# Safety Impact of Connected and Autonomous Vehicles for Older Drivers

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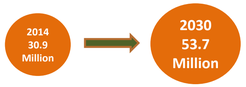
## Motivation

- The U.S population over the age of 65 is projected to grow over the next decades.




- Total crashes with older drivers involved are expected to increase by 178% and those that are fatal with the same cohort are expected to rise by 155% by 2030[1].
- Connected and fully autonomous vehicles (CAVs) are expected to be on the road by 2020.

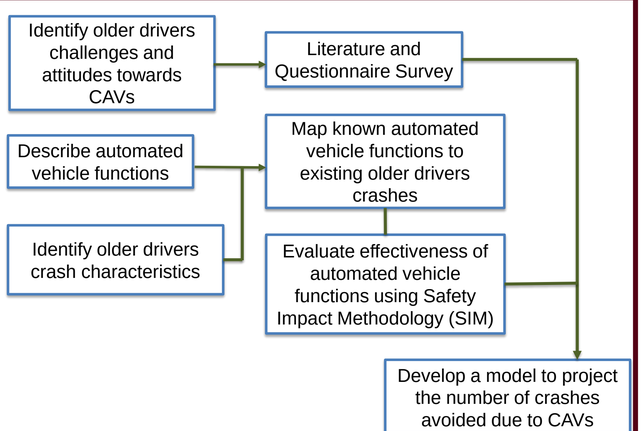
## Goals

- To evaluate effectiveness of CAVs technologies to provide safe and efficient mobility to older drivers.
- To assess on how aging drivers interact with CAVs technologies as well as to determine their attitudes and willingness to use CAVs.
- To develop a model to project future reduction in older drivers' crashes based on the usage of CAVs.

## Background

- Connected and autonomous vehicle technology includes the use of sensors and advanced software for the vehicle to interpret its surroundings and make intelligent decisions on routing and maneuvering.
- Automated vehicles promise to offer extraordinary improvements to both the safety and efficiency of our existing roadways and mobility systems. These benefits promise to be even more profound to aging and transportation disadvantaged populations by providing personal mobility to those who are unable to drive a car.

## Methodology




## Older Drivers Driving Challenges and CAVs

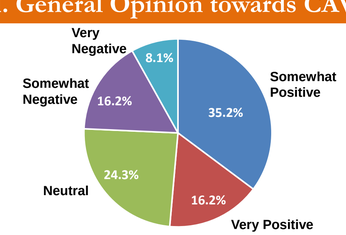
| Age-Related Challenges[2] | Traffic Condition Challenges | Assistance Needed/ CAV Technologies |
|---|---|---|
| Vision | Driving in a bad weather condition and at night. Merging, passing and changing lanes. | Forward Collision Warning, Do Not Pass Warning, and Lane Departure Crash Warning. |
| Memory and speed of processing/making decisions | Driving in heavy traffic and complex traffic scenarios | Cooperative Adaptive Cruise Control and Road Departure Crash Warning. |
| Bones and joints flexibility | Braking, passing and changing lanes | Cooperative Adaptive Cruise Control and Electronic Stability Control |
| Motion perception | Approaching an intersection and correctly judging movements of other road users | Cooperative Intersection Collision Avoidance Systems |

### Automation levels of CAVs

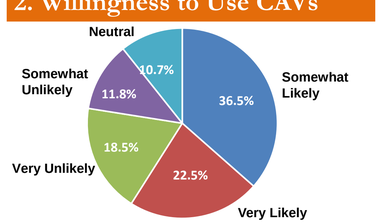

## Older Drivers' Attitudes Towards CAVs

- The results shown below are based on the FDOT survey assessment of Florida residents' attitudes towards autonomous vehicles (AV) in 2015[3].
- 51.4% of respondents reported positive opinion towards the CAVs.
- 59.0% of respondents indicated a willingness to use CAVs.
- 67.6% of respondents reported being familiar with CAVs.
- Overall, Floridians hold positive views about CAV technology.

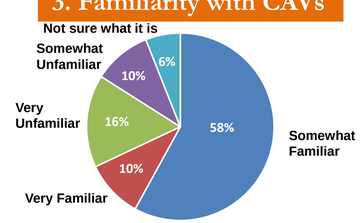
### 1. General Opinion towards CAVs



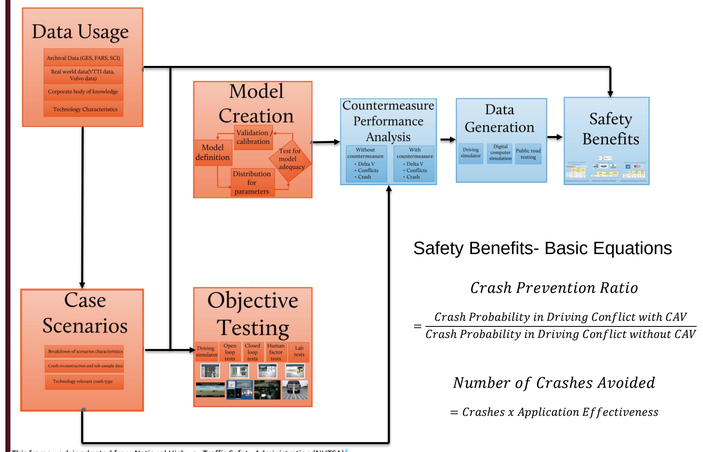

### 2. Willingness to Use CAVs




### 3. Familiarity with CAVs




## Safety Impact Methodology (SIM)




Safety Benefits- Basic Equations

$$\text{Crash Prevention Ratio} = \frac{\text{Crash Probability in Driving Conflict with CAV}}{\text{Crash Probability in Driving Conflict without CAV}}$$

$$\text{Number of Crashes Avoided} = \text{Crashes} \times \text{Application Effectiveness}$$

This framework is adopted from National Highway Traffic Safety Administration (NHTSA)[4]

## Conclusions

- This research will help to affirm the potential of all levels of automated vehicle technology to provide safe and efficient mobility to U.S's growing elderly population and overall population in general.
- It will help agencies and manufactures to invest and to tailor CAV technologies to the needs of aging drivers.
- It will help departments of transportation to plan for the future by promoting the use of CAVs as a solution to the transportation issues faced by aging population.

## Future Plans

- Mapping crash scenarios for older drivers using Florida's crash reports from 2008-2012 to automated vehicle technologies specified in different levels.
- Using SIM framework to estimate safety benefits for pre-crash avoidance technologies in CAVs.
- To develop a model to project future reduction in older drivers' crashes based on the usage of CAVs and estimate the crash-related savings from CAV applications.

## References

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[2]Motamedi, S., Reis, G. F., & Wang, H. J. (2017). Understanding Older Adult Drivers Driving Challenges and Finding In-Vehicle Technology to Ease These Challenges. Proceedings of the Transportation Research Board 96th Annual Meeting, Paper no. 17-03613. Washington, D.C.

[3]Duncan et.al. (2015). Enhanced Mobility for Aging Populations Using Automated Vehicles. Tallahassee: *Florida Department of Transportation.*

[4]Funke, J., Srinivasan, G., Ranganathan, R., & Burgett, A. (2011). Safety Impact Methodology (SIM): Application and Results of the Advanced Crash Avoidance Technologies (ACAT) Program. Proceedings of the 22nd International Technical Conference on the Enhanced Safety of Vehicles (ESV). Paper no. 11-0367-O. Washington, D.C.

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