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Summary and Objectives

- This work investigated the potential effects and synergies between autonomous technology and electric vehicle charging infrastructure placement.
- Used Seattle, WA as case study for optimization of vehicles and chargers under different levels of automation.

Background and Motivation

- Electric vehicles need to be charged
- Charging stations are expensive
- Vehicle charging is time consuming
- Level 4 & 5 automation could allow for a reduction in the number of necessary chargers

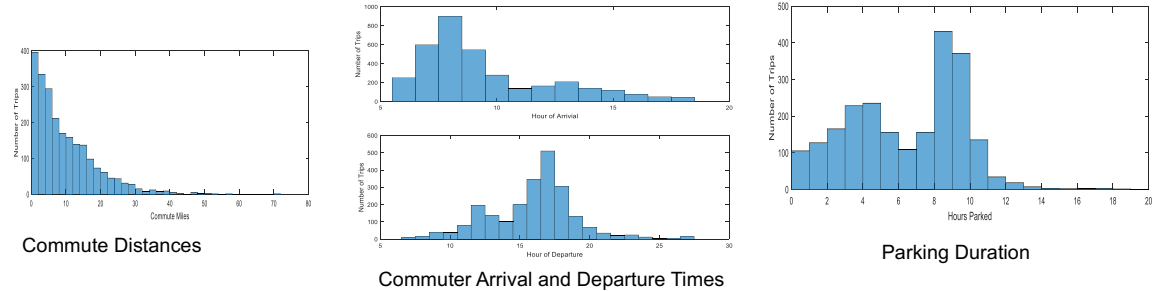
How Vehicle Automation May Affect EV Charging

- Charging stations are expensive
- Vehicle charging is time consuming
- Level 4 & 5 automation could allow for a reduction in the number of necessary chargers
- Level 4 Automation: The vehicle can move itself on and off the charger. The commuter must still walk after parking
- Level 5 Automation: The vehicle can move itself on and off the charger. The vehicle and drop off and pick up the commuter
- Automation can increase charger utilization and reduce peak electricity load

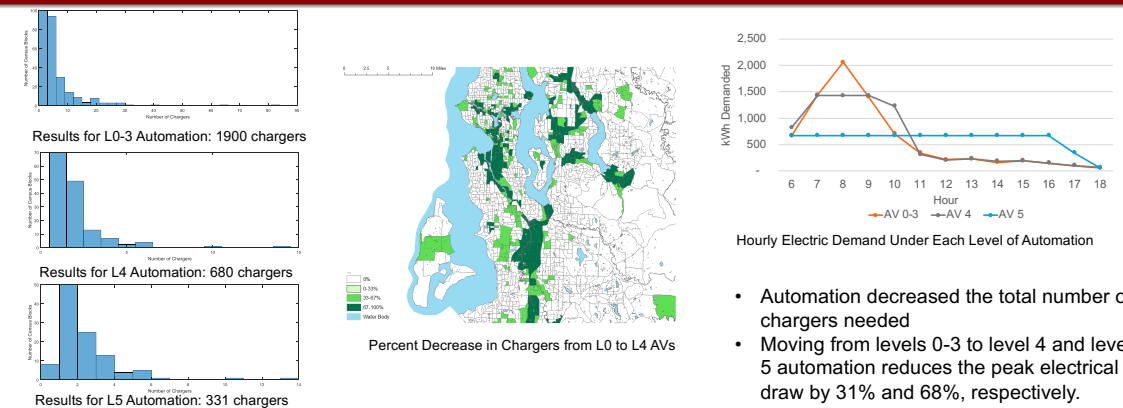
Data and Methods

- Level 0-3 Automation
 - Min the sum commuter walking distance and the operator budget
 - Operator cost depends on number of chargers and real estate costs
 - One charger is required for every peak vehicle
 - Max walking distance of 0.25 miles
- Level 4 automation
 - Same as Level 0-3 but chargers can now serve multiple vehicles
 - Vehicles can queue up to a charger with a one minute switching time after charging is finished
 - Chargers serve miles, not vehicles
- Level 5 Automation
 - Same as level 4 automation but no max walking distances
 - Vehicles energy and depreciation costs instead ~20 times less per mile than walking
- AC Level 1 / 120 V Charging: About 5 miles per hour, <\$2,000 (significantly less for new construction)
- AC Level 2 / 120 V Charging: About 20 miles per hour, about \$10,000 per charger
- DC Fast Charging: About 150 miles per hour, about \$50,000 per charger

Commuter Characteristics in Seattle, WA



Results



- Automation decreased the total number of chargers needed
- Moving from levels 0-3 to level 4 and level 5 automation reduces the peak electrical draw by 31% and 68%, respectively.

Conclusions

- Optimizing EV infrastructure for AVs naturally smooths out peak EV electric demand with fewer chargers than non-automated smart charging
- Automation allows for significant decreases in operator cost
- But shifts a smaller portion of this to commuters

- These two technologies have potential synergies and a novel method to take advantage of these synergies while optimizing electric vehicle infrastructure deployment.
- Taking advantage of the potential synergies between these technologies would allow for significant decreases in support infrastructure cost.

Acknowledgments

This research was supported by a US DOT University Transportation Center grant, award No. DTRT12GUTC11. This document is disseminated under the sponsorship of the U.S. Department of Transportation's University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.