Autonomous Vehicles Solving the Trillion-Dollar Problem

Maher Absar

Automated vehicles (AV) have become the next big interest of many tech companies and increasingly seem to be a viable solution to a multi-trillion-dollar traffic congestion problem that plagues the global economy (Here, 2017). Wide-scale implementations of this cutting-edge technology would lessen traffic congestion by utilizing vehicle-to-vehicle communication to dissipate stop-and-go traffic waves, using in-lane techniques to keep traffic moving efficiently and by better navigation through various junctions.

Traffic congestions are typically found during rush hour where the density of vehicles is high. During these hours, drivers experience phantom traffic jams where the smallest disturbances can magnify and cause issues (Stern, et al., 2018). A recent study suggests that the introduction of one AV can influence the traffic flow of 20 or more human-controlled cars. In this study, the AV was able to increase the flow by decreasing velocity standard deviation, braking and fuel consumption (Stern, et al., 2018). This is possible due to GPS equipped vehicles which allow for high accuracy communication between cars on the road and the autonomous vehicle (Herrera, et al., 2010). As society transitions to more automated vehicles on the road, the ability to communicate enables multi-car cooperative driving strategies (Hyldmar, He, & Prorok, 2019).

When more modes of driving become autonomous, there are additional techniques that can be used on the road to slowly eliminate traffic congestion (Here, 2017). One of these techniques is vehicle platooning, which increases the capacity of roads while maintaining a steady flow (Bang & Ahn, 2017). This technique has collision concerns with human-controlled vehicles and presents an argument for wide implementation of automation on the road. The presence of vehicle-to-vehicle communication platooning coupled with adaptive cruise control (ACC) can serve as an effective congestion avoidance strategy. ACC is currently used for comfort and safety but can be used in autonomous vehicles to actively avoid jams based on traffic conditions using specific models (Kesting, Treiber, Schönhof, & Helbing, 2008).

The ability of self-driving cars to adapt to road conditions, optimize and avoid collisions is desirable especially at intersections. Safe and fast automated navigation through various junctions on the road can further mitigate traffic jams (Rios-Torres & Malikopoulos, 2017). The use of AVs at intersections eliminates the decision making time humans need thus making intersection quicker. Effectively using appropriate models and making efficient use of the intersection lanes, connected automated vehicles can almost double intersection capacity (Sun, Zheng, & Liu, 2017). All this can be done by ensuring safety with collision avoidance embedded into the development of the technology (Hult, Zanon, Gros, & Falcone, 2019).

In conclusion, to reap the full benefits of self-driving cars, the implementation needs to happen - ideally for every mode of driving. Even with only a few cars on the road, a transition to automated vehicles can provide benefits by dissipating stop-and-go traffic. As society continues to adopt higher levels of automation, there are increased methods, such as platooning, ACC and detailed junction behaviour in solving the trillion-dollar congestion problem.

References

Bang, S., & Ahn, S. (2017). Platooning Strategy for Connected and Autonomous Vehicles: Transition from Light Traffic. Transportation Research Record: Journal of the Transportation Research Board, 2623(1), 73–81. doi: 10.3141/2623-0845

HERE. (2017). How autonomous vehicles could relieve or worsen traffic. Retrieved from https://www.here.com/sites/g/files/odxslz166/files/2018-12/HERE_How_autonomous_vehicles_could_relieve_or_worsen_traffic_congestion_white_paper.pdf

Herrera, J. C., Work, D. B., Herring, R., Ban, X. (J., Jacobson, Q., & Bayen, A. M. (2010). Evaluation of traffic data obtained via GPS-enabled mobile phones: The Mobile Century field experiment. Transportation Research Part C: Emerging Technologies, 18(4), 568–583. doi: 10.1016/j.trc.2009.10.006

Hult, R., Zanon, M., Gros, S., & Falcone, P. (2019). Optimal Coordination of Automated Vehicles at Intersections with Turns. 2019 18th European Control Conference (ECC). doi: 10.23919/ecc.2019.8795770

Hyldmar, N., He, Y., & Prorok, A. (2019). A Fleet of Miniature Cars for Experiments in Cooperative Driving. 2019 International Conference on Robotics and Automation (ICRA). doi: 10.1109/icra.2019.87944

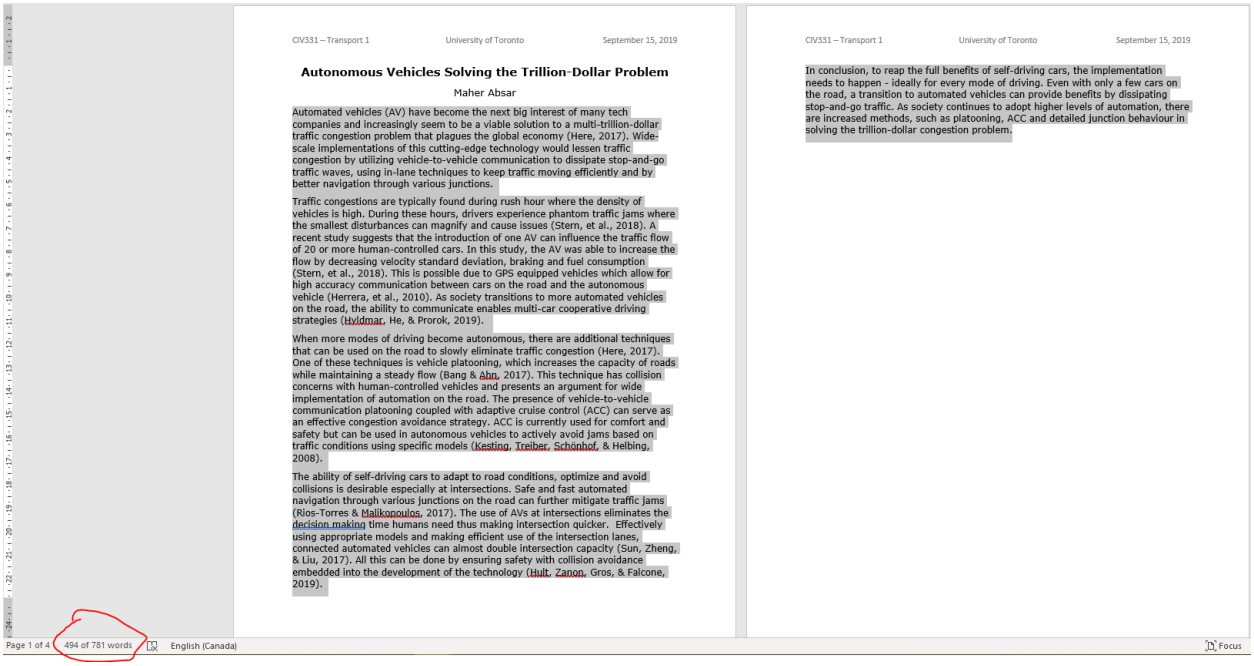
Kesting, A., Treiber, M., Schönhof, M., & Helbing, D. (2008). Adaptive cruise control design for active congestion avoidance. Transportation Research Part C: Emerging Technologies, 16(6), 668–683. doi: 10.1016/j.trc.2007.12.004

Rios-Torres, J., & Malikopoulos, A. A. (2017). A Survey on the Coordination of Connected and Automated Vehicles at Intersections and Merging at Highway On-Ramps. IEEE Transactions on Intelligent Transportation Systems, 18(5), 1066–1077. doi: 10.1109/tits.2016.2600504

Stern, R. E., Cui, S., Monache, M. L. D., Bhadani, R., Bunting, M., Churchill, M., Work, D. B. (2018). Dissipation of stop-and-go waves via control of autonomous vehicles: Field experiments. *Transportation Research Part C: Emerging Technologies, 89, 205–221. doi: 10.1016/j.trc.2018.02.005*

Sun, W., Zheng, J., & Liu, H. X. (2017). A capacity maximization scheme for intersection management with automated vehicles. Transportation Research Procedia, 23, 121–136. doi: 10.1016/j.trpro.2017.05.008

Word Count (494 Words)



CIV331 – Transport 1 University of Toronto September 15, 2019

Autonomous Vehicles Solving the Trillion-Dollar Problem

Maher Absar

Automated vehicles (AV) have become the next big interest of many tech companies and increasingly seem to be a viable solution to a multi-trillion-dollar traffic congestion problem that plagues the global economy (Here, 2017). Wide-scale implementations of this cutting-edge technology would lessen traffic congestion by utilizing vehicle-to-vehicle communication to dissipate stop-and-go traffic waves, using in-lane techniques to keep traffic moving efficiently and by better navigation through various junctions.

Traffic congestions are typically found during rush hour where the density of vehicles is high. During these hours, drivers experience phantom traffic jams where the smallest disturbances can magnify and cause issues (Stern, et al., 2018). A recent study suggests that the introduction of one AV can influence the traffic flow of 20 or more human-controlled cars. In this study, the AV was able to increase the flow by decreasing velocity standard deviation, braking and fuel consumption (Stern, et al., 2018). This is possible due to GPS equipped vehicles which allow for high accuracy communication between cars on the road and the autonomous vehicle (Herrera, et al., 2010). As society transitions to more automated vehicles on the road, the ability to communicate enables multi-car cooperative driving strategies (Hyldmar, He, & Prorok, 2019).

When more modes of driving become autonomous, there are additional techniques that can be used on the road to slowly eliminate traffic congestion (Here, 2017). One of these techniques is vehicle platooning, which increases the capacity of roads while maintaining a steady flow (Bang & Ahn, 2017). This technique has collision concerns with human-controlled vehicles and presents an argument for wide implementation of automation on the road. The presence of vehicle-to-vehicle communication platooning coupled with adaptive cruise control (ACC) can serve as an effective congestion avoidance strategy. ACC is currently used for comfort and safety but can be used in autonomous vehicles to actively avoid jams based on traffic conditions using specific models (Kesting, Treiber, Schönhof, & Helbing, 2008).

The ability of self-driving cars to adapt to road conditions, optimize and avoid collisions is desirable especially at intersections. Safe and fast automated navigation through various junctions on the road can further mitigate traffic jams (Rios-Torres & Malikopoulos, 2017). The use of AVs at intersections eliminates the decision making time humans need thus making intersection quicker. Effectively using appropriate models and making efficient use of the intersection lanes, connected automated vehicles can almost double intersection capacity (Sun, Zheng, & Liu, 2017). All this can be done by ensuring safety with collision avoidance embedded into the development of the technology (Hult, Zanon, Gros, & Falcone, 2019).

CIV331 – Transport 1 University of Toronto September 15, 2019

In conclusion, to reap the full benefits of self-driving cars, the implementation needs to happen - ideally for every mode of driving. Even with only a few cars on the road, a transition to automated vehicles can provide benefits by dissipating stop-and-go traffic. As society continues to adopt higher levels of automation, there are increased methods, such as platooning, ACC and detailed junction behaviour in solving the trillion-dollar congestion problem.

Page 1 of 4 494 of 781 words English (Canada) Focus