Smarter and Safer Decisions Using Connected Vehicle Data

Cody A. Pennetti, PhD – Presented By Ben Revette, P.E.
Contributions

• This pilot was funded by the Virginia Department of Transportation (VDOT) and completed by faculty and students of the University of Virginia, partnership with the CCALS. This research demonstrates how transportation professionals and decision-makers can use CV data to make informed decisions in the planning and operations of transportation systems.
Background

Traditional transportation performance metrics, such as Average Annual Daily Traffic (AADT), simplify the inherent variability of transportation operations.
Connected Vehicle (CV) Data Accuracy

- Location accuracy within 3 meters
- Collected every 2-3 seconds to see actual movements
- Limited to select vehicles and vehicle types

*Image Source: WeJo*
CV data includes vehicle-specific performance information, reported every few seconds, with metadata such as vehicle speeds, trajectories, and event data like harsh braking, environmental conditions, and other attributes.
Connected Vehicle observations can be evaluated by vehicle, day, and event-related data (such as change in speed)

Example CV Dataset Animation
Event attribute data, such as harsh braking, can serve as a predictive measure of high-risk intersections.
CV datasets are classified as big data. This data set was comprised of 55 billion observations, averaging around 600 million observations per hour and 8,000 GB (8TB) of data.

Analysis required cloud services like AWS (Amazon Web Service) which is more efficient at hold large amounts of data, merging data (AWS Glue), and then running some initial filters (Amazon Athena) before working in a more familiar local data analytics environment.
CV attribute data, such as speed, vehicle count, and harsh braking, is used for a highway corridor to find high-risk access points that would be generalized by traditional datasets.
Ranked in priority, the top five spots were:
1. Elementary school
2. Unsignalized intersection
3. **Median Break**
4. Visitor center
5. High School | **Median Break**
Extended Use Cases

Electric vehicles
Find optimum vehicle range and charging locations

Freight logistics
Determine route optimization and trends by day and hour

Driver Safety
Identify hot spots of harsh braking (ABS use) to predict crashes.

Real-time Analysis
Use historic data to find patterns that emerge before events. Vehicle-to-everything (V2X) technology.
Connected Vehicle Data for Risk Analysis and Transportation Performance Evaluation

Cody A. Pennetti, Ph.D., P.E.
Lecturer
University of Virginia
151 Engleman’s Way, PO Box 400736, Charlottesville, VA 22903
Email: cpennett@dewberry.com

Megan C. Marcellin
Ph.D. Student
University of Virginia
151 Engleman’s Way, PO Box 400736, Charlottesville, VA 22903
Email: mmarcellin0@email.virginia.edu

Travis J. Pennetti
Independent Researcher
Chicago, IL
Email: travis.pennetti@gmail.com

Sreehari Kotturi Madam
Planning and Data Specialist
Virginia Department of Transportation
1401 E. Broad Street, Richmond, Virginia 23219
Email: sreehari.kotturi@tdot.virginia.gov

Jungwook Jun, Ph.D., P.E.
Planning Data Solutions Manager
Virginia Department of Transportation
1401 E. Broad Street, Richmond, Virginia 23219
Email: jungwook.jun@dot.virginia.gov

James H. Lambert, Ph.D., P.E., FASCE, D.WRE
Professor
University of Virginia
151 Engleman’s Way, PO Box 400736, Charlottesville VA 22903
Email: Jlambert@virginia.edu

Keywords: connected vehicle data; risk analysis; data architecture; access management; geospatial information systems.