Hyundai’s Woong-chul Yang on Auto Electronics

This month we conducted a written interview with Woong-chul Yang, vice chairman of R&D for Hyundai Motor’s Automotive Sector. Dr. Yang’s responsibilities cover a wide range of automotive electronics from infotainment, to cloud computing, software and standards, to autonomous and electric vehicles.

Dr. Yang earned his Ph.D. in mechanical and design engineering from the University of California, Davis in 1986. He was a research engineer at the Korea Institute of Science and Technology and in 1987 began working for Ford, where he spent the next 17 years, leaving as a senior technical specialist in Ford’s R&D division. Moving back to South Korea in 2004, he became a leader in the field of alternative powertrains and head of Hyundai’s Electronics R&D Center. He later became president of the Hyundai Motor R&D Center in Namyang.

Q. What is Hyundai’s most pressing need, and can suppliers help?

A. Bringing the information technology industry into the vehicle. We want to provide seamless connectivity, but the industry changes so fast it’s hard to provide the right features at the right time. We are trying to shorten the development period through standardization and modularization, but with so many phone models pouring into the market, we are struggling to assure reliability of the Bluetooth pairing.

Q. What are the biggest obstacles to advances in the state of the art of electrical and electronics engineering?

A. Software development capability—with the growing importance of software, it is required at both the OEM and supplier level. We continue to hire software specialists, and we have developed core

Turn to Hyundai, page 8

Germans Committed to 12/48-Volt Battery System

Production to Begin in 2016

After two prior attempts by the automotive industry to increase vehicle battery voltage—once in the early 1990s and again nearly a decade later—48-volt systems are definitely headed to production, thanks to the efforts of the German Five carmakers, Porsche, Volkswagen, Audi, BMW and Daimler.

“We have finally come to a point where there is no alternative but to go to the next level,” said Audi’s top electrical engineer, Ricky Hudi. He explained how the decision to add 48 volts was not based on a single argument: “One [argument] is surely that the total energy demand in the car now exceeds the three-kilowatt capability of the 12-volt generator. Therefore, we are planning to have a 48-volt generator with MOSFET electronics that goes up to 8-10 kilowatts. That gives us an energy infrastructure in the car with enough headroom for years to come.

“Another reason is you can realize a very comfortable start-stop mechanism. You can keep the air conditioning running while you are in stop mode in traffic. And you can take advantage of the maximum [brake] recuperation available.”

With a 12-volt battery system, recuperation is limited to about two kilowatts. With 48 volts recuperation improves to approximately eight kilowatts.

According to Mr. Hudi, the 48-volt systems will first appear in three to four years in new top-end cars from Volkswagen Group, including Audi, Bentley and Porsche, and “within this decade every new [Volkswagen Group] car from the smallest one to the biggest will have it.”

In order to plan for the new semiconductors needed by the auto industry, Alfons Graf, director of automotive systems at Infineon, has been closely watching 48-volt developments. “Last winter BMW publicly announced that 48 volts will start with the new 7 Series in 2016, and from there move to new 3- and 5-Serie vehicles in 2017 and 2018. And while Daimler hasn’t named a car or a year, they are also preparing for 48 volts,” he said.

Of all the semiconductor makers serving the auto industry, Infineon, the world’s number-one producer of automotive power devices, is probably best positioned to benefit from the move to add a 48-volt battery and motor generator to the vehicle’s power network. Infineon has actively supported past higher-voltage initiatives. “Forty-eight volts adds between €87 and €127 worth of semiconductor content per vehicle to what Infineon could sell, depending on how many new applications are connected to the higher voltage,” said Mr. Graf.

Dual-Voltage Power Network

Version one of the German standard was published by Volkswagen Group, Daimler and BMW a year ago. It calls for a 48-volt battery and motor generator connected to a DC-to-DC converter that’s also connected to the 12-volt system. The 12-volt system remains largely unchanged, except that the 12-volt motor generator is eliminated. (See schematic, left.) The 48-volt battery will be lithium-ion and the 12-volt battery will almost certainly be lead acid.

Turn to 48 Volts, page 7
Down-Market Migration of Advanced Features Well Underway

Safety

In 2006 we described the new autonomous braking feature debuting on 2007 Mercedes S and CL class vehicles. Earlier this month Ford announced that the European version of its 2013 Fiesta subcompact will come equipped with Active City Stop, which (at low speeds) automatically reduces engine power, brakes the car and activates the rear hazard lights if it senses an imminent collision. Most carmakers in Europe offer either the low-speed, Lidar-based autonomous emergency braking (AEB) or radar-based AEB systems that brake at higher speeds, or both. AEB systems that detect pedestrians are still limited to Volvos and high-end vehicles such as the Lexus LS. Audi, Mercedes and BMW have pedestrian detection and warning systems, but they do not activate automatic braking.

Subaru introduced its optional Eye-Sight collision avoidance system on the 2013 Legacy and Outback. The system processes the signals from two cameras mounted in the cabin, on either side of the rearview mirror, to determine the distance to objects and pedestrians ahead. It enables autonomous braking at speeds up to 18 mph, as well as lane departure warning and adaptive cruise control.

Beginning in 2014, Euro NCAP will include AEB in its safety assessments, so a vehicle without autonomous braking will be unlikely to earn a five-star top safety rating. According to research conducted by the Highway Loss Data Institute, forward collision avoidance systems, especially those that incorporate autonomous braking, reduced property damage liability insurance claims (damage to other vehicles) by 14%. Interestingly, the lane departure warning systems it tested did not reduce the number of insurance claims, but rather, they increased claim rates. HLDI found no clear reasons why, but noted that the systems it tested only gave warnings, with no intervention.

More safety features are proliferating in low- and mid-priced vehicles. The under-$13,000 Chevrolet Spark minicar launched in July 2012 comes with ten airbags and front seatbelt pretensioners.

A technology option package available for some top trim level 2013 Nissan Altimas includes lane departure warning, blind spot warning and moving object detection. These features are enabled by a single rear-view, wide-angle (160 degrees) camera mounted near the rear license plate. The camera lens is kept clean with a modified windshield washer pump and compressed air.

Luxury brands continue to improve safety features with advanced electronics and software. For example, some BMW, Mercedes and Lexus models monitor driver behavior for signs of fatigue and issue warnings if they detect a drowsy driver. BMW’s Attention Assistant in the new 7 series analyzes driver behavior based on steering angle, road speed and other engine parameters. Driver monitors are still in very limited use.

The new Cadillac XTS alerts the driver to crash threats through vibrations in the seat cushion, either on the left or right side, front or back, correlating with the direction of the danger. The vibrating seat is included in two optional safety packages.

Fuel Efficiency

In August 2012, the average sales-weighted fuel economy of new vehicles purchased in the United States was just 23.6 miles per gallon, according to UMTRI (University of Michigan Transportation Research Institute). As carmakers worldwide prepare to meet more stringent fuel efficiency and emissions requirements already legislated, nearly all are developing hybridized and/or electrified versions of existing models as well as creating all new EVs and plug-in hybrids. Many have already introduced features in existing gasoline-powered vehicles that, in combination, could have a significant impact on reducing CO2 emissions.

Already widely employed in Europe and Japan, U.S. automakers, notably Ford and GM, are equipping non-hybrid vehicles with start-stop systems, which can improve fuel economy by 3.5% to 10% for relatively low cost—$295 on the new Ford Fusion, for example. According to Johnson Controls, the annual global production of start-stop (micro-hybrid) vehicles is expected to grow from roughly three million in 2012, mostly in Europe, to 35 million in 2015. Forecasts cited by AAA predict eight million cars in the U.S. will have start-stop by 2017.

While not as visible to the consumer as start-stop, regenerative braking, which converts kinetic energy to electrical energy, has been employed in hybrids and EVs to extend the vehicle’s electrically-powered range, and as a fuel saver in vehicles equipped with systems like BMW’s Efficient Dynamics. Recently, Mazda and Nissan announced they are employing regenerative braking in gasoline vehicles to gain more fuel savings: the Nissan Serena van in Japan, and the Mazda6 sedan in Japan and Europe later this year. Mazda’s i-ELOOP system will store the recaptured energy in a capacitor and use it to power the climate control system, audio and other electrical features. According to Mazda, i-ELOOP also works with start-stop to extend the time the engine can be off.

Connectivity/Navigation

Many carmakers are working to integrate more smartphone apps into their latest infotainment systems without compromising safety. Onboard and cloud-based voice recognition has enabled...
Brett Hillhouse, worldwide automotive executive with IBM’s Rational Software division, has talked with many engineering executives at carmakers and tier-one suppliers around the world about systems engineering. Over the years, I have often heard the complaint that in the auto industry, true systems engineering is an underutilized and underappreciated discipline. I asked Mr. Hillhouse if that is still the case. “Systems engineering is a big problem that has not yet been solved in the auto industry,” he confirmed. “What I’m seeing is a complete misunderstanding of what systems engineering is. Many people still look at it from a mechanical perspective.”

As Mr. Hillhouse sees it, systems engineering integrates and manages mechanical, electrical/electronic and software engineering practices, starting with requirements that capture the voice of the customer. In the mechanical product data management world, the bill of materials is the focus. In EE systems engineering, requirements are the backbone. He believes carmakers will eventually be driven to fully embrace systems engineering because there is no other way to manage increasingly complex vehicle systems.

“A contributing factor to the reluctance to utilize systems engineering is the fact that automobiles are historically mechanical products; thus, lots of automotive engineers and execs are mechanical engineers,” Mr. Hillhouse said. “However, as the features and functions of vehicles are increasingly delivered by software and electronics, it’s difficult for these organizations to suddenly transition to put the same level of emphasis on software and EE as has traditionally been placed on things like mechanical testing and mechanical simulation, for instance.”

Mr. Hillhouse believes that in software and EE development and the use of systems engineering, the auto industry is where CAD was 20 years ago, before carmakers went to 3D CAD. “Back then, the 3D CAD world was very new, companies were reluctant to change what had been working for them for years, and the industry was very fragmented. There were lots of vendors, lots of individual tools; now it’s down to just three companies, Dassault, PTC or Siemens PLM.”

Citing a survey done in 2010 by Eric Honour of the University of South Australia, Mr. Hillhouse suggests that developers who devoted about 14% of an engineering project’s development effort into systems engineering were rewarded with the best success in terms of hitting cost, quality and time to market goals.

While carmakers generally put only about 3% or 4% of development time into systems engineering, their electrical engineering departments typically spend anywhere from 10% to 15% on the practice. But, according to Mr. Hillhouse, “Their systems engineering is not holistic across departments. A lot of these carmakers have four different EE groups. They do not use a consistent methodology. They don’t have good ways to share information. They don’t seamlessly collaborate across groups. And they don’t have a consistent view into the requirements or easy access to all of the engineering artifacts across the V [development diagram]. A lot of engineering work is still being done on whiteboards.”

A number of carmakers and suppliers including Honda, GM, BMW, Jaguar Land Rover, Continental, TRW, Delphi, Panasonic and Bosch have engaged IBM to help with their systems engineering initiatives.

An engagement with the Rational Software team from IBM might start with consulting. “We help companies develop a vision for their systems engineering effort,” Mr. Hillhouse explained. “Developing a holistic set of requirements for the whole organization is the first step carmakers are taking. At Rational we have some strong opinions on how to write effective requirements and how to manage them.”

Of course IBM offers plenty of software to help carmakers and suppliers complete their systems engineering vision. For example, there are Rhapsody architecture design tools, DOORS requirements management tools, Team Concert for collaboration, change and configuration management, and Quality Manager. All are supported by the Rational Jazz Lifecycle Integration Platform.

Part of the problem with systems engineering is the way carmakers are organized. Due to the mechanical focus and historical evolution, organizations such as powertrain, chassis, body and infotainment are still separate. “GM’s development of the Volt was an exception. Infotainment was separate but the body, chassis and powertrain teams were brought together,” said Mr. Hillhouse.

To make his point about the correlation between organization and outcome, Mr. Hillhouse likes to quote Melvin Edward Conway, an early computer scientist who coined what’s known as Conway’s Law: “Organizations which design systems are constrained to produce designs which are copies of the communication structures of these organizations. This is why we see the automakers struggle so much to bring systems together. They design the systems in isolation, and don’t discover potential problems until the integration test stage, at which time, minor changes can be expensive and major changes are out of the question.”

An aerospace engineer, Mr. Hillhouse believes Ethernet will quickly make the systems engineering task easier as carmakers cope with snowballing complexity. “With everything on Ethernet and no other buses (no CAN, no FlexRay, no MOST and even no LIN) you get a far simpler architecture that allows you to have a lot more flexibility on where you put the computing power and the software. You can now go to multiple-core ECUs and instead of having 70 ECUs, maybe get down to five or 15. ... The Germans are already moving aggressively in this direction because of cost and simplification. I expect to see all-Ethernet vehicles in production by 2017.”

Systems engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem.

Systems engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation.

Source: INCOSE (International Council on Systems Engineering)
Takata Sales and Operating Margin

2007 to 2012 CAGR: (5.2%)

Operating Margin
FY 2007 7.9% FY 2011 6.9%
FY 2008 7.1% FY 2012 3.6%
FY 2009 0.7% FY 2013 5.1%
FY 2010 4.2% (Forecast)

According to Takata, the yen’s rise in FY 2012 diminished sales by ¥18.2 billion in FY 2012. Had it not been for the yen’s steep rise against the dollar and euro, FY 2012 sales would have risen by 2.6% instead of declining by 2.1%.

Takata Employees by Region

Total as of Fiscal 2012 Year End: 36,500

Japan, 4.1%

Europe, 31.5%

The Americas, 58.9%

Rest of Asia, 5.5%

Takata Corp.

Takata Sales by Product

FY 2012 Total Sales: ¥382.7 billion ($4.83 billion)

Clocksprings and electro-mechanical
SW switches, 4%
Electronics/Sensors, 2%*
Airbags, 43.6%

Other, 21.6**

*Doesn’t produce electronics or sensors for the Japanese region. Those are made by Calsonic Kansei, Denso and Hitachi.

**Includes steering wheels, interior trim, specialty textiles and child restraint seats.

Background

Takata Company was founded in Shiga Prefecture in 1933 as a textile manufacturer. Its focus on automotive safety began in the early 1950s, with research on how to adapt parachute manufacturing experience to seatbelt manufacturing. Takata brought Japan’s first seatbelt to market in 1960. Initial research on airbag technology began in 1976; production of driver side airbag modules followed a decade later. The company became Takata Corporation in 1983.

Forty-three percent of Takata’s business came from Japanese customers in FY 2012, down from 54% in FY 2009, largely due to vehicle production cuts following the 2011 Japan earthquake and flooding in Thailand. The company expects the percentage of its business that comes from its Japanese customers will grow as OEM production increases. Among Takata’s strengths is its closeness to Honda, one of the world’s most demanding carmakers in terms of value and quality. Another is Takata’s ability to provide systems engineering support.

To lower costs and reduce exposure to exchange rate fluctuations, the company has opened nine new manufacturing facilities since 2009, in Russia, Romania, Morocco, China, India, the Philippines, Mexico, Brazil and Uruguay. Today Takata operates 58 subsidiaries in 20 countries, a total of 53 manufacturing plants. A new R&D center in Shanghai is expected to further reduce development costs.

Acquisitions

Takata has grown organically and through acquisitions, notably that of Petri AG, a major German steering wheel manufacturer, in 2000. Given its strong balance sheet and solid credit ratings, Takata will likely continue to look favorably on acquisitions of companies that serve human safety needs, both within

Page 4, September 2012

The Hansen Report on Automotive Electronics, Portsmouth, NH USA www.hansenreport.com
and outside the auto industry. As in the past, Takata will be drawn to companies with strengths that bolster its core automotive restraint system competencies, for example companies serving the emerging markets with low cost products. However, it probably wouldn’t be interested in acquiring airbag ECU makers, since that market is already well served by powerful players like Continental and Denso.

While continuing to specialize in human safety technology, Takata also wants to diversify into non-automotive markets. The company took the first step in that direction with its March 2012 acquisition of two subsidiaries of BAE Systems: BAE Systems Safety Products in the U.S. and Schroth Safety Products in Germany. The subsidiaries produce seatbelts and other safety equipment for fixed-wing aircraft, helicopters and race cars.

Strategic Initiatives

Globalization

In April 2012, Takata realigned its organization to better reflect the increasingly global nature of its customers, many of whom are developing and producing global platforms. Prior to April, Takata was organized by region, with each pursuing a different strategy. “Before the reorganization we had Europe going in their direction, North America going in theirs and Japan going in theirs—and they didn’t necessarily meet. Now we have better planning and a technology roadmap. ... We can no longer have unique parts for Europe, Japan and North America, each with a different price,” said Alby Berman, global vice president for communications and planning.

Emerging Markets

Long term, Takata’s greatest challenge is the maturity of the major markets it serves. Because airbag adoption is nearly universal in Japan, North America and Europe, safety restraints are seen as commodities, so Takata must find ways to diversify into new markets and new products.

Takata has been investing in China, India, Russia, Eastern Europe, Indonesia and Brazil, where demand is rising more quickly, but prices are constrained by the need to make vehicles more affordable. In Brazil, only 20% of vehicles had driver and passenger airbags in 2010, according to IHS Automotive, but by 2014, all vehicles sold in Brazil will be required to have driver and front passenger airbags. While Takata has been the number one supplier in Brazil, it expects competition to heat up in the region as full phase-in of passive restraints gets underway. In India, all new models introduced will have to have front and side airbags around 2016; all cars will need to be so equipped roughly three years later.

Of all the emerging markets, Takata has been investing the most in China. The company recently finished construction of its fourth Chinese plant, this one in Tianjin. Takata already has two plants in Shanghai and one in Changxing. Further, in FY 2011 Takata gave its Vehicle Safety Systems Technical Center in Shanghai full responsibility for product development, design and evaluation to serve local carmakers.

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Distinctions Claimed by Takata

- Brought Japan’s first seatbelt to market in 1960
- First to commercialize driver airbags in Japan in 1987
- First motorized seatbelts in Japan
- First to market with low-risk, twin airbag systems
- First company in the world to mass-produce motorcycle airbags
- World’s first company to commercialize airbelts, in 2010
- Takata is developing what it calls the world’s smallest airbag.
- Brazil’s number-one supplier of airbags and steering wheels
- World’s first center airbag, jointly developed by GM and Takata
- Petri (acquired by Takata) developed Europe’s first airbag system, for Mercedes.
Takata Corp.

**Active Safety**

Takata is also investing significantly to develop products that take it beyond passive safety, more deeply into electronics and active safety. Five years from now the company expects that 5% of sales will come from active safety products.

Takata is particularly interested in the human machine interface and the human factors that will be critical to managing the driver's workload to make driving safer. Dirk Meissner, vice president of global research, in charge of Takata's research division based in Berlin, Germany, has engineers doing advanced research on "virtual copilot" concepts for future vehicles that might even be able to recognize the driver's physical and emotional state. "Understanding the driver and his condition I think will be key to the design of future safety systems addressing safe driving," said Mr. Meissner.

"Because Takata already touches the driver through its core products, seatbelts and steering wheels, we are well-positioned to play a role also in active safety," said Len Cech, director of global electronics research. The company already produces lane departure warning systems and will soon bring a stereo-vision-based pedestrian detection system to the market.

Carmakers have begun evaluating prototypes of Takata's new stereo vision system. The system could detect moving objects as well as pedestrians. Takata plans to produce the entire stereo vision sensing unit, from the algorithm, to the hardware, to the imagers, packaged in its enclosure. The system is designed to be mounted behind the windshield, integrated into the headliner in front of the mirror.

Soon Takata will begin validation of the new product, aiming for the ASIL (Automotive Safety Integrity Level) B or C risk class under the ISO 26262 safety standard, the same risk level as other warning applications. Takata engineers expect to have the product ready for the 2015 or 2016 model year.

A compelling feature of Takata's imaging unit is its small size compared with Subaru's EyeSight, which is already in production. Takata's megapixel CMOS imagers are mounted 165 millimeters apart, much closer than the Subaru unit's imagers, which are 300 millimeters apart. Takata's unit accurately measures distance up to 120 meters; EyeSight has a range of 80 meters. Like EyeSight, Takata's system will be able to manage adaptive cruise control, automatic braking, throttle control and lane departure warning.

**Other New Products**

**Adaptive Steering Wheel**

Together with a global carmaker, Takata is developing for a series vehicle program a steering wheel that provides adaptive steering functions. "When the vehicle is driving slowly in a parking lot, for instance, instead of having to crank the wheel over a turn-and-a-half to change its direction, you could take only a half a turn," explained Takata's Jim Paye, director of engineering, electronics and active safety.

Adaptive steering systems from other suppliers are already on the road, but they are more complicated because they must be integrated with the steering column or the chassis. Takata's adaptive steering wheel, with its motor actuator entirely self-contained, could be used in multiple vehicles, across multiple platforms. As such, Takata's adaptive steering wheel is cost competitive with existing products.

Takata is working to make its development of the new steering wheel conform to ISO 26262, ASIL D.

**Products**

<table>
<thead>
<tr>
<th>Seatbelts</th>
<th>Continuing Evolution Safety System Products</th>
<th>Electronics</th>
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<tbody>
<tr>
<td>Webbing</td>
<td>Airbelts</td>
<td>Airbag ECUs</td>
</tr>
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<td>Retractors</td>
<td>Motorcycle airbags</td>
<td>Occupant classification systems including seat weight sensors</td>
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<tr>
<td>Tension reducers</td>
<td>Pop-up hood devices</td>
<td>Interior Parts</td>
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<tr>
<td>Load limiters</td>
<td>Lane-departure warning systems</td>
<td>Seat covers</td>
</tr>
<tr>
<td>Motorized seatbelts</td>
<td>Pedestrian head protection airbags (concept)</td>
<td>Headrests</td>
</tr>
<tr>
<td>Buckles</td>
<td>Steering Wheels</td>
<td>Cargo shades</td>
</tr>
<tr>
<td>Latch plates</td>
<td>Front center airbags</td>
<td>Center and door armrests</td>
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<tr>
<td>Height adjusters</td>
<td>Decorative parts</td>
<td>Sun visors</td>
</tr>
<tr>
<td>Airbags</td>
<td>Switches</td>
<td>Bolsters</td>
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<tr>
<td>Driver airbags</td>
<td>Rims (grips)</td>
<td>Other</td>
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<tr>
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<td>Spokes</td>
<td>Textile products</td>
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<tr>
<td>Knee airbags</td>
<td>Heating</td>
<td>Child safety seats*</td>
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<tr>
<td>Side airbags</td>
<td>Frames</td>
<td>Multipoint harnesses for motor sports</td>
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<td>Passenger airbags</td>
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*Takata sells child restraint seats in Japan and Europe but not in the U.S.

**Alcohol Detection**

Using a $2.25 million grant from the U.S. Department of Transportation, Takata and TruTouch Technologies, a pioneer in non-invasive intoxication detection, began a partnership in January 2011 to adapt the TruTouch technology for use in consumer and commercial vehicles.

Takata has an equity position in TruTouch Technology.

The TruTouch measurement is performed by transmitting near-infrared light into the skin via contact with an optical touch pad, and collecting a portion of the light reflected back by the skin. The collected light is analyzed to determine alcohol concentration in the tissue.

Not only does the measurement yield information about alcohol concentration but it also provides details that are unique to the individual being measured. The measurement contains spectroscopic information from the molecules present in each layer of the skin, which provides insights into the characteristics of the tissue being measured such as dermal hydration, collagen density and layer thickness. That ability to verify a person's identity is also of interest to Takata. "You could start the vehicle by putting your finger on a button that establishes your identity and lets you know if you happen to be too drunk to drive," suggested Mr. Berman.

continued on following page
Adaptive Restraints

As the developed markets mature and the emerging markets demand lower prices, airbag unit prices have suffered. “In 1995 a driver’s side airbag was probably $140 to $150. They're around $20 today,” said Mr. Berman. One answer to declining prices is to make airbags that provide even more protection by adapting the restraints according to the crash signature, and the size and position of the occupants.

“Using cameras and other sensors, we can gain a lot of information about the oncoming crash situation, where it's coming from, where the occupants are, how big they are and adapt the size and shape of the airbags accordingly,” explained Dirk Meissner.

Airbag actuators won’t change very much. “Most inflators today are already dual-stage types,” said Mike Scavnicky, vice president and global lead for systems and simulation. “We are looking at the changes you can make to the airbag cushion itself to vary pressure, separately from the inflator. These are passive measures but they use more input from electronics.

Honda Recall

Takata’s operating profits in North America declined by 97% in FY 2012 compared with the prior year due to an increase in R&D expenses and warranty costs including a warranty charge associated with a Honda recall involving 437,000 vehicles manufactured in North America.

According to NHTSA documentation and a Honda press release issued in February 2010, the multiple recalls addressed problems Honda was having with driver’s side airbag inflators that ruptured during airbag deployment causing fragments of airbag parts to scatter and possibly injure vehicle occupants. The problem was traced to a Stokes press used by Takata to form the inflator's repellant tablets that were deemed insufficiently dense. Takata’s North American region produced ¥3,914 million ($49.4 million) in operating profit in FY 2011.

48 Volts...

One of the obstacles confronting the high-voltage initiatives of the past was the expense of beefing up all the 12-volt components to withstand an unintended connection to the higher voltage.

“That was the death of the 42-volt initiative,” pointed out Mr. Graf. “With this new approach, the 12-volt system stays unchanged—there is no added cost there. The specification states that everything has to be done to eliminate the possibility of a short circuit between the 12-volt and 48-volt systems.”

The cost of this approach is instead borne by the 48-volt cabling, which must be well insulated and routed to maintain sufficient distances from the 12-volt cables, so any chance of arcing to the 12-volt network is eliminated. The only component connected to both voltages is the DC-to-DC converter, so it must be equipped with numerous safety switches, and that doubles the converter's silicon cost.

A second version of the 48-volt specification is due later this year, according to BMW’s Ottmar Sirch, the electrification project manager who heads the German team of power supply experts working on the quasi-standard, which they hope will become a worldwide standard. “The European car manufacturers have shown interest in the specification because of CO2 regulations proposed for 2020,” Mr. Sirch said. In July 2012, the European Commission proposed a law to cap CO2 emissions by passenger vehicles at 95 grams per kilometer in 2020.

Improved start-stop systems are the main motivation for 48 volts, according to Infineon’s Mr. Graf. “Today’s start-stop systems turn the engine off when the car is at a standstill, which is good, but carmakers now want to stop the engine even when the car is moving. Passive coasting stops the engine each time the foot is lifted from the gas pedal. The 48-volt battery is needed to maintain the steering, cooling, air conditioning, lighting and everything else, for the time the engine is shut down. The start-stop we have today reduces fuel consumption by 3% to 5%, whereas with passive coasting it can yield up to a 15% fuel reduction.”

According to Lars Reger, vice president of strategy, new business and R&D at NXP Automotive, the leading candidates for connection to the 48-volt network are electric power steering for SUVs and active damping. “Fortunately our CAN and FlexRay transceivers are already 48-volt proof because we are using silicon on insulator technology, capable of plus or minus 100 volts,” said Mr. Reger. Other potential 48-volt loads include the air conditioner compressor, PTC (positive temperature coefficient) heater and the engine cooling fan.
controller capability in house. Winning suppliers are those with CMMI (Capability Maturity Model Integration) based processes and those with whom we can develop software platforms based on standards such as AUTOSAR.

Q. Integration. Will the number of ECUs per vehicle decline?
A. Hyundai has a number of projects underway that could lead to combining two or three ECUs into one. Autosar will help us integrate ECUs, but we also have to be conscious of [the functional safety standard] ISO 26262. In addition we are actively researching hypervisors (operating system virtualization), which allow multiple operating systems to run on a single CPU.

Q. Which standards do you support?
A. Ethernet is especially promising. Starting with links for cameras, we are considering using Ethernet in infotainment systems. Later we would like to expand that to an Ethernet backbone linking each automotive domain.

Hyundai and BMW are members of the OPEN Alliance special interest group promoting widespread adoption of automotive Ethernet connectivity. Hyundai plans to apply the AUTOSAR 4.0 and Genivi standards, but won’t reach high volume with them until after 2017.

Some other standards that will be in play are ISO 26262, WiFi-Direct, HTML5 and MHL [Mobile High Definition Link].

Q. Which standards for device connectivity are you supporting?
A. Hyundai/Kia implemented USB mass storage and wired Apple iPod connectivity in 2007, Bluetooth hands-free and streaming audio in 2008, and Wi-Fi hotspot service based on 802.11 in 2012. We plan to launch a vehicle with MirrorLink and DLNA (Digital Living Network Alliance) connectivity standards in 2013. We think MirrorLink will replace VNC Automotive. Hyundai will continue to support Apple’s own connectivity protocol for digital video connectivity to Apple devices.

Q. What features will come to the automobile by way of the cloud?
A. Soon we will see server-based voice recognition and off-board navigation. Within ten years personalized, location-aware driver services are expected to be a dominant cloud-based service. The cloud will also provide data to support vehicle control systems but won’t control the vehicle directly.

Q. What are the biggest obstacles to affordable electric vehicles?
A. Batteries. By 2020 we expect lithium-ion batteries will have three times today’s energy density and cost 20% of what they cost in 2010. We are already looking at next-generation technologies such as all-solid-state batteries and metal-air batteries. With government support, carmakers and suppliers need to develop less expensive power electronics components. Government subsidies and tax incentives are important for the successful commercialization of EVs.

Q. It’s been suggested that vehicles that automatically steer, brake and accelerate in stop-and-go traffic are the next step toward fully autonomous vehicles. Do you agree? What technology advances are most crucial?
A. I agree. Automatic stop-and-go driving is under advanced development at Hyundai-Kia.

Autonomous driving will require advances in environment recognition and path planning techniques using V2X, laser scanning and map-based ADAS [advanced driver assistance systems].

Q. It seems inevitable that in the not-too-distant future software in a vehicle will be remotely updated while the car is parked. Do you agree?
A. I agree. Hyundai-Kia is conducting advanced research on remote updates via 3G/4G networks and plans to apply this solution to mass production after fully checking the stability. Among the challenges is perfecting the means to compress the data so network fees and the time required for downloads can be minimized. Also, a process needs to be developed to robustly accommodate incidents that may occur during an update.

Q. Which safety systems not yet widely applied to production vehicles are showing the most promise in terms of saving lives?
A. Front collision avoidance by steering and braking, blind spot intervention and lane departure prevention systems are individually all promising. Ultimately these systems will be integrated into a single omni-directional collision avoidance system.◆

Features...

access to at least some of the features of social networking sites, text messaging, Internet radio and more. Pandora is already available on more than 50 vehicle models. Harman’s Aha Radio is available on the all new 2013 Honda Accord, one of the top selling sedans in the U.S.

The newest version of Chrysler’s UConnect comes with a suite of downloadable apps, but Chrysler also includes an embedded modem rather than relying on the consumer’s smartphone for a cellular connection. The new system will first be offered in the 2013 Ram pickup and the 2013 SRT Viper. Like Hyundai’s BlueLink system, UConnect users will pay a subscription fee for the Internet service but can also connect at free Wi-Fi hotspots.

High-end embedded navigation systems are providing enhanced graphics, for example, Audi’s Google Earth navigation introduced last year. BMW’s latest generation of Connected Drive navigation features what it calls High Guiding. The arrow guidance on the display switches to a “detailed, bird’s-eye perspective of the surrounding area” when the car is within 150 meters (in urban areas, 300 meters elsewhere) of the next navigation instruction. It also shows the detailed view on the instrument cluster display and on the head-up display. An optional feature called 3D City Models renders a realistic view of the surrounding buildings and streets.

Mercedes’ mbrace2 telematics system, launched this past spring on the 2013 SL Class, builds on the functionality of the first generation mbrace with more mobile apps, safety, infotainment, diagnostics, navigation and convenience features. In the latest generation, all of the vehicle’s software modules can be remotely updated via the cloud.◆

Continued from page 1

Continued from page 2