ABS  Anti-lock braking system.

accelerometer  A transducer commonly used in electronic sensors. The device generates a signal in accordance to the acceleration experienced by the sensor unit. The signal is then fed into the electronic circuit for processing.

AHRS  Adjustable head restraint system.

airbag deployment process  The sequence of an air bag deployment cycle. From the start of a collision, it takes generally 10–50 milliseconds for the crash sensors to determine if it is a situation requiring air bag deployment. After the sensing system yields a trigger signal, the inflator takes 30–60 milliseconds to fill the bag to a fully inflated state. Then the air exits from the bag through the vent holes, and the bag becomes deflated within 75–150 milliseconds. The exact timing depends on crash conditions and system specifications, but the whole process lasts only 0.2–0.3 seconds.

airbag module  Typically referring to a packaged unit containing the inflator and the air bag itself.

A-pillar  Structural member forming the forward corner of the cab or passenger compartment. In structural analysis, the pillar may be assumed to include adjacent (contingent) parts of the door frame. Also A-post [1].

ASV  Advanced safety vehicles, a Japanese research program.

B-pillar  Nominally vertical structural support of the roof of a vehicle, against which the front door closes. Also B-post; central pillar [1].

crash data  A time series of acceleration and other related data obtained in a crash test. Measuring devices are often installed on multiple locations of a vehicle and the dummies seated inside the vehicle during a crash test.

crash duration  A time period during which the crash event occurs with significant and observable deceleration occurring to the subject vehicle. The period is typically 80 to 150 milliseconds long for light-duty passenger cars in common crashes.
crash library  A collective set of crash data obtained from a variety of crash tests.
crash sensors  A single or multiple units of devices installed on a vehicle to detect collisions and to initiate the deployment of occupant restraints.
crush-dependent sensing  A crash sensing concept based on the crush or deformation experienced at one or more locations on a vehicle.
discriminating sensor  A crash sensor designed to discriminate crashes between non-deployment and deployment situations.
distributed sensing system  A crash sensing system with multiple units of sensing devices located at different locations of a vehicle. Air bag deployment often requires the simultaneous triggering of more than one sensor in a distributed system.
DOT  Department of Transportation.
ECU  See electronic control unit.
electronic control unit (ECU)  A unit in a sensing system, often abbreviated as ECU, that monitors sensor status and controls sensing functions. In an electronic single-point system, ECU also contains crash sensors within the unit.
electronic crash sensor  A type of crash sensor, which contains a signal-generating transducer and electronic circuits that process such signals to determine if a crash of pre-programmed severity occurs. The processing procedures and criteria embedded in the circuitry are often called sensing algorithms.
EMI  Electro-magnetic interference.
g  Commonly used unit for acceleration measurement. One g is equal to 9.8 m/s$^2$ or 32.2 ft/s$^2$.
HPS  Head protection system (BMW).
IIHS  Insurance Institute for Highway Safety.
JPL  Jet Propulsion Laboratory.
mechanical crash sensor  A type of crash sensor, which relies on the mechanical movement of components within the sensor to determine if a crash of certain severity occurs. The motion of the moving element may cause sensor triggering by releasing a mechanism, bridging a circuit, or closing a switch.
MY  Model Year.
NASA  National Aeronautics and Space Administration.
OEM  Original equipment manufacturer.
OOP  Out of position. See out-of-position occupant.
OPC  Occupant performance criterion.
out-of-position occupant  Occupant who is too close to the airbag module or improperly seated when airbag deployment occurs. Probabilities of deployment-induced injuries are high in such situations.

occupant sensing  Sensing devices installed in the interior of a vehicle to determine the size, weight, position, or other status indicators regarding occupants. These devices are used as part of advanced restraint systems that can adjust the deployment of restraints based on occupant and crash conditions.

passive occupant restraints  Safety apparatus deployed automatically for restraining occupant motions when collisions occur. Standard equipment for current model vehicles includes three-point seat belts and air bags.

PAV  Pyrotechnically actuated venting.

PRM  Passive retracting module.

SAE  Society of Automotive Engineers.

safing (arming) sensor  A type of crash sensor that acts as a safety switch in a sensing system. A safing or arming sensor can be used as part of a distributed system to ensure the closure of a discriminating sensor is accompanied by another sensor. It can also be used in conjunction with electronic sensors to rule out electronic-magnetic interference as a cause of faulty sensor triggering. The general purpose of safing or arming sensors is to prevent inadvertent deployment.

sensor triggering (firing) time (STT)  The time instant when crash sensors indicate an “ON” status or release a mechanism for the recognition of a crash of predetermined severity. Sensor triggering typically occurs within 10–20 milliseconds from the onset of a severe crash, such as a 30–35 mph head-on barrier impact, or within 40–50 milliseconds in mild crashes, such as a 10–20 mph collision. The sensor firing time varies with vehicle crash characteristics, types of crashes, and design settings of a sensing system.

single-point sensing system  A crash sensing system with its function performed at one single location, typically in the passenger compartment.

SIPSBAG  Side impact protection system bag (Volvo).

SOMS  Seat occupancy monitoring system (BMW).

speed-dependent sensing  A crash sensing concept based on the speed or speed change experienced at one or more locations on a vehicle.

STT  See sensor triggering (firing) time.

T5 - 30  5 inch – 30 millisecond criterion.

TEA-21  Transportation Equity Act for the 21st Century.

TTF  Time to fire.

TTT  Time to trigger.
Reference

Bibliography

This section contains a list of publications that are relevant to the topics addressed in this book. Specific references cited in various sections of the book already have been given at the end of each chapter. The list below covers a wider collection of publications which may be useful for readers who are interested in exploring the related subjects further. The list is arranged in reverse chronological order with the papers having the latest dates appearing first.

With the availability of internet and computerized databases, searching for information has never been easier than it is today. For example, a search conducted by the author at a local university using the Applied Science and Technology Index and Engineering Index with “airbag” as the key word came up with more than 500 articles and papers published in the last 25 years. But as comprehensive as this number may seem, these publications only represent a small fraction of those that have been written on this subject.

Even though many readers have the ability and opportunity to conduct a specialized or general search of information by themselves, the selected list of references provided here offers a quick review of the types of sources and interesting topics. The publications selected are those that most frequently contain crash-sensing-related materials.

The selection should serve two purposes. One is to provide a service for readers who are limited by time to do such a search. The other is to review how the topics have evolved over the years in the course of airbag developments.

Recently, National Highway Traffic Safety Administration (NHTSA) has developed a website at www.nhtsa.dot.gov with specific pages for airbag-related issues. Readers who are interested in regulations, statistics, press releases, and news should visit that site often for new developments. To conduct a search of related patents and inventions, refer to the website of the Patent and Trademark Office at www.uspto.gov.
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Dr. Chan is a member of the Society of Automotive Engineers (SAE), the American Society of Mechanical Engineers (ASME), and the Institute of Electrical and Electronics Engineers (IEEE). He is also a certified Professional Engineer in California. He teaches professional courses on crash sensing technologies for SAE on a regular basis and has produced with SAE a video tutorial on the same subject.