C19 Air Bag Control Module Response to Multiple Vehicle Impacts

Kurt D. Weiss, BSMS, MSME, Automotive Safety Research, Inc., 5350 Hollister Avenue, Suite D, Santa Barbara, CA 93111-2326; Holly A. Adams, BSME, Automotive Safety Analysis, 12015 Cantor Lane, Reston, VA 20191*

After attending this presentation, attendees will understand how the timing between impacts, even minor ones, can explain the nondeployment of a frontal airbag in an event that is clearly above the deployment threshold.

This presentation will impact the forensic community and/or humanity by demonstrating the analysis of timing between multiple vehicle impacts, and the ability of airbag control modules to adequately protect vehicle occupants in these common situations.

THEORY OF THE ANALYSIS: The primary function of an airbag control module is to predict impact severity, and to deploy the airbags when necessary. However, when vehicles are exposed to two impacts in close succession, the airbag control module may not be able to recognize the more severe second impact. Without the benefit of a supplemental inflatable restraint, the seat belted driver can sustain significant head and facial injuries. This paper discusses the phasing of two impacts during which the vehicle's airbags did not deploy.

Prior to a tree impact, a vehicle veered sharply to the right and struck a curb at the roadway edge. The vehicle's momentum was sufficient enough for front wheels to rise over the curb. After the curb impact, the vehicle was involved in a more severe second collision with a tree having a diameter of approximately 15 inches. This tree impact caused considerable property damage to the front centerline of the vehicle. As a result of the tree impact, the driver's head forcefully struck the steering wheel rim. The steering wheel rim was deformed, and both shear capsules were completely separated. The driver sustained a severe laceration to the forehead requiring reconstructive surgery. Witness statements supported by physical evidence on the seat belt system indicate the driver was wearing the available 3-point lap and shoulder belt at the time of collision. However, the airbags did not deploy.

Collision data retrieved from the vehicle's Sensing and Diagnostic Module (SDM) indicated a pre-impact speed of approximately 22 miles per hour. A near deployment event was recorded by the SDM with a maximum velocity change of 0.21 miles per hour at 35 milliseconds after the sensing algorithm was activated (AE). A near deployment event is an impact that is not severe enough to warrant activation of the airbags, but initiates the computer's crash discrimination algorithm. This near deployment event is consistent with the collision severity of a curb strike.

A geometric analysis of the roadside dimensions was undertaken. Based on vehicle specifications, the relative approach angle to the curb, and the location of the tree, the vehicle traveled approximately 5.4 to 7.9 feet between the curb and tree impacts. The time between these two impacts was approximately 168 to 245 milliseconds. Based on the recorded data, the SDM was actively analyzing the crash for 40 ms. Therefore, there was only approximately 128 to 205 milliseconds of time for the SDM to record, reset and resume collision detection before impact with the tree.

Based on published specifications of microprocessors of the type in this vehicle, it takes approximately 10 ms to write a byte of data, and the time required for system reset is approximately 200 to 500 milliseconds. There are a total of 80 bytes of data stored in a near deployment record, of which 56 contained a value other than $FF (the unwritten value). Therefore, the vehicle struck the tree when the SDM was continuing to reset. As a result, the SDM was unable to evaluate the second collision within adequate time to command the deployment of the airbags. The injuries sustained by the driver in this impact would have been significantly reduced by the added protection of an airbag.

Air Bag, Multiple Impacts, Timing

 ** Presenting Author*