

Better than 'Average': Potential Crash Rate Standards for Automated Vehicles

Poster number: 21-01736

Noah Goodall, Ph.D., P.E.



Introduction

How safe should an automated vehicle be?

'Safer than the average driver' is insufficient, as national crash rates include drunk and distracted driving. An 'average' AV is somewhere between drunk and sober.

Better sources for crash rate targets:

1. Model human driving (sober, rested, attentive) from naturalistic driving studies
2. Stated preference surveys
3. Transit crash rates

Proposed benchmarks can serve as targets for industry and regulators.

Model Human Driving

Crash Rates and Odds Ratios from SHRP 2 Naturalistic Driving Study

Driver Status	Crashes per 100 Million Vehicle-Miles	Odds Ratio to Model Driving
All Driving	2020	1.5
Sober	2010	1.5
Rested	2007	1.5
Non-impaired	1954	1.5
Cautious	1479	1.1
Attentive	1350	1.0
Model Driving	1347	1.0
Child in rear seat	673	0.5

Stated Preference Surveys

Literature is hard to interpret as respondents routinely underestimate their *own* crash rates.

A 40th percentile driver who thinks they are at the 70th percentile may say they want a 90th percentile AV, but really only want 20 points higher than themselves, i.e., a 60th percentile AV.

Safety by Travel Mode

Crash, Injury, and Fatality Rates by Transportation Mode

Mode	Per Unit Distance			Per Unit Time		
	Crashes / 100 M VMT	Occupant Injuries / 100 M PMT	Occupant Fatalities / 100 M PMT	Crashes / 100 M VHT	Occupant Injuries / 100 M PHT	Occupant Fatalities / 100 M PHT
Passenger cars	213.9	29.9	0.28	5,946	831.7	7.9
Motorcycles	546.3	375.9	20.27	13,385	9,210.5	496.6
Large trucks	130.8	9.4	0.24	5,885	421.2	10.5
Buses	408.4	5.1	0.015	4,655	57.8	0.18
Commercial air	0.37	0.003	0.001	161	1.5	0.52
Pedestrians	-	208.6	14.7	-	688.4	48.5
Cyclists	-	599	8.65	-	3,893	56.2
Passenger rail	-	6.7	0.034	-	155	0.8
Elevators	-	993	0.74	-	1,523	1.1
Escalator	-	1944	0.50	-	1957	0.51

Proposed Benchmarks

Potential Crash, Injury, and Fatality Rate Safety Standards for Automated Vehicles

Exposure Metric	Safety Metric	Passenger cars	20% safer	Model driving, 33% safer	Tolerable, 80% safer	Broadly acceptable, 99% safer	Buses for comparison
100 M VMT	All Crashes	2020	1616	1347	404	20	-
	PR Crashes	214	171	137	43	2.1	408
	Non-occupant injuries	36	29	24	7.3	0.36	70
100 M VHT	Non-occupant fatalities	0.8	0.6	0.5	0.2	0.008	1.6
	PR Crashes	5946	4757	3964	1189	59	4656
	Non-occupant injuries	1013	810	675	203	10	803
100 M PMT	Non-occupant fatalities	21	17	14	4.2	0.21	18
	Occupant Injuries	30	24	20	6.0	0.3	4.9
100 M PHT	Occupant Fatalities	0.28	0.23	0.19	0.057	0.003	0.015
	Occupant Injuries	832	665	554	166	8.3	56
	Occupant Fatalities	7.9	6.3	5.3	1.6	0.079	0.18