A Compendium of Current Supplier and Automaker Positions on the Implementation of Advanced Driver Assistance Systems

The wide-spread implementation of Advanced Driver Assistance Systems (ADAS), otherwise known as Driver Assist Technology (DAT), will revolutionize the concept of driving and automotive products liability. These technologies are the first steps towards autonomous driving. ADAS is not just some idealized goal to be accomplished in the future, but it is happening right now. Although we might best classify ADAS as within the first stage of implementation, automotive manufacturers and suppliers are moving quickly to get this technology on the road. It is expected there will be more than 100,000 autonomous cars on American highways by 2025. Nissan Motor Co., for example, said last summer that it will have the technology ready to start selling a self-driving car by 2020. A driving force accelerating the trend will be new government mandates for vehicle-to-vehicle communication technologies that are intended to improve safety. But, as the automotive industry has shown; flaws and defects in vehicles continue, although they may be slightly different types of defects as to the structural type defects in years past. The legal profession, with AIEG leading the way, as it has always done, will play a critical role in protecting the American public, and holding the automotive industry accountable when their vehicles fail and harm the public. This article will highlight the different types of ADAS and DAT along with the current and anticipated implementation programs of a variety of leading automotive manufacturers and suppliers. Included at the end of the article is a list of DAT currently in production and the DAT sections of various manufacturers websites.

Acceleration, Braking, and Pre-Collision Systems

Adaptive Cruise Control (ACC) is a cruise control system that automatically engages the vehicle’s brakes and acceleration to control the distance between the driver and other vehicles or objects on the road. For example, when the cruise control is set on the highway and a slower moving car merges ahead, your vehicle will automatically engage the brakes to prevent or mitigate a collision. When that car merges back over, the ACC system will bring your vehicle back up to speed. TRW’s system utilizes a 24 GHz ISM frequency band radar sensor to detect relative speeds between a vehicle and object in the road. Their system also provides both distance and collision warnings to the driver. Bosch is currently also producing ACC systems, and manufacturers such as Infiniti, BMW, Opel, Cadillac, Jeep, Dodge, Ford, and Toyota have already designed their newest models with this safety feature.

The “Stop & Go” function, which is actually a sub-system of ACC, is designed for use in traffic jams, and will automatically accelerate, steer within the same lane, and bring the vehicle to a stop. The driver’s vehicle will basically follow the vehicle in front of it as long as it is in the same lane. Accordingly, when the Stop & Go feature is engaged in a traffic jam and a vehicle ahead merges into a separate lane, your vehicle will begin to follow the next-in-line forward vehicle. The system developed by Bosch will automatically activate, when the ACC function is being used, at speeds below 20 mph. Bosch has stated that “[i]n the following years, the system will be enhanced to cover
ever-faster speeds and more complex driving situations, including automatic lane change.” Manufacturers including BMW and Jeep are currently utilizing this feature in their 2014 production line.

Forward Collision Warning (FCW) is a camera-based or radar-based system that utilizes object recognition and speed detection to determine whether the relative speed between a vehicle and object in the road presents a risk of impending collision. A camera-based system uses a mounted camera with object recognition on the windshield behind the rearview mirror, and the radar-based system uses a 24 GHz medium-range sensor connected to a warning device. TRW, Bosch, and HELLA are currently producing these systems. Infiniti, BMW, Opel, Mercedes, Cadillac, Jeep, Honda, Dodge, and Ford have already begun implementing FCW into their latest models.

In conjunction with FCW, the Automatic Emergency Braking System (AEBS) or Predictive Emergency Braking System (PEBS) activates automatically when the FCW system determines that the distance between the driver and a vehicle or object in road is becoming critically short. When a critical situation is detected, the system may alert the driver, may initiate partial braking, and may prepare the brakes for emergency stopping in such a way that the driver may engage full braking potential as soon as the slightest pressure is applied to the brake pedal. Suppliers currently producing this technology include TRW and Bosch. Manufacturers currently implementing this technology include Infiniti, Opel, Mercedes, Cadillac, Jeep, Hyundai, Dodge, and Toyota.

As a subsystem of AEBS or PEBS, Pedestrian Detection systems warn the driver or automatically engage emergency braking when pedestrians are detected in the same lane as the vehicle or to be moving dangerously into this direction. Bosch is currently manufacturing Pedestrian Detection systems. BMW and Toyota are currently implementing this technology.

Also in conjunction with FCW, suppliers and manufacturers are working on adaptive restraint systems and other pre-crash systems. TRW, for example, is currently producing the Active Control Retractor (ACR), a system that provides full or limited reversible belt retraction when dangerous situations are detected. In addition, Mercedes has implemented a system called Pre-Safe® into their latest line of production, a system which automatically engages when an imminent collision is detected and prepares the vehicle’s occupants by tightening the front seat belts, adjusting the front head restraints and passenger seats, and closing the windows and sunroof.

**Lateral Safety Systems**

Lane Assist systems, such as Lane Departure Warning (LDW), Lane Keeping Assist (LKA), and Lane Centering Assist (LCA), are designed to promote lateral safety. LDW is a camera-based system that provides a driver with visual, audio, or haptic (involving a vibrating steering wheel or seat) warning when the driver’s vehicle unintentionally crosses a road lane marking or the edge of the road. LKA is also a camera-based system and is designed to utilize electronically powered steering to provide counter-steering
torque to assist the driver in moving back into the center of the lane. LCA is essentially an LKA system, except that its purpose is to continually assist the driver in keeping the vehicle in the center of the lane. To prevent misuse of the system for autonomous driving, both the LKA and LCA employ hands-off detection systems. Furthermore, for safety reasons, both the LKA and LCA are designed to be easily overruled by the driver. Automotive suppliers producing this technology include TRW and HELLA. Manufacturers currently implementing Lane Assist technology include Infiniti, BMW, Opel, Mercedes, Cadillac, Jeep, Hyundai, Honda, Ford, and Toyota.

In addition to the Lane Assist systems, Side View Assist (SVA) systems promote lateral safety by continually monitoring a range of area alongside and diagonally to the rear of the vehicle through an ultrasonic sensor. When another vehicle is situated in the monitored area, a warning LED light may display in the driver’s side mirror. If the driver uses a turn signal while a vehicle is in the monitored area, an audible warning will activate. The SVA system is not activated by stationary roadside objects, such as guardrails, poles, or parked vehicles. Bosch is currently producing SVA systems, and manufacturers including Infiniti, Opel, Mercedes, Cadillac, Jeep, Hyundai, Honda, and Ford, have implemented similar technology into their current line of production.

**Parking Assist Systems**

Parking Assist systems, such as Bosch’s Rear View System, Parking Assistant, Parking Aid, and Rear Cross Traffic Alert, are all designed to promote safe backing up techniques. The Rear View System complements a normal rear-view camera with an ultrasonic sensor, giving the driver the ability to see an image of what is behind the vehicle as well as the distances of objects behind the vehicle. Parking Assistant utilizes an ultrasonic sensor and calculates the best path into a parking spot. Once found, the system alerts the driver to press a button to park. The driver will still have to engage the gas and brakes, but the steering will be hands-free. Parking Aid gives the driver an alert when ultrasonic sensors in the front and rear of the vehicle detect an object within 250cm of the vehicle. The Rear Cross Traffic Alert system issues an audible or visual warning to the driver when the vehicle is backing out of a parking space and other vehicles are crossing to the right or left behind the driver’s vehicle. In addition to Bosch, HELLA is also currently producing Parking Assist systems. Manufacturers including Infiniti, BMW, Opel, Cadillac, Jeep, Hyundai, Dodge, and Ford currently provide one or more of these Parking Assist systems into their latest production line.

**Advanced Lighting Systems**

Intelligent Headlight Control systems utilize a video camera to measure ambient brightness and estimate the distance from vehicles in front and oncoming traffic. Bosch’s system includes three different functions: the driver may set the high beams to switch on or off automatically depending on whether other vehicles are detected; the driver may set the high beams to continually adjust between low and high beam levels depending on the distance between the driver’s vehicle and other vehicles; or the driver may set the high beams so that they automatically tilt either vertically or horizontally depending on where
other vehicles are located. BMW, Opel, Mercedes, Cadillac, Honda, and Toyota currently manufacture automobiles with a similar feature as an option.

Night vision systems utilize either an active infrared light invisible to humans or a thermographic camera to provide the driver on a video screen the ability to see greater distance than is possible with conventional low beam lights. Bosch is currently producing an active system, and manufacturers such as BMW, Mercedes, and Toyota currently feature night vision technology in their vehicles.

**Additional Features**

Road Sign Recognition systems utilize a video camera to detect speed limit road signs and then display the speed limit in the form of a symbol in the cockpit of the vehicle. The driver has an option to employ an audible warning when the vehicle’s speed exceeds the speed limit. Bosch has indicated that in the future they expect the system they produce to detect other road signs in addition to speed limits. BMW, Opel, and Honda currently manufacture vehicles with similar Road Sign Recognition technology.

Driver Drowsiness Detection is a system that identifies when a driver does not steer for a brief period of time and then makes an abrupt correction to the steering. The system analyzes the frequency and strength of the driver’s reactions, as well as other data such as vehicle speed, time of day and use of other indicators, to calculate a threshold for when to engage warning signals. Warning signals may be visual or audible to remind the driver of the danger of nodding off at the wheel. Currently Bosch is producing this technology, and manufacturers including Ford and Mercedes are implementing it.

The current position of automobile manufacturers and component suppliers as it relates to ADAS or DAT is that the technology is already on the road. While there is certainly more to come in terms of advances in road technology, 2014 will make for a huge step in what is actually being implemented into production vehicles.
I. TRW

A. Forward Collision Warning (FCW)
   i. A camera-based or radar-based system that utilizes object recognition and speed detection to determine whether the relative speeds between a vehicle and object in the road presents a risk of impending collision.
   ii. The camera-based system uses a mounted camera with object recognition on the windshield behind the rearview mirror.
   iii. The radar-based system uses a 24 GHz medium-range sensor connected to a warning device.

B. Adaptive Cruise Control (ACC)
   i. Utilizes a 24 GHz ISM frequency band radar sensor to detect relative speeds between a vehicle and object in the road.
   ii. Provides distance and collision warnings to the driver.
   iii. When used in conjunction with Collision Mitigation Braking (CMB), drivers are able to avoid collisions at speeds up to 20 Km/h (roughly 12.5 Mph), or reduce collision impact speed by 20 Km/h.

C. Lateral Support (LDW/LKA/LCA)
   i. Lane Departure Warning (LDW) is a camera-based system that provides a driver with visual, audio, or haptic (involving a vibrating steering wheel) warning when the driver’s vehicle crosses a road lane marking or the edge of the road.
   ii. Lane Keeping Assist (LKA) is a camera-based system utilizing electronically powered steering to provide counter-steering torque to assist the driver in moving back into the center of the lane.
   iii. Lane Centering Assist (LCA) is a camera-based system utilizing electronically powered steering to provide support for the driver in keeping the vehicle in the center of the lane.
   iv. Both LKA and LCA employ hands-off detection systems to avoid misuse of the system for autonomous driving. For safety reasons, both systems are also designed to be easily overruled by the driver.

D. Automatic Emergency Braking (AEB)
   i. Used to “slow the vehicle down and potentially mitigate the severity of an impact when a collision is unavoidable.”
   ii. Works with or without driver intervention, although provides maximum braking when the driver engages the brakes.
   iii. “AEB is the highest escalation step for a safety system to react to a critical situation.”

E. Steering Torque Control (STC)
   i. Oversteer Control Assist helps by “coaching” the driver during hard cornering or rapid lane changes by generating steering torque.
   ii. Enhanced Split μ Assist combined the braking and steering systems to maximize vehicle stability and potentially reduce stopping distance when the brakes are engaged.

F. Adaptive Restraints
   i. The Active Control Retractor (ACR) provides full or limited reversible belt retraction in dangerous situations.
G. Pre-Crash Systems
i. TRW is working on passive-safety pre-crash systems, such as pre-crash activation of the Active Control Retractor.

H. GPS-Based Safety
i. TRW is working on an integration of adaptive restraint systems with GPS to provide foresighted and curve-predictive control.

II. Bosch
A. Traffic Jam Assist
i. When the ACC “stop & go” is turned on, the system is able to detect dense traffic by comparing the speeds of surrounding cars with the driver’s own vehicle. When dense traffic is detected, the user may press a button and the vehicle will automatically accelerate, brake, and steer within the same lane.

ii. “The first generation of traffic jam assist is expected to enter series production in 2014. In the following years, the system will be enhanced to cover ever-faster speeds and more complex driving situations, including automatic lane change.”

B. Side View Assist
i. An ultrasonic-based system for monitoring a range of three meters alongside and diagonally to the rear of the vehicle.

ii. When another vehicle is situated in the monitored area, a warning LED light will display on the driver’s side mirror. If the driver uses a turn signal while a vehicle is in the monitored area, an audible warning will activate.

iii. The system is not activated by stationary roadside objects, such as guardrails, poles, or parked vehicles.

C. Rear View System
i. Essentially, a rear-view camera is complemented by an ultrasonic parking aid so that the driver will be able to see what is behind the vehicle, and will be given the precise distances of objects behind the vehicle.

D. Parking Assistant
i. Utilizing an ultrasonic sensor, the system calculates the best path into a parking spot and alerts the driver to press a button to park. The driver will still have to engage the gas and brakes, but the parking will be hands-free.

E. Parking Aid
i. Utilizing ultrasonic sensors in the front and rear of the vehicle, the system alerts the driver when an object comes within 250cm of the vehicle.

F. Nightvision Plus
i. An active infrared night vision system that provides the driver on a video screen the ability to see approximately three times further than is possible with conventional low beam lights.

G. Road Sign Recognition
i. A video camera detects speed limit road signs and displays the speed limit in the form of a symbol in the cockpit of the vehicle.

ii. The driver has an option to employ an audible warning when the vehicle’s speed exceeds the speed limit.

iii. In the future, Bosch expects the system to detect other road signs in addition to speed limits.

H. Intelligent Headlight Control
i. Utilizes a video camera to measure ambient brightness and estimate the distance from vehicles in front and oncoming traffic.

ii. Three different functions: first, the driver may set the high beams to switch on or off automatically depending on whether other vehicles are detected; second, the driver may set the high beams to continually adjust between low and high beam levels depending on the distance between the driver’s vehicle and other vehicles; third, the driver may set the high beams so that they automatically tilt either vertically or horizontally depending on where other vehicles are located.

I. Adaptive Cruise Control
i. Standard ACC operates at speeds between approximately 20 mph and 125 mph. “Stop & Go” Acc (for traffic jam assist) functions at speeds below 20 mph.

J. Driver Drowsiness Detection
i. The system identifies when the driver does not steer for a brief period of time and then makes an abrupt correction, and then analyzes the frequency and strength of these reactions with other data such as vehicle speed, time of day and use of other indicators to calculate a “tiredness index.” A visual or audible warning will be given to remind the driver of the danger of nodding off at the wheel.

K. Predictive Emergency Braking System
i. The system continuously analyzes traffic to determine whether the distance between the driver and a vehicle or object in front is becoming critically short. When a critical situation is detected, the system may alert the driver, may initiate partial braking, and may prepare the breaks for emergency stopping in such a way that the driver may engage full braking potential even when less pressure is given the brake pedal.

L. Lane Assist Systems
i. Warns the driver when the vehicle unintentionally drifts into another lane, and warns the driver when there are vehicles in a critical area to changing lanes.

M. Rear Cross Traffic Alert
i. Issues an audible or visual warning to the driver when the driver is backing out of a parking space and other vehicles crossing to the right or left behind the driver’s vehicle are detected.

N. Construction Zone Assist
i. Warns the driver when driving through narrow lanes and the driver’s vehicle comes within critical distance of other vehicles, guard rails,
and barriers. May also initiate automatic steering or braking for correction.

O. Predictive Pedestrian Protection
   i. Warns the driver or initiates emergency braking when the system detects pedestrians in the same lane as the vehicle or moving dangerously into this direction.

III. HELLA
   A. Lane Change Assist
   B. Rear Active Safety
   C. Rear Cross Traffic Alert
   D. Distance Warning Sensor

IV. Continental AG
   A. Short Range Radar Sensors
      i. Will launch production for use in systems such as Blind Spot Detection, Rear Cross Traffic Alert, Lane Departure Warning, Intelligent Headlamp Control, and Traffic Sign Recognition.

V. Infiniti
   A. Lane Departure Prevention (with Active Lane Control)
   B. Predictive Forward Collision Warning
   C. Direct Adaptive Steering
   D. Backup Collision Intervention
   E. Blind Spot Intervention
   F. Around View Monitor (for parking)
   G. Blind Spot Warning
   H. Intelligent Cruise Control
   I. Intelligent Brake Assist with Forward Collision Warning
   J. Lane Departure Prevention
   K. Distance Control Technology

VI. BMW
   A. Traffic Jam Assist
   B. Night Vision
   C. Park Assistant
   D. High Beam Assistant
   E. Traffic Sign Detection
   F. Lane Departure Warning
   G. Collision Warning
   H. Pedestrian Warning
   I. Active Cruise Control with Stop & Go

VII. Opel
   A. Traffic Sign Recognition
   B. Lane Departure Warning
   C. Opel Eye Image Processing
      i. Recognizing road signs and creates an image of the sign on the vehicle display.
   D. Adaptive Cruise Control
   E. Following Distance Indication
i. Activated automatically at speeds from 40 km/h, directly measures the distance to the vehicle ahead up to 150 meters.

ii. When within a range of 60 meters from the car ahead, the central car display shows the corresponding distance value in seconds.

F. Forward Collision Alert
G. Collision Imminent Braking
H. Adaptive Forward Lighting
   i. Headlamps automatically adapt to driving and road conditions by changing intensity and range.
I. High Beam Light Assistant
J. Side Blind Spot Alert
K. Advanced Park Assist

VIII. Mercedes
   A. PRE-SAFE®
      i. When the system detects an imminent collision, PRE-SAFE prepares the vehicle’s occupants by tightening the front seat belts, adjusting the front head restraints and passenger seats, and closing the windows and sunroof.

B. DISTRONIC PLUS
   i. When the system detects an imminent collision, the brakes engage automatically up to 40% braking power. When the driver engages the brakes, 100% braking pressure is applied instantly.

C. Attention Assist (drowsiness detection)
D. Active Blind Spot Assist
E. Active Lane Keeping Assist
F. Adaptive Highbeam Assist
G. Night View Assist PLUS
H. Active Full-LED Headlamps

IX. Cadillac
   A. Rear Automatic Braking
   B. Adaptive Cruise Control
   C. Intelligent Brake Assist
   D. Forward Collision Alert
   E. Safety Alert Seat
   F. Automatic Collision Preparation
   G. Lane Departure Warning
   H. Side Blind Zone Alert
   I. Rear Cross Traffic Alert
   J. Adaptive Forward Lighting

X. Chrysler
   A. Adaptive Cruise Control with Stop & Go
   B. Blind Spot Monitoring
   C. Forward Collision Warning with Active Braking
   D. Lane Departure Warning with Lane Keep Assist
   E. Perpendicular Park Assist
   F. Rear Back Up Camera
XI. Hyundai
   A. Brake Assist
   B. Front and Rear Parking Assistance
   C. Automatic Emergency Braking
   D. Blind Spot Detection
   E. Rear Cross Traffic Alert
   F. Lane Change Assist
   G. Lane Departure Warning
   H. Lane Keep Assist

XII. Honda
    A. City-Brake Active System
    B. Forward Collision Warning
    C. High Beam Support
    D. Traffic Sign Recognition
    E. Blind Spot Information
    F. Cross Traffic Monitor
    G. Lane Departure Warning

XIII. Dodge
     A. Adaptive Cruise Control
     B. Forward Collision Warning
     C. Back-Up Assistance
     D. Brake Assist
        i. Detects when the driver engages the brakes for a critical situation and boosts power to the brakes as needed.
     E. Rain Brake Support
        i. Removes water from the brake pads.
     F. Ready-Alert Braking
        i. Prepares the brakes for an emergency.
     G. Electronic Stability Control
        i. When extreme maneuvering is detected, this system applies the brakes and reduces engine throttle to help maintain directional control.
     H. Rain-Sensing Wipers

XIV. Ford
     A. Blind Spot Information
     B. Cross-Traffic Alert
     C. Electric Power-Assisted Steering
     D. Park Assist
     E. Adaptive Cruise Control
     F. Lane-Keeping Assist
     G. Forward Collision Warning

XV. Toyota
    A. Lane Departure Warning
    B. Lane Keeping Assist
    C. Brake Assist
    D. Vehicle Stability Control
    E. Adaptive Cruise Control
F. Adaptive Front-Lighting
G. Night Vision
H. Approaching Pedestrian Warning

TOYOTA:
http://corporatenews.pressroom.toyota.com/releases/toyota+advanced+driving+
support+system+technology.htm
http://www.toyota-global.com/innovation/safety_technology/safety_technology/technology_file/
active/lka.html

FORD:
expedition-with-ecoboost-engine--advanced-tech

DODGE

HELLA
http://www.prnewswire.com/news-releases/hella-driver-assistance-systems-
now-on-audi-chrysler-llc-vehicles-58793387.html

HONDA
http://hondanews.com/channels/issue-brief/releases/2792e86b-320c-4247-906d-e9004c34be8e?query=safety

HYUNDAI

CHRYSLER

CADILLAC
http://media.gm.com/media/us/en/cadillac/news.detail.html/content/Pages/new
s/us/en/2013/Feb/0226-cadillac.html
http://media.cadillac.com/media/us/en/cadillac/news.detail.html/content/Pages

MERCEDES
https://www.mbusa.com/mercedes/benz/safety

AUDI
http://audiusanews.com/newsroom.do;jsessionid=F09EED56191C0FB114406565112A949C?&id=26&allImage=1&name=safety-driver-assistance&mid=114

OPEL

BMW

CONTINENTAL AG

BOSCH
http://www.bosch-automotivetechnology.com/en/de/driving_safety/driving_safety_systems_for_passenger_cars_1/driver_assistance_systems/driver_assistance_systems_2.html

VOLKSWAGEN

INFINITI
http://www.infinitiusa.com/now/technology

TRW
http://www.trw.com/integrated_systems/driver_assist_systems