CENTER FOR CONNECTED AND AUTOMATED TRANSPORTATION

Project Title	Predicting Driver Takeover Performance in Conditional Automation (Level 3) through Physiological Sensing	
PIs	PI Carol Menassa (UM)	Co-PIs (bullet list if more than one) • Vineet Kamat (UM) • Da Li (Clemson University) • Julian Brinkley (Clemson University)
Telephone #	734-764-7525	
E-mail:	menassa@umich.edu	
Institution:	University of Michigan	
Department:	Civil and Environmental Engineering	
Industry or Government Principal, organization, and contact information	Industry: Aisin Technical Center of America - Regulations & Research Contact Information: Thomas Miller, General Manager (Email: tmiller@aisintca.com)	
Most relevant CCAT research thrusts (choose all applicable)	_____ Enabling Technology _____ Planning and Policy __X__ Human Factors _____ Infrastructure Design and Management _____ Control and Operations _____ Models and Implementation	
Funding Request	$149,278	
Matching Funds and Source (if any)	Total Matching Funds: $57,000. Driving Simulator at Clemson University: ProSimu T5 with motion platform. The total cost is approximately $27,000 including the screens and other necessary components. Infrared Driver Monitoring System: Aisin will provide their infrared driver monitoring system to be integrated into our driving simulator. The total cost is $30,000.	
Total Project Cost	$206,278 including 57,000 in matching funds	
Contract Number	69A3551747105	
Project start/end dates	Start date: 03/01/2021 End date: 02/28/2022	

UMTRI · The University of Akron · Illinois Center for Transportation · Purdue University · Washtenaw Community College · Central State University

Project Abstract	The National Highway Traffic Safety Administration (NHTSA) calls for fundamental research on "the driver performance profile over time in sustained and short-cycle automation … and driver-vehicle interface to allow safe operation and transition between automated and non-automated vehicle operation." The emerging level 3 autonomous vehicle (AV) has the potential to transform driving because it can perform all aspects of the driving task and allow for complete disengagement of drivers (e.g., sit back and relax) under certain driving scenarios. The vehicle can handle situations that require an immediate response, such as emergency braking. However, this is not fully autonomous, and still requires the driver to be prepared for takeover at all times with a few seconds of warning. Being able to measure and predict the takeover performance (TOP) ahead of time and issue adequate warnings is thus critical to ensure driver comfort, trust, and safety in the system and ultimately acceptance of the technology by different stakeholders. This has not been explored to the extent of establishing complete and irrefutable trust in the autonomous vehicle system and its ability to engage the driver in safe and effective takeover under certain driving scenarios. Therefore, the objective of this project is to perform fundamental research to understand drivers' capabilities of taking over the vehicle safely and promptly at any time in level 3 automation. This project advances fundamental research in human factors in level 3 AVs. This is achieved through an integrated treatment of the drivers' TOP measured and predicted through physiological features and driving environment data in level 3 AVs. Thus, the main objective of this research will be to investigate the feasibility of using multimodal physiological features collected from drivers in level 3 AVs under different driving and disengagement scenarios (secondary tasks) to develop a personalized and real-time prediction of TOP. The project will engage a diverse group of students and faculty and develop a research program in an unexplored area of level 3 AVs, leading to substantial advances in how human physiological sensing can be used to understand the driver's TOP, especially in a personalized manner. Such an understanding can eventually lead to the design of adaptive and personalized alerts that can be integrated in level 3 AVs.

High-level implementation plan	- Arrange weekly research team meetings - Arrange a monthly research team meeting with industry sponsor - Develop an anonymized driver performance dataset - Disseminate project results to the public - Develop educational material in human-machine interactions - Facilitate transfer to auto industry
Project Metrics	This research effort will significantly advance the design of driver monitoring systems in level 3 automation (and also contributes to level 2) by continuously integrating physiological data into the automated system such that takeover alerts can be issued accordingly to avoid accidents even when the driver is not actively engaged in any driving or monitoring tasks. Moreover, data collected in this research will be used to provide a comprehensive and publicly available driving dataset capturing TOP under a large range of driver states and behaviors to enable consistent evaluation and benchmarking of new methods in the future.
Web Links: [leave blank until project approval]	ccat.umtri.umich.edu