# Traffic Collisions Involving Autonomous Vehicles in California: Bayesian Model Based Clustering

**Subasish Das, Ph.D.,** Assoc. Trans. Researcher, Texas A&M Transportation Institute (s-das@tti.tamu.edu)
**Anandi Dutta, Ph.D.,** Senior Lecturer, Dept. of CSE, Ohio State University (dutta.34@osu.edu)
**Ioannis Tsapakis, Ph.D.,** Assoc. Research Scientist, Texas A&M Transportation Institute (i-tsapakis@tti.tamu.edu)

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THE TEXAS A&M UNIVERSITY SYSTEM

Texas A&M Transportation Institute

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## Abstract

- Safety outcomes from AV deployment is a critical issue. Ensuring safety of AVs requires a multi-disciplinary approach which monitors every aspect of these vehicles.

- This study collected all crash reports filed by different manufacturers testing autonomous vehicles in California (September 2014 to May 2019).

- This study demonstrated a variational inference algorithm for Bayesian latent class models.

## Methodology

- Safety outcomes from AV deployment is a critical issue. Ensuring safety of AVs requires a multi-disciplinary approach which monitors every aspect of these vehicles.

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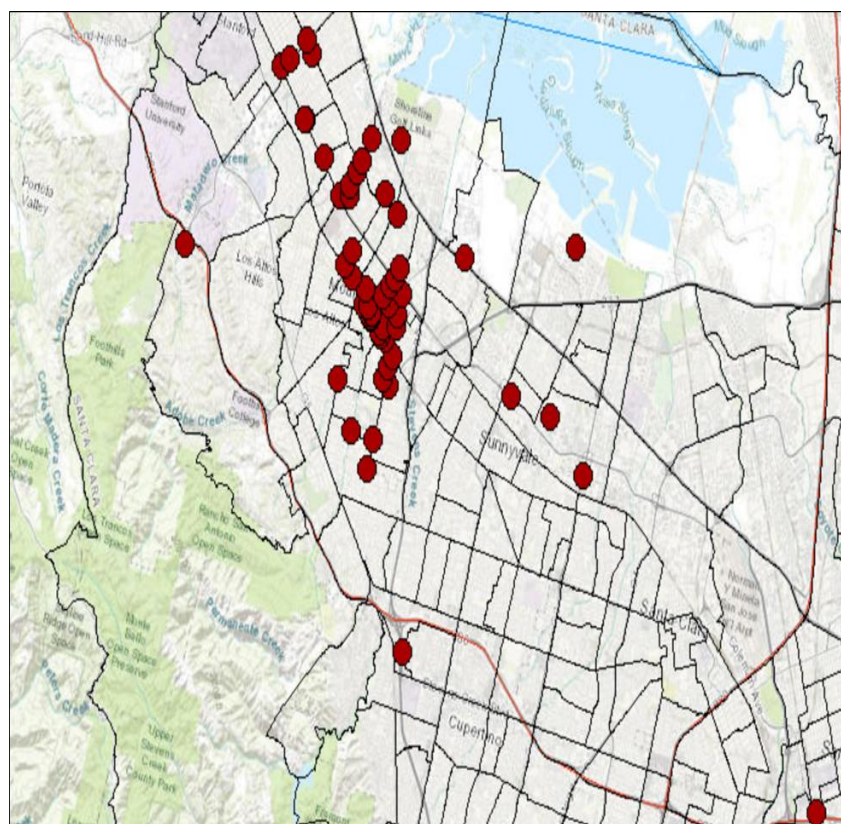


**AV crash locations at Santa Clara**
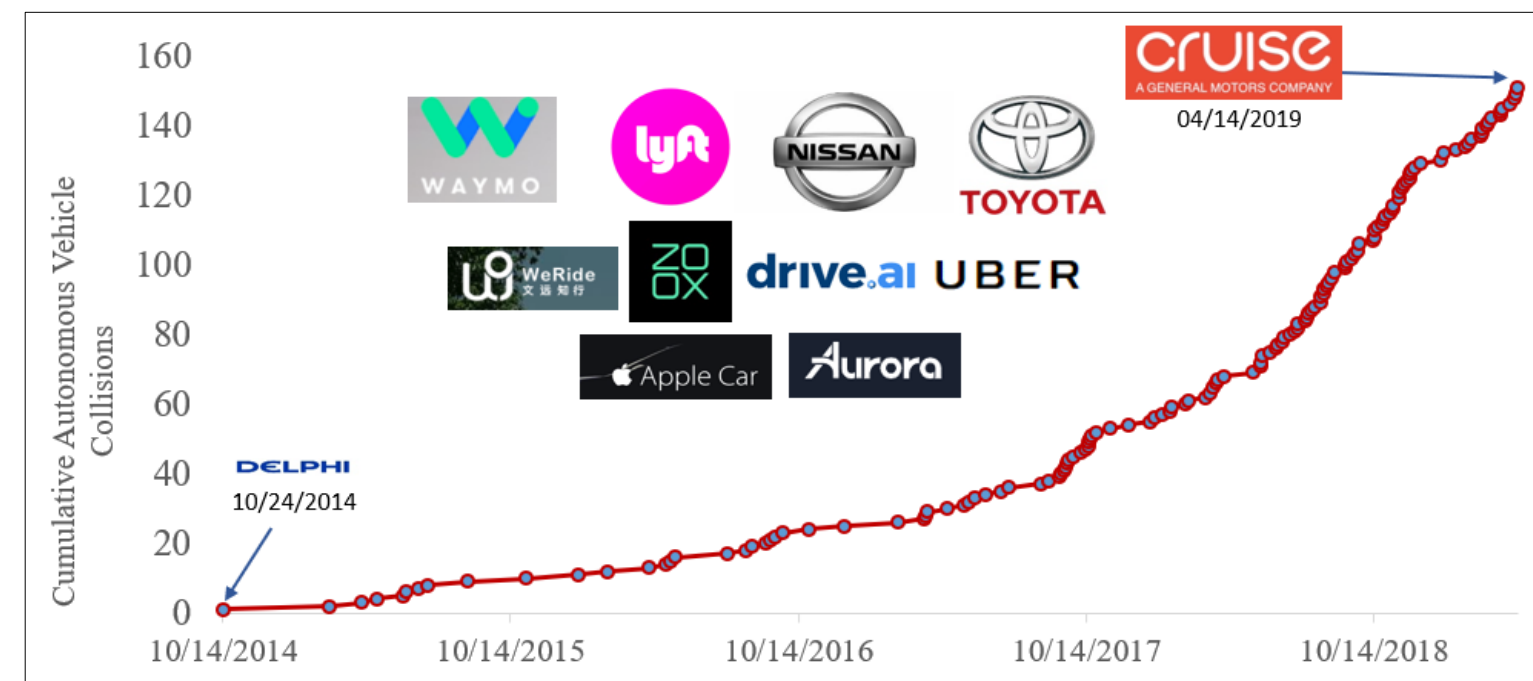


**Cumulative AV collisions in California**
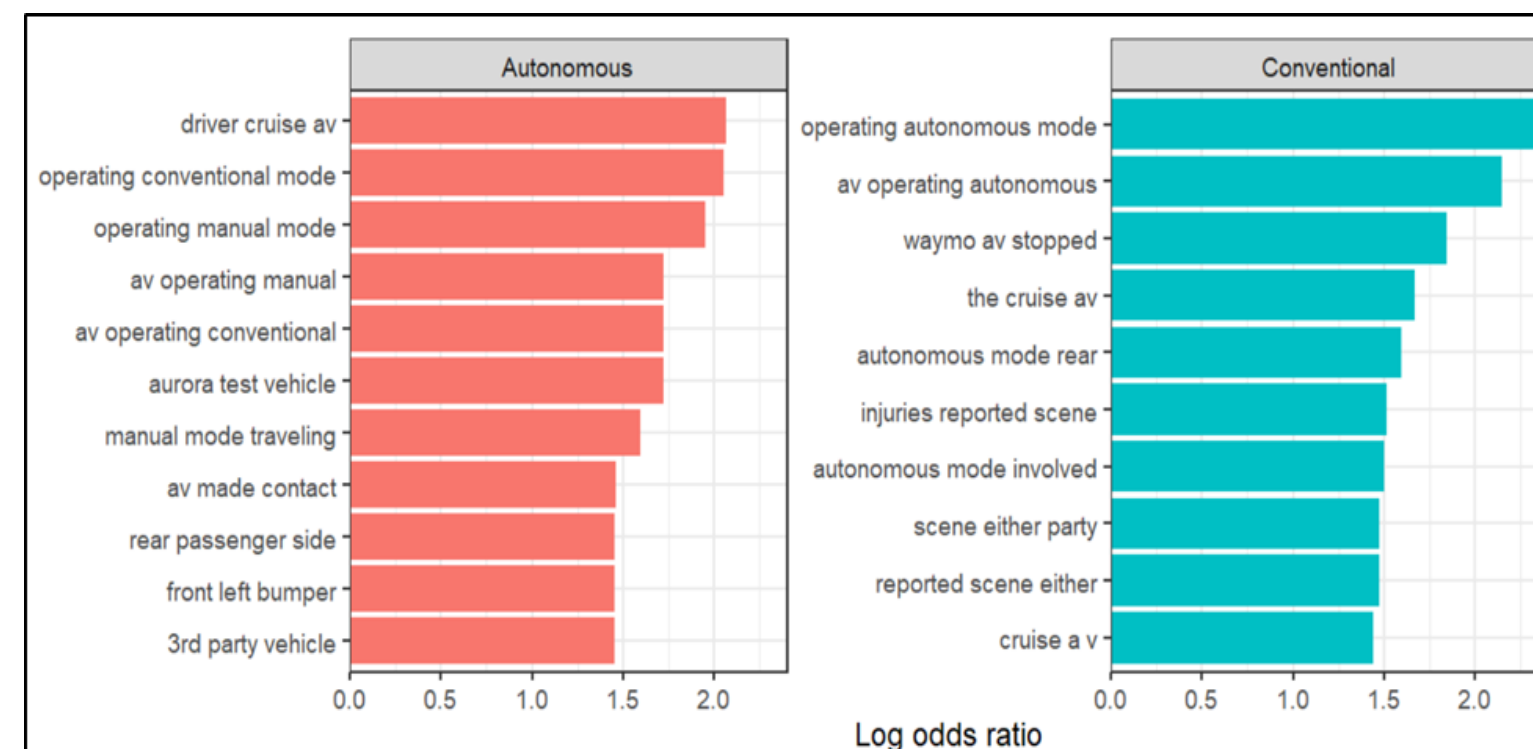


**Traigram bar plots from crash narratives**

## Distribution of Attributes by Classes (partial table on display)

| Attribute | Count | Class 1 (28) | Class 2 (11) | Class 3 (21) | Class 4 (1) | Class 5 (26) | Class 6 (64) |
|---|---|---|---|---|---|---|---|
| **DRIVING MODE** | | | | | | | |
| Autonomous | 89 | 21.35 | 4.49 | 12.36 | 0 | 24.72 | 37.08 |
| Conventional | 62 | 14.52 | 11.29 | 16.13 | 1.61 | 6.45 | 50 |
| **DRIVER SEVERITY** | | | | | | | |
| No | 143 | 19.58 | 7.69 | 11.19 | 0.7 | 16.08 | 44.76 |
| Yes | 8 | 0 | 0 | 62.5 | 0 | 37.5 | 0 |
| **PRIOR EVENT** | | | | | | | |
| Left Turn | 6 | 16.67 | 0 | 50 | 0 | 0 | 33.33 |
| Right Turn | 5 | 0 | 0 | 60 | 0 | 0 | 40 |
| Stopped | 43 | 0 | 0 | 2.33 | 0 | 0 | 97.67 |
| Straight | 25 | 0 | 0 | 56 | 4 | 0 | 40 |
| Other/Unk. | 72 | 37.5 | 15.28 | 0 | 0 | 36.11 | 11.11 |
| **VEHICLE WAS** | | | | | | | |
| Moving | 93 | 10.75 | 9.68 | 21.51 | 1.08 | 27.96 | 29.03 |
| Stopped | 58 | 31.03 | 3.45 | 1.72 | 0 | 0 | 63.79 |

## Conclusions

- A majority of the collision types were a rear-end collision (58 collisions), and the second most common type was sideswipe collisions (17 collisions). The damage level of the vehicle was most commonly minor (63 collisions) or moderate (17 collisions).

- Turning, multi-vehicle collisions, dark lighting conditions with streetlights, and sideswipe and rear-end collisions are associated with a higher proportion of injury severity level.

- When a vehicle was in autonomous mode, there was a high likelihood of adverse weather crash occurrences when the vehicle's prior condition was stopped.

- The crash narrative reports are insufficient to extract insightful information.