MSU research professor taking leadership role in NATO teams focused on off-road autonomy

STARKVILLE, Miss.—A Mississippi State research professor is helping lead international efforts to advance off-road autonomous vehicle capabilities.

Daniel Carruth, associate director for human factors and advanced vehicle systems at MSU's Center for Advanced Vehicular Systems, is part of a North Atlantic Treaty Organization research task group examining autonomous vehicle modeling and simulation tools. The group will work through 2023 to determine standards for modeling and simulation tools, allowing military and research personnel to more effectively develop algorithms that will allow autonomous vehicles to navigate off-road and unknown terrain.

The research task group is part of the NATO Science and Technology Organization's applied vehicle technology panel. Carruth said the ongoing work with NATO brings together advances in virtual environment and mobility modeling.

"With mobility modeling, it was mostly about dynamics between the tire/track and the terrain it's driving on," Carruth said. "With autonomy, you have more questions about the environment and need to account for things such as trees, people, animals and other obstacles. We're trying to take two domains that have advanced a lot over the last 10 or 15 years and bring them together to improve off-road vehicles."

At CAVS, researchers use the MSU Autonomous Vehicle Simulator to test navigation software in virtual environments. Recently, MSU acquired 50 acres adjacent to CAVS to test autonomous vehicles in a variety of off-road environments. The center recently was awarded

over $3 million from the U.S. Army Engineer Research and Development Center to support the Army's ground mobility research.

"Off-road autonomy is a new space that's being created, and we're right there at the forefront," said CAVS Executive Director Clay Walden. "It's invaluable to have Dr. Carruth being involved with the NATO working group, which allows us to better see the vision for future military research and puts our work in mobility on the international stage."

Carruth is leading two NATO sub-groups, one focused on virtual environments and sensors, and another focused on benchmarking modeling and simulation tools. He said the benchmarking group will help determine gaps in current simulation software. The group plans to test autonomous vehicles in the real world and compare their performance to the modeling tools.

"Once we can show that the modeling and simulation tools work, we can help set standards for them," Carruth said.

According to the NATO Task Group Co-Chair and U.S. Army CCDC Ground Vehicle Systems Center Senior Technical Expert, Dr. Paramsothy Jayakumar, "The autonomous mobility capability development is vital to NATO's mission. It promises to enable new capabilities in the modeling, simulation, and autonomous operation of a broad class of vehicles. These modeling capabilities are of high importance to current and future NATO missions because they have the potential to significantly improve use and performance of autonomous vehicles. The new tools will be applicable to various conventional wheeled and tracked vehicles, and could yield a new paradigm for ground vehicle autonomous mobility, which will allow the possibility of modeling autonomous complex vehicle maneuvering in high fidelity utilizing High Performance Computing (HPC). Having the capability to implement and integrate various autonomous capabilities on military ground vehicles into a complete solution would be highly advantageous in order to understand and assess this technology appropriately. Availability of autonomous technologies that feature complete solutions are expected soon and NATO needs to be able to reliably judge the performance and applicability of autonomous technologies in the military

context. It is critical to set up standard methods and tools for assessing military autonomous vehicles and being able to confirm their ability to fulfill strategical maneuvers and wider operations in a quantitative manner, especially since the military context provides extremely challenging and rough situations whether on the environmental aspect including multiple ground types, varying weather and illumination conditions, or on the vehicle aspect including various military ground platforms with specific characteristics, or finally, on the strategical aspects including tactical and combat configurations. Given that this activity is likely to result in a long-lasting methodology and/or tool similar to the current NATO Reference Mobility Model (NRMM) which is widely used in military acquisitions by NATO member nations, such development will be a valuable investment for the future. The leadership and contributions provided by MSU's Dr. Daniel Carruth is extremely critical to the success of the NATO Task Group."

Carruth's research interests include modeling and simulation of human interaction with autonomous vehicles, as well as the study of human task performance in law enforcement, military and industrial work. He earned his doctorate in psychology from MSU.

CAVS is an interdisciplinary research center that uses state-of-the-art technology to address engineering challenges facing U.S. mobility industries. The center broadens its impact by supporting economic development and outreach activities throughout Mississippi. For more, visit www.cavs.msstate.edu.

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