CENTER FOR CONNECTED AND AUTOMATED TRANSPORTATION

UTC Project Information	
Project Title	Machine Learning, Human Factors and Security Analysis for the Remote Command of Driving
University	University of Michigan
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Brief Abstract of Research Project	Both human drivers and autonomous vehicles are now able to drive relatively well in 'typical' (frequently- encountered) settings, but fail in exceptional cases. Worse, these exceptional cases often arise suddenly, leaving human drivers with a few seconds at best to react—exactly the setting that people perform worst in. This work proposes methods for leveraging groups of remote operators to provide assistance on- demand. Unlike prior work, we introduce collective workflows that enable groups of operators to significantly outperform any of the constituent individuals on control and correction tasks. We propose to develop a software platform that enables a group of remote operators to command the autonomous test vehicles. Through 3D simulations we will collect driving feedback data from realistic scenarios. The proposed work and remote operators is consistent with the US DOT Automated Vehicle guidelines (AV 3.0) and defined by SAE J3016.
Most Relevant CCAT Research Thrusts	Enabling Technology Human Factors Control and Operations

Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	This work aims to establish a workflow that quickly and effectively leverages the collective efforts of human operators in car accident scenarios. In order to understand how we can increase the speed of human operator decision making, the research team conducted a study in which participants watched videos of driving scenarios and predicted whether or not there was a dangerous object in the scene. The long-term goal is to use this pre-fetched information to rapidly detect when a car accident is likely to occur. Our study indicated that participants tended to be cautious when rating objects as dangerous, with 21.3% false positive ratings. We also found that when a dangerous object did appear in a driving scenario, crowd workers need more time to react in order to prevent an accident. Specifically, crowd workers could prevent an accident if the dangerous object appears 6.12 seconds before the accident while drivers in real world scenarios can react effectively if the object appears 4.5 seconds before an accident. This indicates that collective workflows need to account for false positives and slower reaction times in crowdsourcing environments. The research team's next study will ask participants to generate possible trajectories a vehicle might take in the near future. Crowd workers will be asked to identify multiple future states and potentially dangerous objects. The team will then explore different methods for predicting sets of future states that could result in a car accident, rather than making predictions based on only one future state at a time.
Impacts/Benefits of Implementation (actual, not anticipated)	The work we have done so far contributes to the body of scientific knowledge by uncovering new challenges when using look ahead approaches in crowdsourcing in a more complex and realistic autonomous vehicle context. We find that false positives and premature prediction of danger are not uncommon and need to be accounted for in instantaneous crowdsourcing workflows. We also find that dealing with a large number of potential futures with many variable objects is another challenge for instantaneous crowdsourcing prediction workflows. This work has also made a broader impact by receiving press coverage from multiple different news outlets, such as Stateside Michigan Radio, TechXplore, CMU Mobility 21, and MLive. This research has also been featured on the University of Michigan's news webpage.
Web Links • Reports • Project website	ccat.umtri.umich.edu