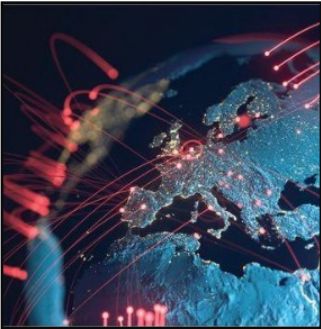




CATM Sponsored Research

Machine Learning for Dynamic Airspace Configuration Towards Optimized Mobility in Emergency Situations



Natural disasters, such as hurricanes, tornadoes and thunderstorms, can affect large populations and cause severe economic losses every year. Unfortunately, with global warming, such events are becoming more common and more severe.

"[I]t is clear that extreme weather is the new normal. From Germany to China to Canada or the United States: wildfires, floods, extreme heat waves. It is an ever-growing tragic list," said Joyce Msuya, deputy executive director of the U.N. Environment Program.

When disasters do occur, air travel is a vital and efficient mode of transportation for emergency evacuation. In an emergency, large numbers of people need to travel in a short period of time. The current structured, static airspace is not designed to accommodate rapid increases in traffic demand during such crisis situations. An adaptive and dynamic scheduling program for air travel during an emergency is needed. ([continued on page 2](#))

Usability of Urban Air Mobility: Quantitative and Qualitative Assessments of Usage in Emergency Situations

The goal of this research was to assess the usefulness of urban air mobility (UAM) vehicles in response to natural disasters. Specifically, researchers sought to determine the ideal locations for take-off and landing sites of UAM vehicles. UAM includes those aerial vehicles, mostly operated autonomously, which can complete short flights, historically, in urban areas, but their use has expanded to rural areas more frequently. UAM vehicles were originally designed and used to support advanced transportation mobility, but they could potentially offer numerous advantages in emergency response efforts to natural disasters.

This research, which began in December 2020 and ended in December 2021, was conducted by principal investigator (PI), Scott Winter, assistant professor of graduate studies in the School of Graduate Studies, College of Aviation, ([continued on page 3](#))

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Machine Learning for Dynamic Airspace *(continued from page 1)*



Embry-Riddle Aeronautical University (ERAU) professors, Houbing Song, Ph.D., an assistant professor of electrical engineering and computer science and Dahai Liu, Ph.D., a professor in the College of Aviation, are addressing this need by developing a prototype for dynamic airspace configuration (DAC) through the use of machine learning (ML) techniques to achieve optimized mobility in emergency situations. Ke Feng, a Ph.D. student, is contributing as a graduate research assistant. The researchers propose to identify, apply and evaluate ML principles as they relate to DAC. The resulting prototype would demonstrate the ML-augmented capability supporting DAC.



This novel approach differs from the statistical and graphical based DAC approaches. The proposed ML-based framework aims to discover the difference of DAC on areas with different air traffic patterns to enable mapping between ATC control and the air traffic evaluation metrics to be determined. The proposed framework will provide a new DAC model that is able to self-adjust the airspace configuration based on the air traffic demands at different times of the day or during emergency events. This information would allow increased airspace capacity, greater safety and improved efficiency of ATC operations under unexpected situations with rapid demand changes. *(top left: Houbing Song bottom: Dahai Liu)*

Song envisions DAC's major potential is in emergency response.

"The integration of artificial intelligence with air transportation, especially for real-time operation, is transforming the emergency evacuation procedure," Song said. "DAC will trigger more applications of AI/machine learning in improving transportation mobility."

The research, which is funded by CATM and ERAU, began in October 2020 and was originally scheduled to conclude in March of this year. However, because of COVID-19, the project has been extended. A paper detailing the research, "Trust of Airspace Configuration Transition Concerning the Fluctuation of Air Traffic", was published in the IEEE DASC 2021. The second paper from the research, "Blockchain Enabled Secure Authentication for Unmanned Aircraft Systems", received the Best Paper Award from IEEE GLOBECOM 2021 Workshop on AI and Blockchain-Enabled Secure and Privacy-Preserving Air and Ground Smart Vehicular Networks (SVNs). The research also produced a book, *[Aviation Cybersecurity: Foundations, principles, and applications.](#)*



Usability of Urban Air Mobility: Quantitative and Qualitative Assessments of Usage in Emergency Situations *(continued from page 1)*



Stephen Rice, professor in the College Arts and Sciences, and co-PI, Sean R. Crouse, assistant professor in the College of Aviation, at ERAU. Graduate students, Austin Vaughn and Nadine K. Ragbir assisted. *(top left: Scott Winter)*

The investigators approached the research through four studies involving over 2,000 participants. The studies were designed to provide quantitative and qualitative assessments of:

1. participants' willingness to support the use of UAM technology in response to natural disasters,
2. the creation of a valid scale to measure vertiports' usability,
3. the evaluation of the ideal locations for vertiports in various scenarios, and
4. a qualitative analysis of perceptions related to vertiport locations.



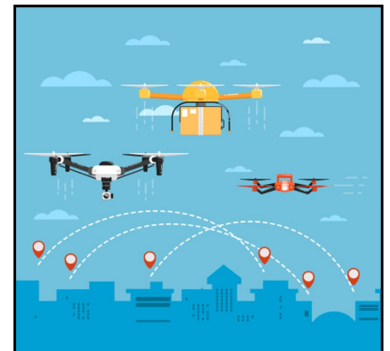
Study 1 assessed the willingness to support using a mixed factorial design. The findings demonstrated strong, robust support for the use of UAM when responding to natural disasters. Study 2 worked to create and validate a scale that could assess vertiports' current and proposed locations. A vertiport usability scale was developed and shown to have strong psychometric properties to validly assess vertiport locations through a multi-stage process. Study 3 used the vertiport usability scale to understand the preferred locations for vertiports in three conditions from a multi-stage process: temporary disaster locations, permanent disaster locations, and permanent consumer locations. Study 4 used qualitative methods to complement the quantitative approaches. *(Middle left: Stephen Rice, bottom: Sean Crouse)*



Through an initial survey and follow-up interview, three clear themes emerged regarding the attitudes of people in relation to using UAM technology and vertiports in response to natural disasters. These were: human involvement in UAM operations, scenarios for usage, and setup and deployment of vehicles.

Winter said:

“The findings from these studies demonstrate strong support for the use of UAM vehicles in response to natural disasters. This usage could serve as another initial deployment venue for UAM and also assist municipalities in offering life-saving resources to members of the public.”



CATM Virtual Research Symposium 2022

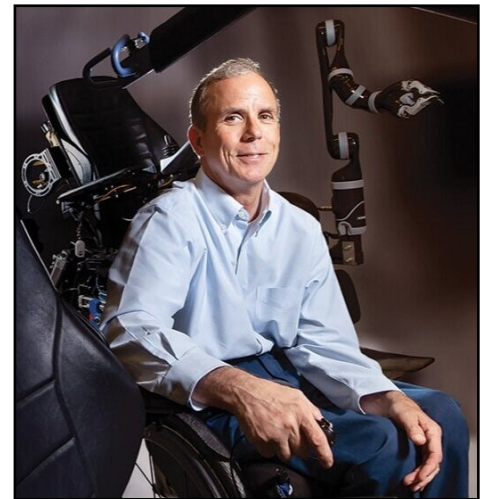
The fourth Center for Advanced Transportation Mobility (CATM) Research Symposium was an online event held Feb. 7 - 8, 2022, from 11 a.m. to 5:30 p.m. Jon Antin, CATM research program manager and leader of the Vulnerable Road Users group at Virginia Tech Transportation Institute, and staff organized the event.

The symposium was an opportunity for students, faculty and researchers from the three consortium member institutions, including North Carolina Agricultural and Technical State University (lead), Virginia Polytechnic Institute and State University (VTTI) and Embry–Riddle Aeronautical University (ERAU), Daytona Beach, to share and learn transportation-related research information. Specifically, the principal investigators and graduate students involved in research projects, partially or fully funded by CATM, presented the progress or final conclusions of the studies.



On the first day of the symposium, Greg D. Winfree, J.D., who is the director of Texas A&M University's Transportation Institute and has a prestigious background in transportation law and the U.S. Department of Transportation, was the keynote speaker. Winfree gave an informed and interesting talk on "The Transformation of Transportation: The Road Ahead." The theme was "Emergency Situations." An index of both days' presentations is [here](#). (left: Greg D. Winfree)

On the second day of the symposium, the keynote speaker was Rory A. Cooper, Ph.D. He is the founder, director and CEO of Human Engineering Research Laboratories, a joint venture of the University of Pittsburgh, the U.S. Department of Veteran Affairs and the University of Pittsburgh Medical Center. He currently serves as a distinguished professor (and past chair) in the Department of Rehabilitation Science and Technology and professor of bioengineering, physical medicine and rehabilitation and orthopedic surgery at the University of Pittsburgh. Cooper, who is a disabled veteran who uses a wheelchair, spoke with experience and passion about "Accessible Autonomous Vehicles and Transportation Systems – The Need for Greater Inclusion of People with Disabilities." The research presentations that day focused on "Vulnerable Road Users" and you can view recordings of both days' presentations [here](#).



Maranda McBride, Ph. D., director of CATM, professor of management at N.C. A&T, and former director of N.C. A&T's Transportation Institute, opened and closed the symposium daily with remarks. At the end of each day, a virtual networking session provided attendees and presenters the opportunity to explore that days' subjects further as well as discuss current supply chain, pandemic and transportation topics. (above right: Rory Cooper)

Other Transportation Research News

John Park's New Patent Will Reduce Wait Time at Red Lights



Hyoshin “John” Park, Ph.D., assistant professor of computational data science and engineering at N.C. A&T was awarded a patent to help alleviate traffic congestion using optimized relocation and placement of portable sensors. The [original research](#), “Anticipatory Traffic Sensor Location Problems (SLPs) with Connected Vehicle Technologies” was conducted by Park and colleagues Ali Haghani, Song Gao, Michael A. Knodler, Siby Samuel and sponsored, in part, by CATM.

Park noted while the potential benefits are great for optimized sensor deployment, the challenges associated with solving traffic demand patterns can obscure opportunities for researchers to create innovations in the field. His patent taps into one of those challenging innovations and prioritizes a proactive approach for mitigating traffic congestion. Traditionally, cities deploy localized sensors, such as embedded loop sensors and cameras, at traffic intersections to trigger traffic signals. The intersections using these sensors are typically the city’s most frequently congested and most prone to experience queue spillback when a turn lane exceeds its capacity. The localized sensors help, yet are incapable of evaluating the larger transportation network. Park’s patent offers a cost-effective, efficient and flexible solution that prioritizes the larger network of traffic, instead of localized sensors. According to Park:

“The algorithm uses portable sensors to assess the traffic flow in nearby intersections, detect queue spillback and make changes to the timing of the traffic signals as necessary. All of these will help to ease the flow of traffic and make traffic more efficient.”

Smaller portable sensors, unlike permanently embedded ones, can be positioned at traffic intersections and moved at regular intervals – weekly or monthly – to better detect new congestion trends and build a historical data log of the intersections across a city. From there, the city’s traffic trends can be fed as input data to a simulation of that city modeled as a network of interconnected roads. This enables the timing of traffic signals to be adjusted to improve the flow of larger areas of the city, instead of focusing only on the individual road or intersection. This strategy is able to improve drivers’ experiences as traffic patterns evolve throughout the year, including during major events like festivals, sporting events and concerts. The sensors work by collecting data from the vehicle’s onboard equipment and transmitting it to road-side sensors, which are integrated with the traffic signal controllers and with the larger road network.

“The power of the coordinated approach is that green-light phases can be evenly distributed at intersections in real-time to enable open flows of traffic where needed, thus reducing network delays and improving the efficiency of traffic flow,” said Park. He hopes to leverage the patent’s innovations across North Carolina and the nation by collaborating with local and federal partnerships he has established while at N.C. A&T.



CATM Personnel Update

Nicholas Allen Joins N.C. A&T Transportation Institute



In August of 2021, Nicholas (Nick) Allen, started in the position of program manager for the N.C. A&T Transportation Institute and project director of the Summer High School Transportation Institute (STI). Allen, who began the job a year-and-a-half into the COVID-19 pandemic, started on-site in August welcoming the students back to campus for the fall semester.

Navigating the student-focused role around virus restrictions and surges has required flexibility. Most early events took place virtually. However, in January 2022, Allen accompanied seven students to Washington, D.C. for five days to attend the Transportation Research Board Annual Meeting.

Allen earned a dual English degree from Virginia Tech, focusing on literature and technical writing. After working in web development, he expanded his educational purview with a master's in health humanities from UNC-Chapel Hill. His master's research focused on aging and end of life, and his thesis used oral histories to explore a variety of overlooked perspectives on end of life and encourage families to have difficult discussions before it's too late.

During his graduate work, Allen was employed as a program coordinator for the Health Humanities Interdisciplinary Venue for Exploration and a research associate for the Southern Oral History Program. After matriculation, he gained experience in program management while working for UNC-Chapel Hill's World View where he helped run professional development events for K-16 teachers.

Allen also coached volleyball at Chapel Hill Area Volleyball Club for the past three years. This new role gives him the opportunity to combine the various skills gained from each of his previous experiences to uniquely serve the students of N.C. A&T. Allen said:

"I am pleased to be supporting the Transportation Institute's longstanding tradition of top-notch student programming while working with the new department director, Dr. Liu, to expand our research agenda and institutional presence within the field of transportation."

CATM Webinars

Mask-Wearing in Air Travel During Coronavirus Pandemic – an Extended Theory of Planned Behavior Model



On Oct. 8, 2021, Jin Yu Pan, Ph.D., assistant professor in the School of Graduate Studies, College of Aviation at ERAU, discussed the methodology and findings of her research which aims to develop an extended theory of planned behavior model to examine the relationship between potentially relevant factors, like attitude, social norms, risk avoidance, information factors and the intention ([continued on page 7](#))

Webinar: Mask-Wearing in Air Travel During Pandemic *(continued from page 6)*

to wear masks in an airplane cabin.

Research shows that air transportation is a likely vehicle for the rapid spread of infectious diseases. Previous studies have identified effective measures to help prevent transmission in air travel, but mask-wearing has not been thoroughly studied. Currently, there is a large research gap in understanding what motivates airline passengers to wear face masks when flying during pandemics. Click [here](#) to view the video.

Modeling Approaches for Equitable Dynamic Congestion Pricing



On Dec. 23, 2021, Venkatesh Pandey, Ph.D., assistant professor in the Department of Civil, Architectural and Environmental Engineering at N.C. A&T held a webinar detailing his [research](#) focused on investigating the equity issues of express lanes' dynamic pricing. Congestion pricing implementations, such as express lanes and tolls, ease traffic congestion by internalizing travelers' external traffic costs while generating revenue for infrastructure projects. Express lanes provide reliable travel time in exchange for a toll that changes dynamically with the time of day.

However, these lanes do raise equity concerns because the dynamic tolls may put a hardship on the economically disadvantaged traveler. [Click here](#) to view the webinar video.

Education News and Student Activities

N.C. A&T Awarded \$200K National Science Foundation Grant to Establish Digital Badge Program to Advance STEM Education

A team at N.C. A&T received a \$200,000 grant from the National Science Foundation (NSF) to implement a digital badge program which seeks to increase the competitive science, technology, engineering and math (STEM) skillsets of students entering the transportation workforce and transportation graduate school programs.



Maranda McBride, Ph.D., professor of management in the Willie A. Deese College of Business and Economics, along with the College of Engineering's Hyoshin Park, Ph.D., assistant professor of computational data science and engineering, and Venkatesh Pandey, Ph.D., assistant professor of civil engineering, proposed the new transportation digital badge program.

Their proposal is in response to a National Science Foundation Historically Black College and University Undergraduate Program Targeted Infusion Project (HBCU-UP TIP) and is titled "Advancing STEM Education Through Transportation Studies" (ASETTS). The project began in September 2021 and is funded ([continued on page 8](#))

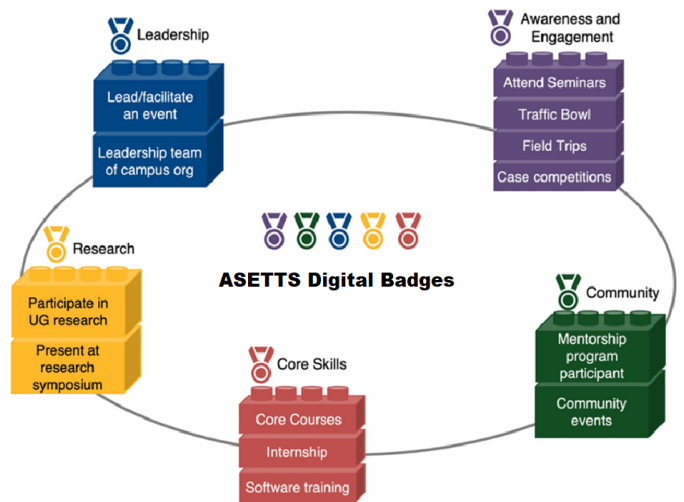
ASETTS Digital Badge Program *(continued from page 7)*

for two years. ASETTS will create a digital badge program encouraging and enabling undergraduate students to increase their knowledge in STEM and core subject skills by establishing mentorship programs, embedding engaging experiential learning activities in courses, providing research opportunities and scholarships, and increasing students’ exposure to transportation career opportunities through an array of experiential learning activities.

Digital badges are validated indicators of a student’s accomplishment and skill in a specific area that they can include on their resume to assure potential employers of basic knowledge and competency. Like a school transcript, digital badges can provide credentialing for a person that includes specific information about the requirements necessary to earn the badge.

In ASETTS, students will earn points toward specific digital badges upon the completion of various activities. Some examples are:

- Participation in transportation-related field trips
- Participation in transportation competitions
- Attendance at transportation conferences, workshops, or symposia
- Engaging in transportation-related mentorship or community volunteer opportunities
- Attendance at transportation-related student organization meetings and campus events.



The North Carolina Department of Transportation and the Institute of Transportation Engineers will endorse the badges, and the supporting agencies will be involved in creating, reviewing, and providing opportunities for ASETTS participants. Badges also will be “stackable” and consist of different levels of achievement depending on student effort and the number of hours invested.

2021-2022 CATM Student Scholars

Since its inception in Nov. 2016, CATM has awarded scholarships to students to support and encourage pursuits in educational paths that lead to careers in the transportation industry. The transportation scholars’ award is open to transportation/supply chain majors who are interested in participating in experiential learning and extra-curricular activities and events organized by CATM and the Transportation Institute. Award recipients receive between \$1,000 and \$5,000 based on GPA and engagement in transportation/supply chain activities. The 2021-2022 CATM scholars are:

Lauren Atkinson	Quadir Donaldson	Jaylin Roberts
Rhyan Baker	Winston Griffin	Miles Stanton
Arie Bethea	Nicole Lewis	Josette Stewart
Brandon Daye	Felicia Park	Boateng Woodson

2021-2022 Dwight D. Eisenhower Transportation Fellowship Recipients

N.C. A&T students Brandon Daye, Aliyah McCray and Kendal Tidwell received grants totaling \$22,500 from the Dwight David Eisenhower Transportation Fellowship Program (DDETFP). The awards were procured under the recommendation of the CATM Director Maranda McBride, Ph.D., and N.C. A&T Transportation Institute program manager Nicholas Allen. The funds contributed to 2021-22 academic school year tuition assistance, a stipend and expenses to attend the 101st Transportation Research Board annual meeting, which the students attended Jan. 9-13 in Washington, D.C.

The recipients are marketing and supply chain management students in the Willie A. Deese College of Business and Economics. Daye is also studying agribusiness and food industry management in the College of Agriculture and Environmental Sciences.



Brandon Daye, of Burlington, North Carolina, is also a Thurgood Marshall College Fund Leadership Scholar. He is also president of the Student Food Advisory Board, development coordinator of the Leadership Engagement and Development Staff, chair of the Get Out to Vote and Excitement Workgroup for the University Civic Engagement Coalition, chair of the Campus Life Committee and senator for the College of Agriculture, Natural Resources and Related Sciences for the Student Government Association. He is an active member of The Village Mentoring, Inc., Men on the Move, NAACP, Supply

Chain Aggies and Toastmasters International. Daye often quotes the words of the great Booker T. Washington :

“Success is to be measured not so much by the position that one has reached in life as by the obstacles which he has overcome while trying to succeed.”



Aliyah McCray, of Raleigh, North Carolina, is currently a first year MBA student concentrating in supply chain management. She received her undergraduate degree from A&T in May 2021 with a B.S. in supply chain management. McCray has been a member of the Blue and Gold Marching Machine throughout her years at A&T and was also a CATM Transportation Scholar for the 2019-2020 and 2020-2021 academic years. She is a former 2020-2021 Dwight David Eisenhower Fellow Program recipient. McCray is working as a graduate assistant for the department of Accounting and

Finance at A&T and is also completing a one-year co-op at Centric Brands as a Distribution Bypass Supply Chain intern in Greensboro, North Carolina. She will be interning with the Corning Life Sciences Division this summer. McCray is in the University Honors Program and has served on the executive board for the NCAT Association for Supply Chain Management, focusing on marketing and recruitment. She lives by this quote from Joyce Meyers:

“You cannot have a positive life and a negative mind.”

Dwight D. Eisenhower Transportation Fellowship Recipients *(continued from page 9)*



Kendal Tidwell, of Indianapolis, Indiana, is a member of Alpha Lambda Delta National Honor Society, Beta Gamma Sigma International Business Society, the Chancellor's List and the Honors Program. She also was a recipient of the Willie A. Deese College of Business and Economics Scholarship in 2020. Tidwell has served as an Aggie Ambassador and was treasurer for the freshman class in the 2018-2019 school year. She receives inspiration from this quote by Carol Burnett:

"When you have a dream, you've got to grab it and never let it go."

The DDETFP local competition is designed to stimulate interest among students attending a minority-serving institution of higher education or community college to conduct transportation-related research, pursue transportation-related degrees, enter the transportation workforce and enhance the breadth, scope and diversity of knowledge of the entire transportation community in the United States.

The program provides funds for students to pursue associate, bachelor, master and doctoral degrees in transportation-related fields. The awards are given based on merit considering academic records, class standing, GPA, transcripts, transportation work experience and personal recommendations.

Students Attend Transportation Research Board Annual Meeting

Seven N.C. A&T students and CATM scholars attended the Transportation Research Board Meeting in Washington D.C. on Jan. 9-13.



From left: Arie Bethea, Brandon Daye, Nicole Lewis, Jaylin Roberts, Aliyah McCray, Kendal Tidwell, Rhyan Baker.

Students Attend Southern District ITE Student Leadership Summit

Six N.C. A&T students attended the ITE Student Leadership Conference at Virginia Tech in Blacksburg, Virginia, Feb. 25-27. *(below left)*

Student-to-Student Workshop

On March 17, N.C. A&T students Brian and Brandon Daye visited Cummings High School in Burlington, North Carolina, and introduced students in a career and technical education class to the education and career paths available in transportation and supply chain management. *(below right)*



From left: Kamaria Worgs, Malaika McNeil, Felicia Park, Melissa Petit-Jean, Ashley Nimley, and Mary Bakre

From left : Brian Daye and Brandon Daye talk to high school students.



N.C. A&T
Transportation Institute
Willie A. Deese College of Business and Economics
402 Craig Hall
Greensboro, NC 27411

Phone: 336-334-7745
Fax: 336-334-7093

bit.ly/ncatthetransportationinstitute

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