UNIVERSITY TRANSPORTATION RESEARCH CENTER **RESEARCH BRIEF**

Project Title: Simulation of Automated Vehicles' Drive Cycles

Principal Investigator: Dr. Scott Le Vine, SUNY New Paltz

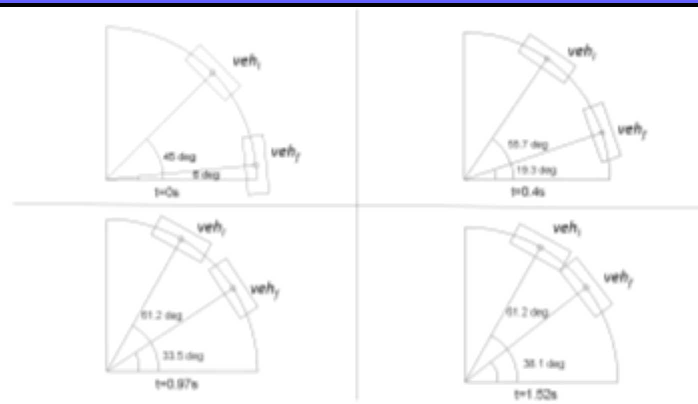
This research has two objectives:

1) To develop algorithms for plausible and legally-justifiable freeway car-following and arterial-street gap acceptance driving behavior for AVs
2) To implement these algorithms on a representative road network, in order to generate representative drive cycles for AVs that are both theoretically-grounded and based on empirical driving conditions.

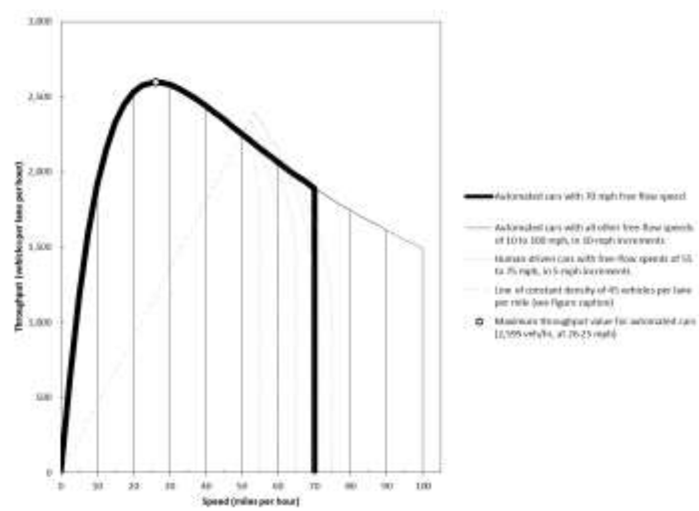
The theory underpinning the colloquial concept of defensive driving is known as Assured Clear Distance Ahead. ACDA-compliant driving strategies were initially implemented for AVs (in the specific context of queue discharge at signalized intersections) in research recently undertaken by the study team. This research focused on two contexts: freeway 'pipeline' and intersection-turning-movements.

Empirically, we demonstrate that automated cars pursuing ACDA-compliant driving strategies would have distinctive ''fundamental diagrams'' (relationships between speed and flow). Our results suggest that such automated-driving strategies (under a baseline set of assumptions) would sustain higher flow rates at free-flow speeds than human drivers, however at higher traffic volumes the rate of degradation in speed due to congestion would be steeper. ACDA-compliant automated cars also would have a higher level of maximum-achievable throughput, though the impact on maximum throughput at free-flow speed depends on the specific interpretation of ACDA. We demonstrate that, under plausible behavioral parameters, AVs appear likely to have positive impacts on throughput of turning traffic streams at intersections, in the range of +0.2% (under the most conservative circumstances) to +43% for a typical turning maneuver. We demonstrate that the primary mechanism of impact of turning radius is its effect on speed, which is likely to be constrained by passenger comfort. Finally, we show heterogeneous per-lane throughput in the case of "double turn lanes."

Results are published Open Access at:
http://dx.doi.org/10.1007/s11116-017-9825-8 and
https://doi.org/10.1155/2018/1879518.



Time-lapse sequence of two left-turning vehicles, with ABS-engaged braking trajectories. Parameters: $r = 50'$, $\beta_l = 45°$, $v = 20$ mph



Speed versus throughput for automated cars (solid curves) under the *Baseline 'Weak' Scenario* and human-driven cars (dashed curves) per the HCM-2010 model (dashed lines; reproduced from TRB 2010, Exhibit 11-2 and 11-3).

Sponsors: University Transportation Research Center, Region 2

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University: State University of New York (SUNY) at New Paltz