under the supervision of Professor Al-Deek. He plans to join the transportation engineering graduate program at UCF once he is completed with his BS degree, Fall 2017. He is the current President of the UCF Chapter of Institute of Transportation Engineers (ITE). Antony has been working on wrong-way driving projects at UCF.

Please see detailed resumes (page 12 and beyond) for more information on team members.

Student Involvement

Professor Haitham Al-Deek, Ph.D., P.E., *UCF Principal Investigator* will guide the above students who have various roles and responsibilities in all tasks of this project as listed in the proposal. Specifically, the above students will have the following roles and responsibilities:

Andres Velasques and Antony Shamma. These two undergraduate student researchers are trained to conduct field tests. So, they will participate in concept testing and field visits to sites where technology may be implemented. They will also work on literature review and attend project presentations.

Search is ongoing to hire additional undergraduate students and support them from either this proposed STC project or the matching fund CFX project during the overlapping period of both projects.

Adrian Sandt. He will work on data preparation and analysis, developing and testing the survey, preparing power point presentations to the sponsor, documenting results, and report writing and editing. He will participate in project presentations.

Md Imrul Kayes. He will work on literature review, developing and testing the survey, data preparation and analysis, and power point presentations. He will participate in project presentations.

Omar Al-Sahili. He will work on literature review, testing the survey, making field trips, and will conduct concept testing. He will also participate in data preparation and analysis and project presentations.

Technology Transfer

A technology transfer implementation plan will be prepared for this project. It will include submission of articles for publication in archival journals, such as *Transportation Research Record: Journal of the Transportation Research Board,* and the *Journal of Transportation Safety & Security*. Also, papers will be submitted for presentation at the Transportation Research Board annual meeting and/or other conferences such as STC conferences that are held regularly in fall and spring semesters. The presentation material will be sent to STC for posting on their web site. A press release of final results will be issued upon project completion.

Schedule/Timeline, Peer Review and Project Description

Schedule is on page 6, Project Description Form is on page 7, and Peer Review Forms are on pages 8 and 9.

Budget

For the Budget Form, please see page 10.

STC Research Schedule/Timeline

Task / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Task 1- Literature and Research Review	33%	67%	100%															
Task 2- Customer Survey on WWD Notification Methods		20%	40%	60%	80%	100%												
Task 3 - Evaluation of V2I Communications to Warn and Disable Wrong-Way Vehicles			10%	20%	30%	40%	50%	60%	70%	80%	90%	100%						
Task 4 - Collection and Analysis of WWD Data	6%	12%	18%	24%	29%	35%	41%	47%	53%	59%	65%	71%	76%	82%	88%	94%	100%	
Task 5 - Development of a Proof of Concept for Testing of WWD Warning and Preventative Technologies											17%	33%	50%	67%	83%	100%		
Task 6 - Quarterly Progress Reports			20%			40%			60%			80%			100%			
Task 7 - Final Report Submitted to STC.																33%	67%	100%

Red Indicates Report Submissions/Deliverables to STC

STC Research Project Description

Project Title: Evaluating the Potential of Connected Vehicles in Combating Wrong-Way Driving

Principal Investigator: Professor Al-Deek, Ph.D., P.E.
University: University of Central Florida
Telephone: 321-695-7664 **Email Address:** Haitham.Al-Deek@ucf.edu

Project Start Date: April 1, 2016 Assumed **End Date:** September 30, 2017
Other Milestones, Dates: Quarterly Progress Report Submissions – Every 3 months from June 30th, 2016 to June 30, 2017. Final Report Submission – September 30th, 2017.
Project #:

Project Objectives: (1) Evaluate various methods of warning right-way drivers about WWD events. (2) Investigate the use of V2I communications to alert wrong-way drivers of their mistake and prevent them from entering the mainline if they do not turn around on their own. (3) Analyze the WWD detection data collected from the RRFBs installed at select CFX ramps to understand how drivers react to these devices. (4) Prepare a proof of concept for WWD warning and preventative technologies that show potential for implementation.

Project Abstract: The goal of this research is to examine the potential application of connected vehicles and infrastructure communication in warning right-way drivers of a WWD event and/or preventing a wrong-way driver who does not notice or ignore the WWD countermeasures from entering the highway mainline.

Task Description: (1) *Literature & research review* (2) *Customer Survey on WWD Notification Methods* (3) *Evaluation of V2I Communications to Warn and Disable Wrong-Way Vehicles* (4) *Collection and Analysis of WWD Data* (5) *Development of a Proof of Concept for Testing of WWD Warning and Preventative Technologies* (6) *Quarterly Progress Reports* (7) *Final Report Submitted to STC.*

Total Budget:	$ 49,999

Student Involvement (Thesis, Assistantships, Paid Employment): 1) Graduate Research Assistants: **Ph.D. Students**: Adrian Sandt and Imrul Kayes; **M.S. Student** Omar Alsahili. 2) Undergraduate Research Assistants (Students): Antony Shamma and Andres Velasquez + TBD.

Relationship to Other Projects: (1) Current wrong-way driving phase 3 project on evaluating countermeasures on CFX toll network (CFX matching fund; August 2015 to August 2017) (2) Previously completed CFX phases 1 and 2 on wrong-way driving (2013 and 2015 respectively), and (3) FTE Phase 1 wrong-way driving pilot test evaluation project completed in 2015.

Technology Transfer Activities: Results of this study will be submitted to various transportation journals for publication and for presentation at national conferences (e.g., TRB). A press release of final results will be issued upon project completion. Post presentations on STC website

Potential Benefits of Project: To determine methods of notifying right way drivers of WWD danger and to investigate the potential of connected vehicles in preventing wrong-way drivers who do not notice or ignore the WWD countermeasures from entering the highway mainline.

TRB Keywords: Connected vehicles, vehicle to vehicle communication, Vehicle to infrastructure communication, Intelligent Transportation Systems, wrong-way driving, safety planning.

PEER REVIEW FORM

Peer Reviewer #1

Name: Corey Quinn, P.E.	
Organization/University Affiliation:	Central Florida Expressway Authority (CFX)
Address:	4974 ORL Tower Road, Orlando, Fl 32807
Phone #:	(407) 690-5332; Cell (407) 429-9098
Fax #:	
Email address:	Quinnc@CFXWay.com
Please submit a brief overview of why this individual is qualified to review the material.	
Qualifications of reviewer: Mr. Quinn is the Chief of Technology/Operations (previously Director of Operations) of the Central Florida Expressway Authority (CFX). Prior to his service in the public sector, he has been active in the ITS Florida community in a consultant role since 2001, serving tenures with Jacobs, TransCore, and Atkins. Mr. Quinn played key roles in numerous "first in Florida" ITS deployments, including the iFlorida project with FDOT District 5, the introduction of ramp metering on I-95 Express with FDOT District 6, and the first deployment of color DMS signs with the City of Orlando Downtown ITS deployment. Mr. Quinn is a PE in 3 states: Florida, Alabama, and North Carolina. He has been the CFX project manager for UCF Phase-1, Phase-2-, and Phase-3- WWD studies (with Prof. Al-Deek as PI). As a practitioner, Mr. Quinn has extensive knowledge in implementing ITS technologies to the CFX system including the UCF's new concept of RRFB implemented on CFX toll road network to combat WWDs.	

Peer Reviewer #2

Name: Eric Gordin, PE	
Organization/University Affiliation:	Florida Turnpike Enterprise (FTE)
Address:	Milepost 263, Operations Bldg. 5317, Turkey Lake Service Plaza, Ocoee, Fl 34761.
Phone #:	(407) 264-3316
Fax #:	
Email address:	Eric.Gordin@dot.state.fl.us
Please submit a brief overview of why this individual is qualified to review the material.	
Qualifications of reviewer: Mr. Gordin, P.E., is the project manager for the FTE phase-1- pilot test project with UCF which was completed in December 2015. He has extensive knowledge in the area of wrong-way driving on the Florida Turnpike Enterprise toll road system. He has more 14 years of experience as practitioner.	

Peer Reviewer #3

Name:	Jon Obenberger, Ph.D., P.E.
Organization/University Affiliation:	Federal Highway Administration
Address:	Turner-Fairbank Highway Research Center
Phone #:	202-366-2221
Fax #:	202-366-3988

Email address:	jon.obenberger@dot.gov
Please submit a brief overview of why this individual is qualified to review the material.	
Qualifications of reviewer: **Jon Obenberger, Ph.D., P.E.,** has 31 years of experience with leading programs, policy initiatives, projects, and day-to-day activities related to the planning, design, and operation of highways and local streets for local, regional, state, and Federal agencies. Dr. Obenberger is a Senior Transportation Research Engineer for the Federal Highway Administration's Turner-Fairbank Highway Research Center and before that in the Operations Office of Research and Development. From 2005 to 2013 he was the Preconstruction Team Leader in FHWA's Office of Infrastructure in Washington, D.C. where he led a wide variety of initiatives aimed at advancing design practices nationally which included FHWA's design discipline and improving the efficiency and effectiveness of FHWA's stewardship and oversight of the delivery of the Federal-aid highway program which included access to and uses of the Interstate System right-of-way, accommodation and relocation of utilities, value engineering, and the procurement and management of consultant services. Dr. Obenberger is also a lecturer for the University of Virginia's Transportation Training Academy and their Transportation Project Management Institute (TPMI). Dr. Obenberger serves on numerous national committees and task forces. Dr. Obenberger is also the Chair of the Freeway Operations Committee of the Transportation Research Board (TRB) of the National Academy of Sciences. He is also a member of the TRB's Traffic Control Devices Committee and Active Traffic Management Joint Subcommittee. He is also a member of the Visiting Committee of the Civil Engineering Department of the University of Wisconsin. He was the he secretary of the American Association of State Highway and Transportation Officials (AASHTO) Preconstruction Engineering Management Technical Committee from 2005 until 2013. Prior to joining FHWA, Jon was the technical lead for the Wisconsin DOT's statewide ITS program. He also served as a Design Squad Leader responsible for conducting special studies, managing and designing complex roadway and freeway improvement projects in the District 1 Design Section of the WisDOT. Prior to joining WisDOT, he was the City Traffic Engineer and MPO Coordinator for the City of Beloit and the Beloit Urbanized Area (WI-IL). Dr. Obenberger earned B.S. and M.S. degrees in Civil & Environmental Engineering at the University of Wisconsin, and a Ph.D. degree from Virginia Tech. He is also a licensed professional engineer in Wisconsin.	

*Two peer reviewers will be selected for each final report. Other appropriate reviewers may be selected at the discretion of the STC.

Southeastern Transportation Center
Proposed Budget
O/E Grant 2016-2017

Title: **Evaluating the Potential of Connected Vehicles in Combating Wrong-Way Driving**

University: **University of Central Florida**

		Federal Funds	Matching Funds
Salaries:			
	Faculty	$11,202	$18,760
	Administrative Staff		
	Other Staff	$4,305	$11,480
	Graduate Student Salaries/Stipends	$10,661	$2,665
	Undergraduate Student Salaries/Stipends	$3,200	
	Total Salaries/Stipends	$29,368	$32,905
	Benefits (including student health insurance)	$3,430	$5,706
	Total Salaries and Benefits	**$32,798**	**$38,611**
Other Direct Costs:			
	Permanent Equipment		
	Expendable Equipment and Supplies		
	Computer Costs		
	Non-salary Education Costs – tuition/fees	$4,657	$1,747
	Other Costs: (specify)		
	Printing / duplication	$388	
	Postal expense		
	Communication		
	Conference Registration / Fees		
	Travel	$2,800	$96
	Computer Costs		
	Other miscellaneous costs:		$5,000
	Total Other Direct Costs	**$7,845**	**$6,843**
	Indirect Costs at 26%	**$9,356**	**(10%) $4,545**
TOTAL COSTS		**$49,999**	**$49,999**

References

1. Al-Deek, Haitham, John Rogers, Adrian Sandt, Ahmad Alomari, and Frank Consoli. *Wrong-Way Driving Incidents on CFX Toll Road Network, Phase-1 Study: What is the Extent of this Problem?* Final report submitted to OOCEA, May 2013.

2. Al-Deek, Haitham, John Rogers, Adrian Sandt, and Ahmad Alomari. *Wrong-Way Driving Incidents on CFX Toll Road Network, Phase-2 Study: Developing Countermeasures*. Final report submitted to CFX, February 2015.

3. Al-Deek, Haitham, John Rogers, Adrian Sandt, and Ahmad Alomari. *Evaluating the Wrong-Way Driving Incidents Problem on the Florida's Turnpike Roadway System: Phase-1 Study*. Final report submitted to FTE, December 2015.

4. Rogers, J., A. Sandt, H. Al-Deek, A. Alomari, N. Uddin, E. Gordin, C. Dos Santos, J. Renfrow, and G. Carrick. "Wrong Way Driving Multifactor Risk-Based Model for Florida Interstates and Toll Facilities." *Transportation Research Record: Journal of the Transportation Research Board*, No. 2484, pp. 119-128. Transportation Research Board of the National Academies, Washington, D.C., DOI 10.3141/2484-13. **This paper has won the best 2015 TRB Freeway Operations paper award (presented to the authors on January 12, 2016 during the TRB 95th annual meeting).**

5. Rogers, J., H. Al-Deek, A. Alomari, E. Gordin, and G. Carrick. "Modeling the Risk of Wrong-Way Driving on Freeways and Toll Roads." *Transportation Research Board 95th Annual Meeting Compendium of Papers*, Washington, D.C., January, 2016.

6. Sandt, A., H. Al-Deek, J. Rogers, and A. Alomari. "Wrong-Way Driving Prevention: Incident Survey Results and Planned Countermeasure Implementation in Florida." *Transportation Research Record: Journal of the Transportation Research Board*, No. 2484, pp.99-109. Transportation Research Board of the National Academies, Washington, D.C., DOI 10.3141/2484-11.

7. Sandt, A., H. Al-Deek, J. Rogers, A. Alomari, and E. Gordin. "Modeling Driver Responses to Wrong-Way Driving Countermeasures through a Driver Survey and Countermeasure Implementation in Florida." *Transportation Research Board 95th Annual Meeting Compendium of Papers*, Washington, D.C., January, 2016.

HAITHAM M. AL-DEEK, Ph.D., P.E.
Professor of Civil, Environmental, and Construction Engineering

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EDUCATION

Ph.D., Civil Engineering-Transportation Engineering, October 1991.
University of California, Berkeley. Graduated with distinction (G.P.A. 3.944/4.00).
M.S., Civil Engineering-Transportation Engineering, December 1987.
University of California, Berkeley. Graduated with distinction (G.P.A. 3.95/4.00).

PROFESSIONAL REGISTRATION (ACTIVE)

1998-Present Registered Professional Engineer in the State of Florida, active PE License No. 0052565.

RESEARCH AND TEACHING EXPERIENCE/APPOINTMENTS

2003-Present ***Professor of Engineering, X-Director of Transportation Systems Institute (1993-2013)***
Department of Civil & Environmental Engineering, University of Central Florida

1997-2002 ***Associate Professor, Director of Transportation Systems Institute (Promoted & Tenured), Associate Director of CATSS for ITS Programs (2000-2003)***
Department of Civil & Environmental Engineering, University of Central Florida

1992-1997 ***Assistant Professor, Director of Transportation Systems Institute***
Department of Civil Engineering, University of Central Florida

1991-1992 ***Research Engineer***
California PATH, University of California at Berkeley

1986-1991 ***Graduate Student Researcher***
Department of Civil Engineering, University of California at Berkeley

CITIZENSHIP: United States Citizen

HONORS AND AWARDS (THIS IS JUST A SAMPLE)

- Associate Editor of the Intelligent Transportation Systems (ITS) Journal,
- TRB Chairman's Award for Recognition of Significant Contributions to the Freeway Operations Field, January 2012
- TRB Award for Significant Contributions to Regional Transportation Systems Management & Operations Field, January 2012
- Best 2015 and 2013 TRB Regional Transportation Systems Management and Operations (RTSMO) Paper Awards.
- Best 2015, 2009 and 2003 TRB Freeway Operations Paper Awards.
- Recommended for the 2004 United States of America Fulbright program.
- Teaching Incentive Program (TIP), UCF, four **times** in 2012, 2007, 2001, and 1996.
- Member of the UCF Millionaire Club, Office of Research, UCF, 2002.
- Researcher of the 1999 Year Award, University of Central Florida, April 1999.

RESRESEARCH OUTLETS AND GRADUATE TEACHING PRPODUCTIVITY

Dr. Al-Deek directed or co-directed about **(70+) sponsored research projects** funded by international, federal, state, and local agencies totaling about **$7.5 million**. He has

accomplished about **320** publications/presentations in **refereed journals and international conferences**. He is **currently supervising 3 Ph.D. dissertations as chairman and many M.S.** students. Throughout his career in academia, he graduated **11 Ph.D.** and **26 M.S. thesis students.**

SELECTED TWO DISSERTATIONS COMPLETED (SUPERVISED AS A CHAIRMAN)

- John Rogers, "Evaluating Wrong-Way Driving for Florida Interstates and Toll Road Facilities: A Risk-Based Investigation, and Countermeasure Development." Chairman, Ph.D. dissertation, defended December 2015.
- Ahmad Alomari, "A New Methodology for Evaluating the Effectiveness of Bus Rapid Transit Strategies," Chairman, Ph.D. dissertation, defended November 2015.

SELECTED FUNDED RESEARCH PROJECTS (OUT OF 70 PROJECTS AND 7.5 MILLION DOLLARS)

- **Principal Investigator**, *"Wrong-Way Driving Phase-3 Study: Allocating and Evaluating Countermeasures on CFX Roadway Network."* Sponsored by the Central Florida Expressway Authority (CFX), total budget **$200,000**, award period August/2015 – August/2017.
- **Principal Investigator**, *"Evaluating the Wrong-Way Driving Incidents Problem on the Florida's Turnpike Enterprise Roadway System"*. Sponsored by the Florida Turnpike Enterprise (FTE), total budget was **$97,050**, award period is January/2014 - December/2015.
- **Principal Investigator**, *"NCHRP 03-117 Traffic Control Devices and Measures for Deterring Wrong-Way Driving (WWD) Movements,"*. Sponsored by Texas A&M Transportation Systems Institute and NCHRP, total UCF subcontract budget is **$65,000**, June/2015 – September/2016.

SELECTED SAMPLE OF REFEREED JOURNAL PUBLICATIONS/BOOK CHAPTER (OUT OF 320)

- Rogers*, J., Sandt*, A. , AL-DEEK+, H., and Alomari*, A., Uddin, N., Gordin, E., Dos Santos, C., Renfrow, J., and Carrick, G. "Wrong-Way Driving Multifactor Risk-Based Model for Florida Interstates and Toll Facilities," Journal of the Transportation Research Board, No. 2484, pp. 119-128, December 2015. Won 2015 Best TRB Freeway Operations Paper Award.
- Consoli*, F. , Alomari*, A. , AL-DEEK+, H., Rogers*, J., Sandt*, A., Noori, M.,Tatari, O., and Hadi, M. "Evaluation of Conditional Transit Signal Priority Technology for Regional Implementation," Journal of the Transportation Research Board, No. 2484, pp. 140-148, December 2015. Won 2015 Best TRB RTSMO Paper Award.
- Consoli*, F. , Rogers*, J., AL-DEEK+, H., Tatari, O., and Alomari*, A. "Smart Event Traffic Management: Impact on the Central Florida Regional Transportation Network and Lessons Learned," Journal of the Transportation Research Board, No. 2396, pp. 107-116, December 2013. Won 2013 Best TRB RTSMO Paper Award.

SYNERGISTIC ACTIVITIES, AND SELECTED PROFESSIONAL SERVICE

- Associate Editor of ITS Journal 2007-present.
- Transportation Research Board (TRB), Chair of Paper Review Freeway Operations, and Regional Transportation Systems Management and Operations committees, 2000-present.

COLLABORATORS:

Asad Khattak, Batten Endowed Chair Professor, Old Dominion University, J-ITS Editor-In-Chief.
Mohamed Hadi, Associate Professor, Florida International University.
Adib Kanafani (Professor of Graduate Studies), University of California at Berkeley.

Adrian James Sandt

Education

August 2014 – Present
University of Central Florida, Orlando, FL
Civil Engineering Ph.D. Program, Advisor: Dr. Haitham Al-Deek, P.E.
Expected Completion in May 2018.

August 2009 – May 2014
University of Central Florida, Orlando, FL
Bachelor of Science in Civil Engineering, Math Minor
Burnett Honors College
Graduated Summa Cum Laude, GPA: 3.99

Experience

May 2014 - Present
Graduate Student Researcher, Department of Civil, Environmental and Construction Engineering, University of Central Florida
Adviser: Dr. Haitham Al-Deek, P.E.
Involved with the following projects:

- "Wrong-Way Driving Phase-3 Study: Allocating and Evaluating Countermeasures on CFX Roadway Network". This study involves scoring interchanges based on previous WWD events, interchange design, and other factors to determine where to implement WWD countermeasures. Technologies to notify right-way drivers of WWD events and prevent wrong-way vehicles from entering the mainline are also being evaluated.
- "Wrong-Way Driving Incidents on OOCEA Toll Road Network, Phase-2 Study: Developing Countermeasures". This project was funded by the Central Florida Expressway Authority (formerly OOCEA) and involved the implementation of wrong-way driving countermeasures on Central Florida toll road ramps.
- "Evaluating the Wrong-Way Driving Problem on the Florida Turnpike's Roadway System, Phase-1 Study". This project was funded by Florida's Turnpike Enterprise (FTE) and involved the analysis of wrong-way driving incidents along FTE's roadway network to determine the counties and roadways where wrong-way driving is most problematic. This study also involved the evaluation of wrong-way driving countermeasures installed at pilot test locations on State Road 821 and State Road 869.
- "Evaluating the Impact and Usefulness of Highway Advisory Radio (HAR) and Citizens' Band Radio Advisory Systems (CBRAS) in Providing Traveler Information and Improving the User Experience on the Florida Turnpike Enterprise's Toll Road Network and the Florida Interstate Highway (FIH) System". This project was funded by the Florida Department of Transportation (FDOT) and involved the design and implementation of various driver and agency surveys on the knowledge and usefulness of HAR and CBRAS, as well as a benefit-cost analysis on HAR, to help FDOT and FTE decide how they should proceed with the existing HAR and CBRAS technologies.
- *"NCHRP 03-117 Traffic Control Devices and Measures for Deterring Wrong-Way Driving*

(WWD) Movements," Funded by Transportation Research Board (TRB) National Research Council in collaboration with Texas A&M Transportation Institute (TTI)—Project Lead, UCF is subcontract. Award period for UCF subcontract June/2015 – September/2016.

December 2012 – May 2014
Undergraduate Student Researcher, Department of Civil, Environmental and Construction Engineering, University of Central Florida
Adviser: Dr. Haitham Al-Deek, P.E.
Responsibilities included the following:

- Analyzing the frequency and locations of wrong-way driving incidents on Central Florida toll roads. This project was funded by the Orlando-Orange County Expressway Authority (OOCEA).
- Evaluating Transit Signal Priority (TSP) technology on International Drive, Orlando, FL. This was part of a larger collaboration between UCF and FIU on a project titled "Performance Measurements of Transportation Systems on Fine-Grained Data Collected by AVI and AVL Systems." This project is funded by the National Center for Transportation Systems Productivity and Management at Georgia Institute of Technology.
- Writing and editing of reports and technical documents, including research proposals, progress reports, and final reports.

August 2013 – May 2014
Undergraduate Teaching Assistant, Department of Civil, Environmental and Construction Engineering, University of Central Florida
Faculty: Dr. Haitham Al-Deek, P.E.
Courses: Highway Engineering, Transportation Engineering Systems
Responsibilities included the following:

- Grading homework and quizzes.
- Assisting students with course material.

Scholarships and Fellowships

- UCF Pegasus Silver Scholarship
- UCF Scholars Award
- UCF Trustees Fellowship

Additional Skills

- Technical Writing
- Software: AutoCAD, Microsoft Office, SAS

MD IMRUL KAYES
Resume

Info

Date of Birth: April 7, 1991
Skype: kayesce
Email Id: imrulkayes@knights.ucf.edu, Imrul.jami@gmail.com.
Mobile: 321-276-7591

Education

August 2015 – Present
University of Central Florida, Orlando, FL
Civil Engineering Ph.D. Program, Advisor: Dr. Haitham Al-Deek, P.E.
Expected Completion in May 2019.

March 2009 – July 2014
Bangladesh University of Engineering and Technology, (BUET).
Bachelor of Science in Civil Engineering.

Experience

August 2015 – Present
Graduate Student Researcher, Department of Civil, Environmental and Construction Engineering, University of Central Florida.
Adviser: Dr. Haitham Al-Deek, P.E.
Involved with the following projects:

- "Wrong-Way Driving Phase-3 Study: Allocating and Evaluating Countermeasures on CFX Roadway Network". This study involves scoring interchanges based on previous WWD events, interchange design, and other factors to determine where to implement WWD countermeasures. Technologies to notify right-way drivers of WWD events and prevent wrong-way vehicles from entering the mainline are also being evaluated.
- "Evaluating the Wrong-Way Driving Problem on the Florida Turnpike's Roadway System, Phase-1 Study". This project was funded by Florida's Turnpike Enterprise (FTE) and involved the analysis of wrong-way driving incidents along FTE's roadway network to determine the counties and roadways where wrong-way driving is most problematic. This study also involved the evaluation of wrong-way driving countermeasures installed at pilot test locations on State Road 821 and State Road 869.
- "NCHRP 03-117 Traffic Control Devices and Measures for Deterring Wrong-Way Driving (WWD) Movements," Funded by Transportation Research Board (TRB) National Research Council in collaboration with Texas A&M Transportation Institute (TTI)—Project Lead, UCF is subcontract.

August 2015 – January 2016

Graduate Teaching Assistant (GTA), Department of Civil, Environmental and Construction Engineering, University of Central Florida.
Faculty: Dr. Haitham Al-Deek, P.E.
Courses: Highway Engineering, Transportation Engineering Systems
Responsibilities included the following:

- Grading homework and quizzes.
- Assisting students with any questions they have about the course.

Computer Skills

- Tools: AutoCAD, SAS, HCS, Microsoft Office, ETABS
- Language: C, C++

Omar Khaled Al-Sahili

EDUCATION

January 2016 – Present
University of Central Florida, Orlando, FL
Civil Engineering MSc. Program, Advisor: Dr. Haitham Al-Deek, P.E.
Expected Completion in Jan 2018.

UNITED STATES CITIZEN

Sep 2010 – Dec 2014
An-Najah National University, Nablus
Bachelor in Civil Engineering, GPA: 3.33

Experience

Jan 2016 – Present
Graduate Student Researcher, Department of Civil, Environmental and Construction Engineering, University of Central Florida.
Adviser: Dr. Haitham Al-Deek, P.E.
Involved with the following projects:

- "Wrong-Way Driving Phase-3 Study: Allocating and Evaluating Countermeasures on CFX Roadway Network". This study involves scoring interchanges based on previous WWD events, interchange design, and other factors to determine where to implement WWD countermeasures. Technologies to notify right-way drivers of WWD events and prevent wrong-way vehicles from entering the mainline are also being evaluated.
- "Evaluating the Wrong-Way Driving Problem on the Florida Turnpike's Roadway System, Phase-1 Study". This project was funded by Florida's Turnpike Enterprise (FTE) and involved the analysis of wrong-way driving incidents along FTE's roadway network to determine the counties and roadways where wrong-way driving is most problematic. This study also involved the evaluation of wrong-way driving countermeasures installed at pilot test locations on State Road 821 and State Road 869.
- "NCHRP 03-117 Traffic Control Devices and Measures for Deterring Wrong-Way Driving (WWD) Movements," Funded by Transportation Research Board (TRB) National Research Council in collaboration with Texas A&M Transportation Institute (TTI)—Project Lead, UCF is subcontract

Dec 2014 – Dec 2015
Transportation Engineer, National Center of Sustainable Development (NCD) "Consulting firm", Nablus
- Projects and Tasks Assigned:
  - **Design of Several Road Projects**, such as the **Internal Roads for the New Campus of Al-Quds University** in Tulkarem City, the **Internal and Connecting Roads of Shaheen avenue** in Bethlahem City, and the **Design and Supervision on construction Main Road**

of Beeta Village. Duties included preparing Site & Designs plans, along with all required approvals and logistics, and conducting site investigation visits, **2015.**

- **Strategic Development and Capital Investment Planning** (SDIP) for Hebron City, **2015.**
- **Strategic Development and Capital Investment Planning** (SDIP) for Tulkarm City, **2015.**
- **Preparation the Physical/Urban Plans for 7 Local Communities.** Including roads and intersections design and layout. In cooperation with the Ministry of Local Government and the Municipalities, **2015**
- **The Naming and Coding Project for 16 Local Government Units**. Duties included creating the first GIS database system for the 16 local government units and creating a naming and coding system for streets and buildings, **2015.**

Jun 2014 to Aug 2014
Summer Intern, Reiss Engineering Inc. - Winter Springs, Florida, USA
Omar Trained as a summer intern for 3 months and was assigned as Proposal Lead for the St. John's County Continuing Utility Engineering Services and Prepared evaluation sheets for inspection with Site visits to evaluate operating conditions of the stations.

- **Software Skills and Programs familiar with:**

HCM2010, SYNCHRO STUDIO traffic ware, AutoCAD Civil 3d, Trans CAD, AutoCAD, AutoTurn and Primavera P6.

General Activities and Interests:

- "Founding" board member of ASCE NNU Student branch
- "Publicity Chair" board member of ASCE NNU Student branch
- Board member of the Civil Engineering Department Committee
- Active member in the Northern Youth Participation Council
- Elected as the leader board member (Head of Public Relations) of the Northern Youth Participation Council

- **LEADERSHIP AND VOLUNTARY ACTIVITES:**

- Organizer in *"**The First Palestinian International Civil Engineering Conference**"* held by the ***Palestinian Engineers Association**, in Ramallah.***2014**.
- Founding Member, ***American Society of Civil Engineers (ASCE),*** *An-Najah Uni.(NNU) Student Branch.* **2013-2014**
- Publicity chair, ***American Society of Civil Engineers (ASCE)**, An-Najah Uni.(NNU) Student Branch.* **2013-2014**

- **PROFESSIONAL MEMBERSHIP:**

- American Society of Civil Engineers (ASCE)
- Jordanian Engineers Association
- Palestinian Engineers Association

Andres Velasquez
9327 Nelson Park Circle Apt 106 • Orlando, FL 32817 • 561.232.7824 •
AndresVelasquez@knights.ucf.edu

Education

University of Central Florida Orlando, FL
Major: **Civil Engineering** May 2017
Class Level: **Junior**
GPA: **3.81**

Awards

1st Place Regional Champion, SkillsUSA AutoCAD Competition 2012
1st Place Regional Champion, SkillsUSA AutoCAD Competition 2013
President's Honor Roll (3 Semesters)
Florida Bright Futures Scholar

Skills

Computer: Proficient in AutoCAD 2012-2015, AutoCAD Architecture 2012-2015, Microsoft Excel, Microsoft Word and Microsoft PowerPoint. Microstation SS4
Language: Fluent in Spanish

Projects

August 2015 – Present

- Undergraduate Student Researcher, Department of Civil, Environmental and Construction Engineering, University of Central Florida.
- Adviser: Dr. Haitham Al-Deek, P.E.
- Involved with the following projects:
- "Wrong-Way Driving Phase-3 Study: Allocating and Evaluating Countermeasures on CFX Roadway Network". This study involves scoring interchanges based on previous WWD events, interchange design, and other factors to determine where to implement WWD countermeasures. Technologies to notify right-way drivers of WWD events and prevent wrong-way vehicles from entering the mainline are also being evaluated. Participated in field work testing the detection system for Wrong Way Drivers.
- "Evaluating the Wrong-Way Driving Problem on the Florida Turnpike's Roadway System, Phase-1 Study". This project was funded by Florida's Turnpike Enterprise (FTE) and involved the analysis of wrong-way driving incidents along FTE's roadway network to determine the counties and roadways where wrong-way driving is most problematic.

This study also involved the evaluation of wrong-way driving countermeasures installed at pilot test locations on State Road 821 and State Road 869.

- "NCHRP 03-117 Traffic Control Devices and Measures for Deterring Wrong-Way Driving (WWD) Movements," Funded by Transportation Research Board (TRB) National Research Council in collaboration with Texas A&M Transportation Institute (TTI)—Project Lead, UCF is subcontract.

Work Experience

Inwood Consulting Engineers Orlando, FL
Transportation Intern October 2015 - Present

Student Organization

ITE- Treasurer

- Participated in the TRB conference through ITE hosted in Washington D.C where several ITS presentations were attended.

Florida Engineering Society- Member

American Society of Civil Engineers (ASCE) - Member

ANTONY SHAMMA
14209 Paradise Tree Drive, Orlando, FL
32828 407.633.9641
ashamma@knights.ucf.edu

OBJECTIVE

To expand my skills and knowledge through a research experience while in my undergraduate program which will allow me to acquire a better understanding of transportation methods.

Education:

University of Central Florida, Orlando, FL **Fall 2017**

Bachelors of Science in Civil Engineering

Relevant Coursework:

Transportation Engineering, Water Resources Engineering I, Civil Engineering Materials, and Engineering Economic Analysis

Valencia College, Orlando, FL **Fall 2014**

Associate in Arts Degree (Articulated Engineering UCF)

Relevant Coursework:

Introduction to the Engineering Profession, Engineering Concepts and methods (Excel (VBA), Matlab)), Engineering Analysis: Statics and Dynamics, Probability and Statistics for Engineers

Relevant Experience:

Undergraduate Student Researcher, Department of Civil, Environmental and Construction Engineering, University of Central Florida.
Advisor: Dr. Haitham Al-Deek, Ph.D., P.E.
Involved with the following projects:

- "Wrong-Way Driving Phase-3 Study: Allocating and Evaluating Countermeasures on CFX Roadway Network". This study involves scoring interchanges based on previous WWD events, interchange design, and other factors to determine where to implement WWD countermeasures. Technologies to notify right-way drivers of WWD events and prevent wrong-way vehicles from entering the mainline are also being evaluated.
- "Evaluating the Wrong-Way Driving Problem on the Florida Turnpike's Roadway System, Phase-1 Study". This project was funded by Florida's Turnpike Enterprise (FTE) and involved the analysis of wrong-way driving incidents along FTE's roadway network to determine the counties and roadways where wrong-way driving is most problematic. This study also involved the evaluation of wrong-way driving countermeasures installed at pilot test locations on State Road 821 and State Road 869.

- "NCHRP 03-117 Traffic Control Devices and Measures for Deterring Wrong-Way Driving (WWD) Movements," Funded by Transportation Research Board (TRB) National Research Council in collaboration with Texas A&M Transportation Institute (TTI)—Project Lead, UCF is subcontract.

Institute of Transportation Engineers (ITE) **Fall 2015- Present**

- President of ITE UCF Student Chapter
- Coordinate and hold meetings on a regular basis
- Attended the Transportation Research Board (TRB) in 2016, visited exhibits and attended presentations on ITS

American Society of Civil Engineers (ASCE) **Spring 2015-Present**

- Active member of ASCE
- Interact and connect with guest speakers

Skills:

Bilingual: Arabic and English

Proficient in Microsoft Office (Word, Excel, Publisher, and PowerPoint)

Strong commitment to work in a team environment, with the ability to contribute knowledge

Strong problem solving and analytical skills

CENTRAL FLORIDA EXPRESSWAY AUTHORITY

February 2, 2016

To Whom It May Concern

RE: Central Florida Expressway Authority Match Funding Commitment for Professor Haitham Al-Deek's Southeast Transportation Center research proposal titled "Evaluating the Potential of Connected Vehicles in Combating Wrong-Way Driving"

Dear Sir/Madam:

This is certify the one-to-one match commitment of the Central Florida Expressway Authority (CFX) to support the University of Central Florida's (UCF) proposal submitted to the Southeast Transportation Center (STC) Opportunity/Exploratory (O/E) Grant Proposal opportunity for the 2016 year, under the direction of Professor Haitham Al-Deek, Ph.D., P.E. (Principal Investigator, UCF).

CFX has an active contract with UCF which supports the project "Wrong-Way Driving Phase 3 Study: Allocating Countermeasures on CFX Roadway Network" which studies and evaluates wrong-way driving countermeasures on our system. The period of performance of this current project extends from August 13, 2015 to August 12, 2017 (24-month duration). CFX will provide funds from this existing CFX project to match the requested amount of $49,999.00 from STC as one-to-one match to support the STC proposed project "Evaluating the Potential of Connected Vehicles in Combating Wrong-Way Driving".

If you have any questions regarding this subject, please contact me at 407-690-5332 or at Corey.Quinn@CFXWay.com.

Sincerely,

Central Florida Expressway Authority

Corey Quinn, P.E.
Chief of Technology/Operations

4974 ORL TOWER RD. ORLANDO, FL 32807 | PHONE: (407) 690-5000 | FAX: (407) 690-5011

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