Thesis Project Portfolio

An Analysis of Vehicular Telematics and Geo-Location Data to Maximize Road Safety

(Technical Report)

Examining the Current Decision-Making Capabilities of Self-Driving Systems

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

My technical project is titled "An Analysis of Vehicular Telematics and Geo-Location Data to Improve Road Safety". This technical project aimed to improve road safety among the grounds of the University of Virginia (UVA) by analyzing telematics data from UVA Facilities Management's (FM) fleet of vehicles to identify safety hotspots. Surrogate measures such as harsh braking, harsh cornering, and speeding along with actual crash data from UVA FM and the state of Virginia were analyzed for this project. From there, cluster maps and density calculations based on surrogate measure violations were used to effectively identify safety hotspots, offering opportunities for targeted countermeasures to mitigate safety violations and crashes. Correlation analysis was also done in order to provide insights into the relationship between surrogate measure violations and actual crashes. By understanding the relationship between surrogate measure violations and actual crashes, stakeholders can prioritize resources and interventions to mitigate safety risks and prevent accidents. Based on the data analyzed for the project, speeding was identified as an effective surrogate measure for identifying potential crashes at UVA. With this knowledge, areas that are prone to speeding violations were identified as safety hotspots and research on speeding countermeasures was done in order to decrease future violations. We also visited each hotspot to take notes of potential indicators of safety concerns. Our observations combined with research on countermeasures were then used to come up with recommendations for UVA FM in order to improve the safety of their fleet and the overall streets of UVA. Future research endeavors could explore the utilization of geofencing to normalize hotspot data and incorporate factors such as vehicle miles traveled within specific areas. Additionally, advanced algorithms may further refine hotspot identification by considering variables such as traffic density, road conditions, and time of day.

In summary, the findings underscore the importance of proactive measures in addressing road safety challenges, with recommendations for further research to validate the effectiveness of prescribed countermeasures and explore vehicle-specific safety recommendations. Ultimately, the study contributes to the ongoing efforts to create safer transportation infrastructures and reduce the incidence of motor vehicle collisions, paving the way for a more sustainable and secure future of mobility.

My STS project is titled "Examining the Current Decision-Making Capabilities of Self-Driving Systems". This project employs the Actor-Network Theory (ANT) framework in order to explore the complex interplay between human and non-human actors involved in the development, regulation, and deployment of self-driving vehicles. This research hopes to shed light on the promises and challenges inherent in the regulation of autonomous systems into our transportation infrastructure. To start, the study highlights pivotal roles played by human actors such as researchers, engineers, policymakers, and ethicists in shaping the trajectory of autonomous vehicle technology. These human actors contribute expertise, resources, and regulatory frameworks that influence the development and deployment of self-driving systems. Furthermore, the study examines non-human actors such as sensor technologies, machine learning algorithms, regulatory frameworks, and infrastructure elements that play a role in the decision-making processes of self-driving systems. From there, the study elucidates the dynamic interactions and power dynamics among human and non-human actors within the autonomous vehicle network. This was done through a case study of Uber's tragic autonomous vehicle incident in Tempe, Arizona in 2018. This study illustrates the interactions that shape decision-making processes, regulatory responses, and public perceptions of autonomous technology. The findings underscore the need for comprehensive regulatory frameworks that balance innovation with safety and accountability. Policymakers are urged to develop adaptable regulations that define safety standards, certification processes, and liability frameworks to ensure the safe integration of self-driving cars into society. From my research, interdisciplinary collaboration among industry leaders, academic institutions, and government agencies is recommended to address complex challenges in autonomous vehicle technology and foster public trust through education and engagement initiatives.

As autonomous vehicles continue to revolutionize transportation systems, proactive measures are essential to ensure safety, accountability, and public trust. By leveraging insights from the ANT framework and informed dialogue on the promises and challenges of autonomous technology, stakeholders can navigate the complexities of autonomous vehicle development and integration, ultimately realizing the transformative potential of autonomous vehicles in creating a safer, more sustainable future of mobility for all.