

## ABSTRACT

Most new vehicles manufactured in the last two years are connected vehicles (CV) that transmit back to the original equipment manufacturer at near real-time fidelity. These CVs generate billions of data points on an hourly basis, which can provide valuable data to agencies to improve the overall mobility experience for users. However, with this growing scale of CV big data, stakeholders need efficient and scalable methodologies that allow agencies to draw actionable insights from this large-scale data for daily operational use. This dissertation presents a suite of applications, illustrated through case studies, that use CV data for assessing and managing mobility and safety on surface transportation systems.

A systematic review of construction zone CV data and crashes on Indiana's interstates for the calendar year 2019, found a strong correlation between crashes and hard-braking event data reported by CVs. Trajectory-level CV data analyzed for a construction zone on interstate 70 provided valuable insights into travel time and traffic signal performance impacts on the surrounding road network. An 11-state analysis of electric and hybrid vehicle usage in proximity to public charging stations highlighted regions under and overserved by charging infrastructure, providing quantitative support for infrastructure investment allocations informed by real-world usage trends. CV data were further leveraged to document route choice behavior during active freeway incidents providing stakeholders with a historical record of observed routing patterns to inform future alternate route planning strategies. CV trajectory data analysis facilitated the identification of trip chaining activities resulting in improved outlier curation and realistic estimation of travel time metrics.

The overall contribution of this thesis is developing analytical big data procedures to process billions of CV data records to inform engineering and public policy investments in infrastructure capacity, highway safety improvements, and new EV infrastructure. These scalable and efficient analysis techniques proposed in this dissertation will help agencies at the federal, state and local levels in addition to private sector stakeholders in assessing transportation system performance at-scale and enable informed data-driven decision making.