



P.O. Box 29537
St. Louis, MO 63126
(314) 753-2301

www.sltar.com



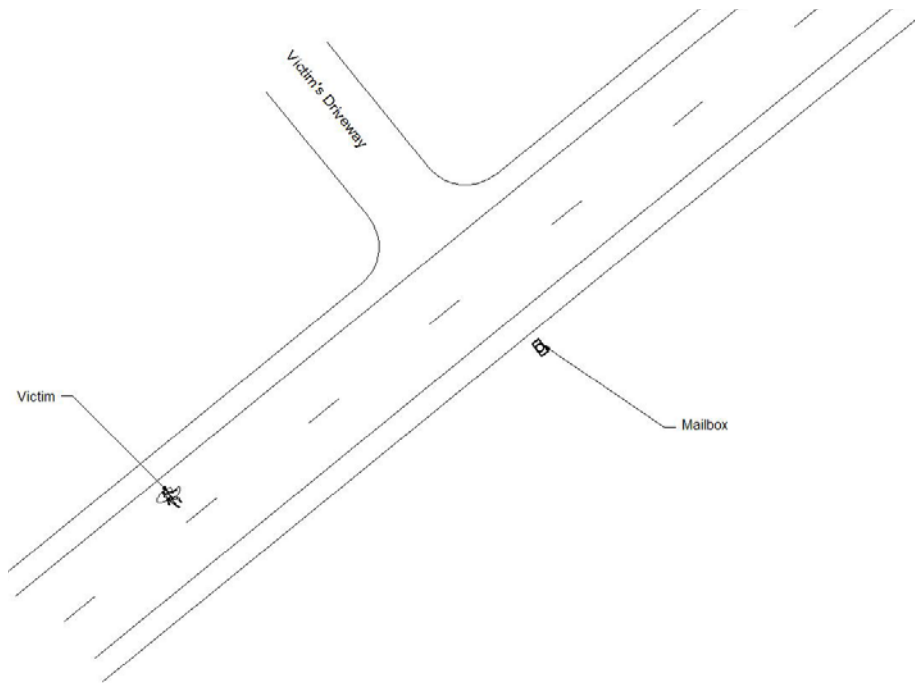
Dealing with Uncertainty in Pedestrian Collisions

Pedestrian cases often produce very little physical evidence. You'll be able to see damage to the vehicle and perhaps have some evidence where the victim came to rest, but most times it's very difficult to identify where they were struck with any precision. At the scene, you're looking for something along the lines of a shoe scuff which can be difficult to detect on the pavement, especially at night. So, how do you deal with this uncertainty? Below, you'll find a hypothetical case to which we will apply the Monte Carlo method of analysis in order to demonstrate what can be known within a reasonable degree of certainty, about this collision.

Scenario

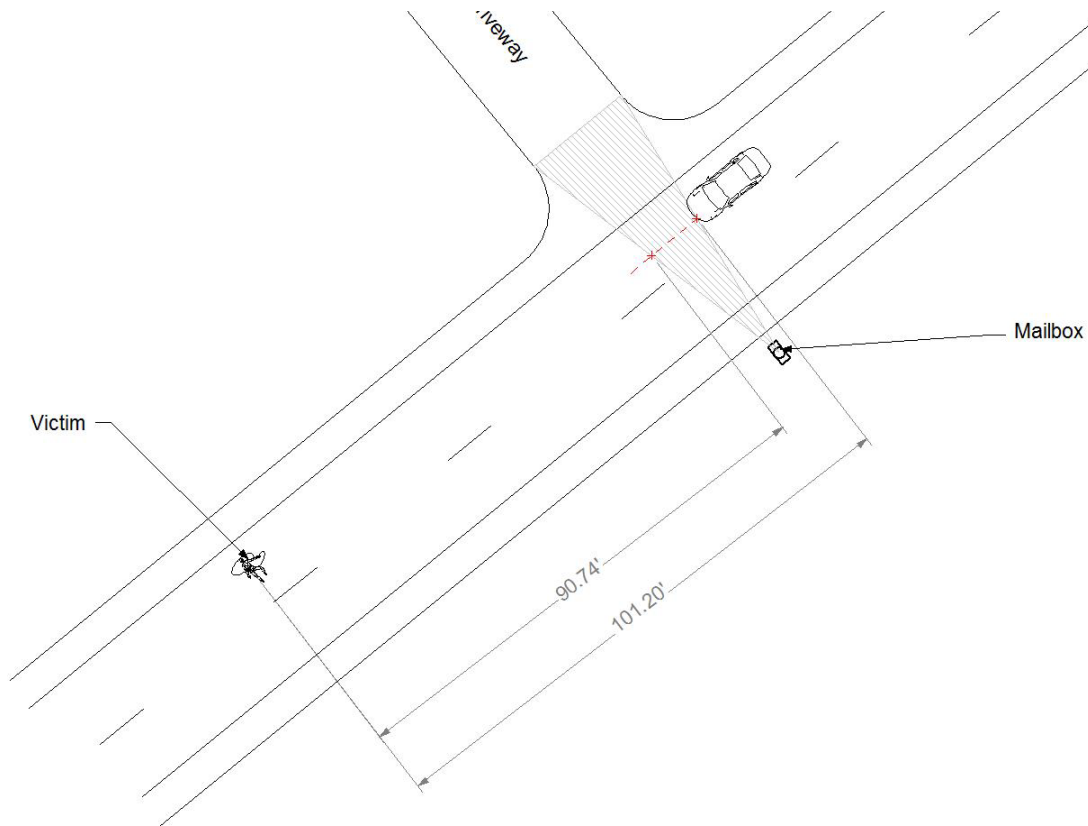
A pedestrian walks across a roadway at night to pick up mail from his box on the other side of the roadway opposite his driveway. It is overcast and there is no artificial lighting present other than the headlights from the approaching vehicle. The approaching driver fails to detect the pedestrian. The pedestrian is struck at a point 2 ft from the left front corner of the 2006 Chevy Impala and thrown forwards, coming to rest in the southbound lane. The posted speed limit is 45 mph. The pedestrian was wearing moderate contrast clothing. The driver was arrested for suspicion of DUI and subsequent toxicology revealed a BAC of 0.21.

Was alcohol a contributing factor to this collision?



Analysis

In order to calculate the impact speed using the Searle formula, the overall throw distance from impact to rest is required. We don't have any physical evidence in the roadway to indicate where the impact occurred. However, we can create a reasonable range by drawing a path from the limits of the driveway to the mailbox. Then we can look at where the path of the approaching vehicle intersects this area to develop a range of locations for impact.



We also need to conduct a time/distance study since both the pedestrian and vehicle are moving. If we know the speed of each, we can calculate the position of the Impala when the pedestrian crosses the fog line. Searle will give us the speed of the vehicle. Research will give us a range of walking speeds for the pedestrian.

T Morris © CSS, LLC

Check for Headlight Beam ONLY (Use L to R)

Left to Right ▾

Crossing 90 degrees ▾

Crossing Time (sec)

Vehicle Speed (MPH)

Pre-Impact Steer/Decel Dist (ft)

Vehicle Deceleration factor (Gs)

Grade (i.e. Down 2% = -0.02)

Headlight Type

Moderate Gray or Modest contrast 0.3 fc

Select Material

Select Percentile

Obj. Ht. (in.) [See BULLOUGH]

Veh Pre-Impact Maneuver Time

HdLite Beam	Dist L / R	Response Time
-26.0		13.8 sec
-24.0		12.8 sec
-22.0		11.8 sec
-20.0		0.0
-18.0		0.0
-16.0		0.0
-14.0		0.0
-12.0		0.0
-10.0		0.0
-8.0		0.0
-6.0		0.0
-4.0		0.0
-2.0		0.0
0.0		0.0
2.0		0.0
4.0		0.0
6.0		0.0
8.0		0.0
10.0		0.0
12.0		0.0
14.0		0.0
16.0		0.0
18.0		0.0
20.0		0.0
22.0		0.0
24.0		0.0
26.0		0.0

The 0 location on horizontal axis is the left front of the vehicle.

No. Mapped: 6
Statified random sample by vehicle type & year

Headlight Illuminated:
249 feet before impact.

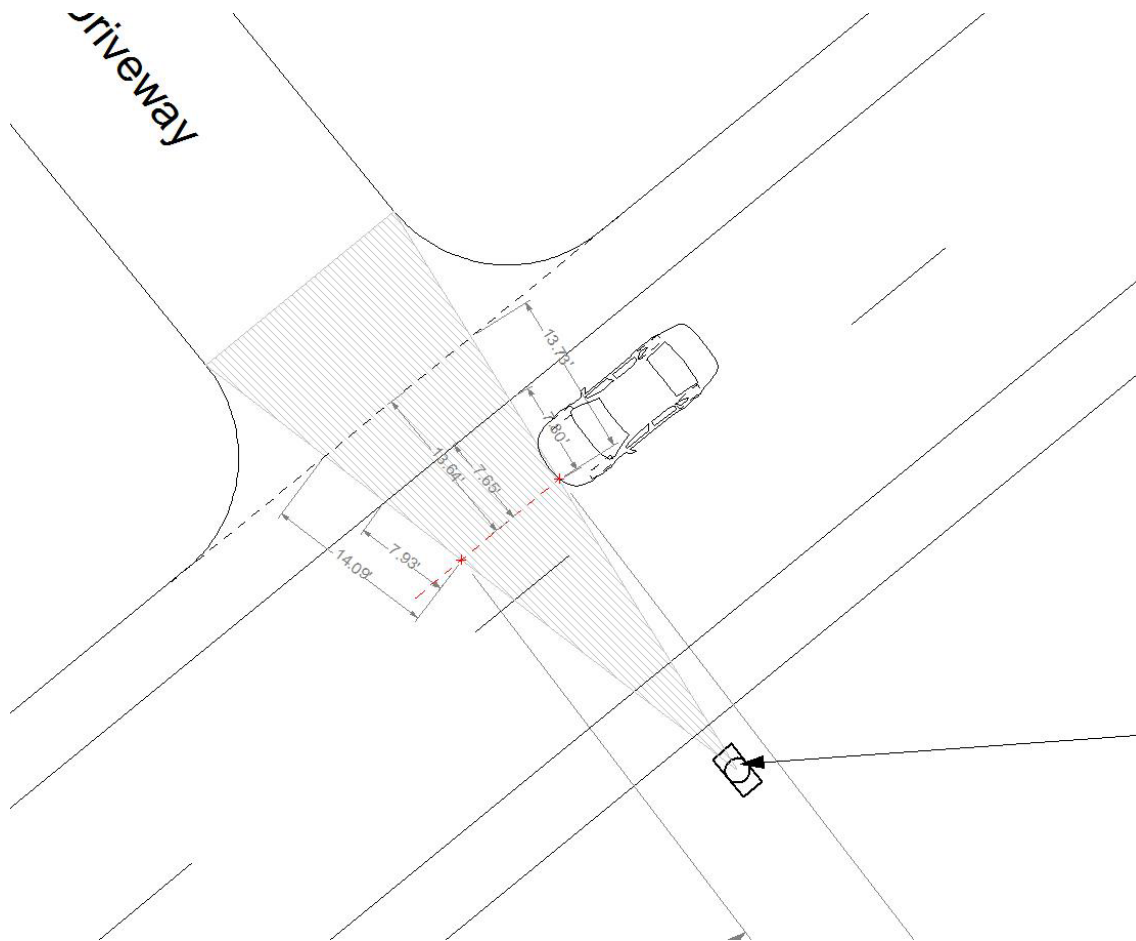
Response Time from Headlight Beam = Headlight Beam Dist / (Speed x Convers) - Pre-Impact Response Time
Response Time from Headlight Beam = 248 / (45 x 1.467) - 0.2

Perception Response Time 3.6 seconds from the point the object entered the headlight beam in roadway.
(If negative, the driver responded before the object entered the headlight beam)

A Total Station measuring system and an NIST certified and calibrated illuminance meter were used to map 6 vehicle headlight beams which included 'H 7 - 13 Series - Low Beam'. Light meter readings were taken at 0.3 foot-candles (3.2 Lux) and at heights of 1 m (39 inches), 0.6 m (24 inches) and ground height. The beam shape represents the peak illumination distance regardless of height. Illuminance measurements are then calculated using the Inverse Square Law (Illumination = Intensity / Distance squared) or the new distance squared = (3.2 x distance squared) divided by the new illumination. The measurements were taken of random vehicles with no pre-measurement modifications (as-is). The purpose of the research was to determine the average illuminance beam pattern for this type vehicle headlight if taken from the street. Equally valuable is the knowledge of how on-street vehicles headlights vary. This analysis shows the beam pattern that is better than 50% of vehicle headlights mapped.

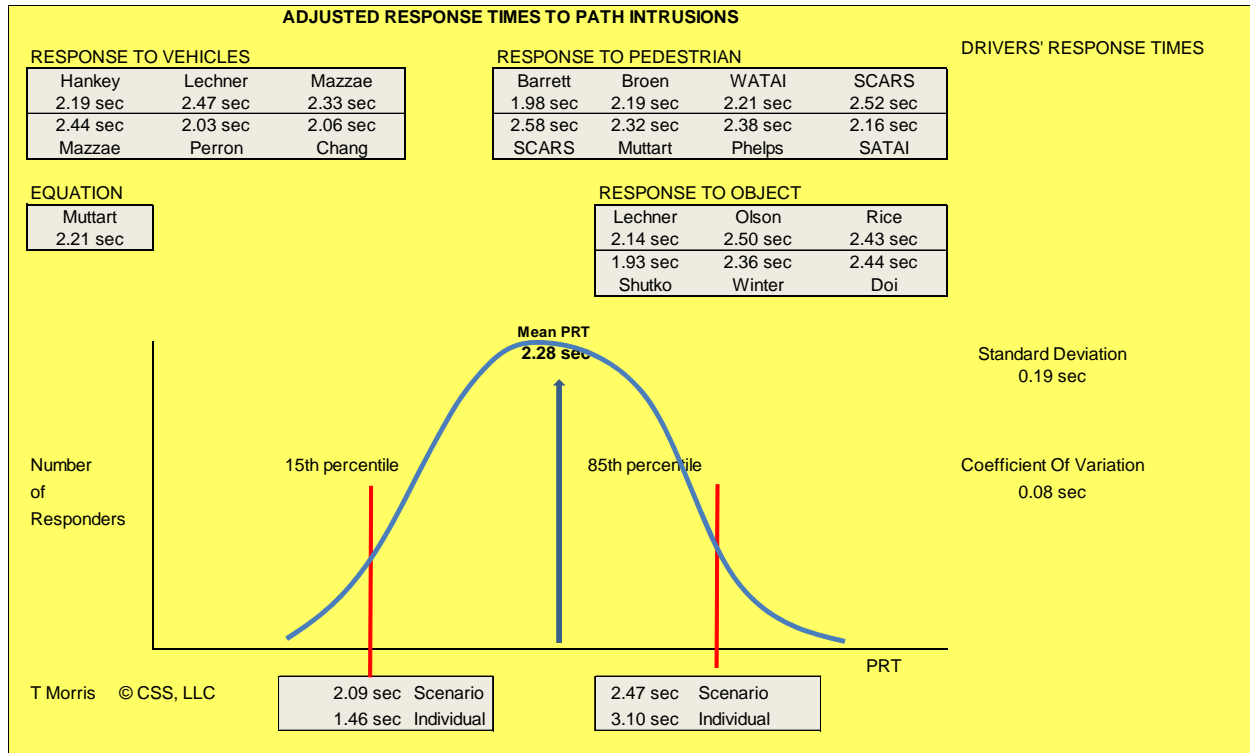
Now we can put the model to work.

Observing a pedestrian walking in a driveway may only be viewed by an approaching driver as a potential hazard. This is one which draws some attention to the subject but doesn't quite yet trigger an emergency response. Therefore, the response only starts when the driver would identify the pedestrian as an immediate hazard requiring an emergency response. This could occur as the pedestrian crosses the edge of the roadway or the fog line. For purposes of the analysis, this will establish our range of interest. Based upon the potential angles and lateral location within the driveway, the min/max distances traveled by the pedestrian can be determined. The time to impact from the detection point will determine the vehicle distance to impact when the driver's response should begin.



The distance we use to evaluate the evasive maneuver is dependent upon whether or not the pedestrian is illuminated at the time he's identified as an immediate hazard.

We identify the mean perception response time from research and calculate the total stopping distance for each trial. Although our driver failed to respond to the hazard, some of our simulations will include braking prior to reaching the pedestrian's travel path. Since the pedestrian need only travel another 2 feet to avoid contact, we must consider whether the braking in the simulated trials allows the pedestrian the additional time required to clear the path. We will also evaluate a decision to steer left or right.



Conclusions from 15,000 Monte Carlo Trials

- There is a 95% probability that the speed of the vehicle was traveling between 36 and 44 mph.
- There is a 99.8% probability that V1 was traveling below the speed limit.
- 99.98% of drivers who braked would have struck the pedestrian.
- 99.975% of drivers who steered left would have struck the pedestrian.
- 99.353% of drivers who steered right would have struck the pedestrian.
- Overall probability of a vehicle striking the pedestrian under these conditions is 99.972%
- The probability that a pedestrian would have attempted to cross the roadway under these conditions was less than 2%.
- The probability that another driver would have responded faster than this driver was only 12%.

Now we can go back and examine our original question. Driving under the influence was undoubtedly a criminal act but in no way contributed to this collision. If 99.972% of sober drivers would have struck the pedestrian, any delayed response due to alcohol was immaterial unless it can be somehow demonstrated that this individual, when unimpaired, was in the top 0.028% of all drivers.