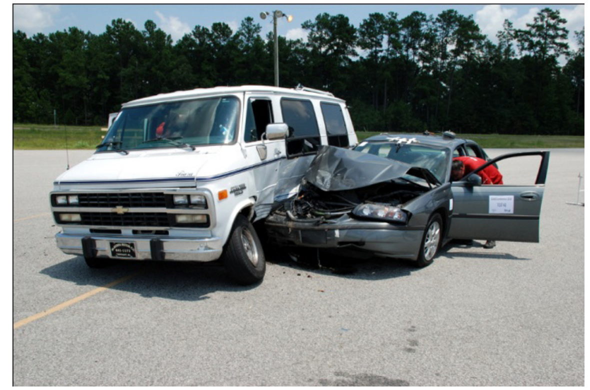
From July 26 through July 29 of this year, I was in Charleston, South Carolina, for the SCARS conference, usually held annually. There was no conference last year; because of economic considerations, there weren't enough people who wanted to attend to justify it. This year, there were about 50 in attendance, including speakers, which was barely enough to make the event feasible. On Monday, we crashed vehicles in the sweltering heat. The most dramatic of the crash photographs is the one to the right of this text.

This crash involved a Chevrolet Impala being driven by remote control into a three-quarter-ton Chevrolet conversion van. Impact was deliberately at an angle and involved the middle of the left side of the van and its left front wheel. The photograph above was taken a few milliseconds after impact and shows the right front wheel of the van off the pavement. When it came back down, that tire was debeaded, and the outer flange of the rim removed a crescent-moon-shaped divot from the asphalt pavement. The photograph to the right shows the vehicles at rest, with a member of the crash crew removing instruments and data recorders.

Staged collisions provide a wealth of information. The simultaneous use of laboratory-grade instrumentation verifies the general accuracy of the accelerometers incorporated into the airbag control modules, and numerical analysis of the crash data and comparison with the recorded data verify the accuracy and validity of the methods used to reconstruct collisions in the real world, where pre-impact speeds weren't documented (except, now, by event data recorders in some cases in some vehicles). Observations of vehicle damages from known speeds help make initial assessments during field investigations. The documented crashes also help with establishment and/or documentation of more subtle factors, like coefficient of restitution, which is an element of vehicular collisions but whose value is generally unknown for a real-world collision. And, it's fun for accident reconstructionists to crash vehicles!

There were other staged collisions. In the first, a Ford Crown Victoria was driven into the rear of a Chevrolet Cavalier which was parked inline with a Saturn sedan. The right front of the Ford hit the left rear of the Cavalier, driving it at an angle into the right rear of the Saturn. The Impala into the van was the second staged collision of the day. The third staged collision of the day was a Ford Crown Victoria driven head-on into the front of a Ford Contour. Each car was instrumented, so that we would have data showing acceleration as a function of time and, therefore, delta-v. A session on the last day presented the data from all staged collisions that had been conducted on Monday and summaries of the data analysis of each.

There were other sessions and speakers. I gave a talk on basic physics principles for the accident reconstructionist, with heavy emphasis on conservation of linear momentum and critical



speed yaw. I touched on the topics of coefficient of restitution, angular momentum, radius of gyration, precession, and a few related topics. I felt compelled to address both linear momentum and angular momentum topics because of a misconception among a few reconstructionists that application of conservation of linear momentum was angular momentum because it involved angles. I gave just enough information about angular momentum to convince them that they don't want to go there! It gets very complicated very quickly.

Another presentation involved Principal Direction of Force (PDOF), dealing with what it meant, how it was determined, and some current confusing "standard" methods of measuring or describing the angle of that direction. One of the presenters showed various methods of obtaining crush coefficients for late-model vehicles which have been crash tested. A lengthy presentation involved the topic of human factors, and particularly the perception-response times to be expected under varying conditions and factors. Those perception-response times have been studied in laboratories and by reviewing videos of real-world crashes such that there is now a substantial database giving consistent results in the perception-response times of a wide range of drivers in the same situations. One of the points made in the talk is that, although young people have quicker reaction times than older people, the experienced driver is often as fast as the young driver in total perception-response time and is more likely to make a decision that provides the most favorable outcome.

A lengthy and interesting talk came from a Georgia State Trooper who was reporting on some experiments conducted by the Georgia State Patrol to validate what is commonly called spin analysis. Vehicles often rotate during post-impact travel, usually with no brakes applied. They are obviously losing speed as they spin, but generally not at the same rate as if they were skidding with brakes applied. There are computer models for spin analysis, but they do not lend themselves to manual calculation because of the time involved. For decades, many accident reconstructionists have simply applied some reduction factor to the post-collision spin; i.e., that the speed loss in spinning was (for instance) 70 percent of the speed loss if the vehicle had been skidding with brakes applied. In **Fundamentals of Traffic Crash Reconstruction** (John Daily, Nathan Shigemura, and Jeremy Daily, published by the Institute of Police Technology and Management, University of North Florida, Jacksonville: 2006) a method of evaluating the speed lost in post-impact spinning by using a drawing and manual calculations was presented. This has been tested by the Georgia State Patrol; in each case, a vehicle was placed into a spin from a documented speed, the spin path was documented, and the spin analysis method was applied. In each case, the calculated speed loss was equal to or slightly less than the speed of the car when it was placed into that spin. He also had some documented case studies of real-world crashes in which spin analysis had been applied and had yielded speed calculations consistent with speeds that had been independently determined by other means (such as event data recorders in the crashed vehicles or critical speed yaw analysis of the yaw preceding the spin).

In August, I attended another week-long training session on Bosch Crash Data Retrieval System technology, which also was held in Charleston, SC. The CDR software is at version 3.5, with a patch in progress. Almost all light trucks and cars now made in America by General Motors, Ford, and Chrysler have event data recorder (EDR) capabilities included in their airbag control modules (ACMs), and most of the newest models will capture pre-crash data, data related to non-deployment events above a certain level, multiple events, and longitudinal and transverse data. Some also have yaw and rollover data. The newest modules are very close to compliance to the NHTSA regulation which will apply to all 2013-model-year vehicles and later models: 49CFR563. Due primarily to that NHTSA regulation, many other manufacturers are in talks with Bosch to interface the EDRs in their ACMs with the current Bosch CDR system, which has already been around and in use for over ten years, but Bosch has not released the names of any of those other manufacturers. The Federal regulation does not require that all manufacturers include EDRs in their ACMs, but it does require that, for those who do, the recorded set of data must include specified elements, and the data must be accessible by non-proprietary means. Because (collectively) the NHTSA is Bosch's biggest consumer of CDR kits, by far, that agency is strongly urging manufacturers to work with Bosch to develop access through the Bosch system already in use. If each currently non-Bosch-accessible manufacturer develops its own crash data retrieval system, the NHTSA may end up having to buy 140 kits for each of the ten (or so) such brands. And imagine how tedious it would be to have to carry the Bosch CDR system and ten other kits into the field to reconstruct a collision! The current cost for a complete Bosch CDR system with a three-year software license is over $6400. That's just for the Bosch components; the purchaser still has to have his own compatible computer and whatever tools are necessary to gain access to the various components in the vehicles. Imagine the headaches that will result if each manufacturer wants to market its own brand of crash data retrieval hardware and software. This is purely speculation on my part—I have no inside information—but I strongly suspect that the next manufacturer who will be providing access through the Bosch CDR system is Toyota. It appears to me that their recent problems with data available only with and by their proprietary equipment, which equipment they had to produce in large numbers and distribute in this country because of consumer unrest, will cause them to realize that their technicians should be spending time fixing cars, not accessing crash data. I'm sure their associated expenditure in manpower for data downloads has now exceeded their investment in hardware and software for crash data retrieval equipment.

I hope you enjoyed my newsletter. Call anytime you have a vehicle-related question.

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