Research Recap

Mobility21
A USDOT NATIONAL UNIVERSITY TRANSPORTATION CENTER

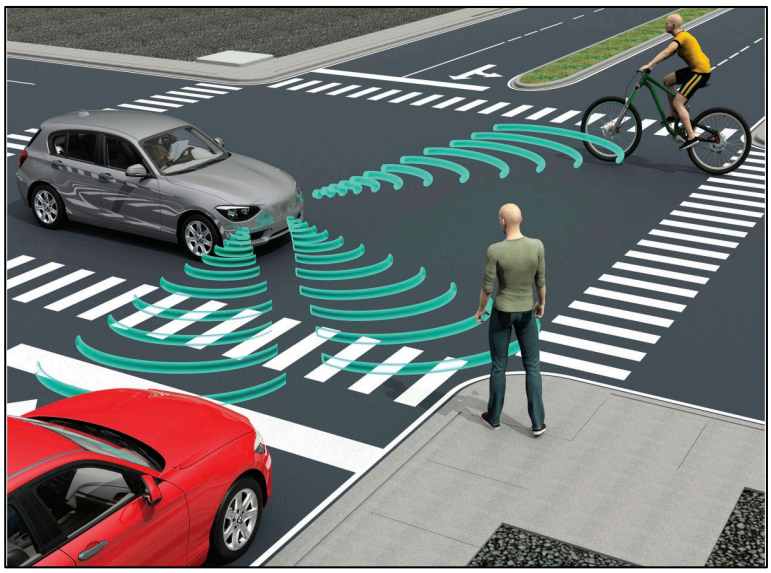
Mixed Autonomy Era of Transportation: Resilience and Autonomous Fleet Management

Purpose: To demonstrate the potential for Autonomous Vehicles (AVs) to improve traffic flow for both autonomous and non-autonomous vehicles in mixed-autonomy settings.

Approach: The team began by formulating a cascading failure model (when a road or service fails due to various reasons, and traffic is re-routed to other roads which overwhelm those roadways). AVs can redirect themselves to take less congested routes, essentially stopping these cascades. The bounds of robustness were found at different levels of disruptions, when both Human driven (HVs) and AV were present. The team then validated these bounds by simulating with real traffic counts, to find which pattern is most resilient. The models were then refined and extended to study how AVs can take actions to induce a better equilibrium traffic flow even in the absence of cascading failures and policy implications of the results.

Key Findings:
With collaboration and information sharing between the AVs and the centralized server, the team found that:

- ✓ AV fleets can take actions that influence the actions of the HVs.
- ✓ Collaboration of AVs can prevent the transportation network from failing. More AVs in the network can eventually reduce congestion.
- ✓ A partial adaptation of AVs can affect the equilibrium traffic flow in the transportation system, reducing vehicles' delays.
- ✓ Drivers' on-road experience could be improved by less speeding and slowing, and driving in less congested roadways in the new era of mixed-autonomy.



Conclusion: AVs have been found to be able to act as transportation system "coordinators" in the mixed-autonomy era, by helping reduce traffic congestion/failures. An AV prevalence of 20-50% is enough to realize most of the achievable reduction in drivers' travel time delays. The analysis made in this project could be applied to different types of networks, and different regulatory policies may be used to enforce AVs to behave in a manner that benefits the transportation system as a whole.

Research Team:

- Carlee Joe-Wong (Principal Investigator)
  https://orcid.org/0000-0003-0785-9291

Project Record:

- https://ppms.cit.cmu.edu/projects/detail/352

Follow Us:

www.facebook.com/traffic21.tset

@Traffic21CMU

2022-10