Auto Industry Steps Toward Autonomous Driving

When Google, a high profile Internet company, unveiled its fleet of self-driving cars tooling around California roads, it raised a lot of public interest and the notion that Google was up to something brand new. But the automotive industry has been working on autonomous driving for many years, and much of the sensor technology, software, computing and actuation required to implement it is already well understood and available now.

Mercedes demonstrated robotic vehicles as early as the 1980s. In 1995, a Mercedes car developed under the Prometheus project, a European Union funded research program which ran from 1987 to 1995, achieved speeds over 100 mph driving in traffic on the Autobahn.

Semi-autonomous features such as electronic stability control (ESC), adaptive cruise control with stop and go (longitudinal control), lane keeping systems and park assist (latitudinal control) are fairly commonplace in mid- and high-end cars on the road today. The safety benefits of ESC are so well proven that government mandates requiring that cars be fitted with the feature. The Highway Loss Data Institute, a U.S. insurance industry backed research organization, recently announced that automatic braking systems such as Volvo's City Safety could reduce low speed traffic collisions by roughly 25 percent. NHTSA's five-star safety ratings now include ESC, forward collision warning and lane departure warning as recommended technologies.

Given the continuously improving track record of advanced driver assistance systems and the global focus on preventing accidents that occur because of driver distraction, it is logical that if more driving tasks can be safely handed off to the computer, it is only a matter of time until autonomous vehicles are a reality.

Google’s Self-Driving Cars Zoom In On the Future

If you want to see what a real-life new product champion looks like, go to TED.com and watch Sebastian Thrun's four-minute talk on driverless cars from the TED2011 conference in March.

"As a boy, I loved cars. When I turned 18, I lost my best friend to a car accident—like this," said Dr. Thrun, snapping his fingers. "And then I decided I'd dedicate my life to saving one million people every year."

Dr. Thrun, a professor of computer science and electrical engineering specializing in robotics and artificial intelligence, is on leave from Stanford University to head up Google’s driverless car project. Google surprised a lot of automotive industry people when its previously unpublicized two-year-old driverless car project was brought to light by an October 9, 2010, article in the New York Times and a Google blog post by Dr. Thrun on the same day.

Directed by Dr. Thrun, a team of 15 Google robotics engineers, several taken from the Carnegie Mellon team that won the DARPA (Defense Advanced Research Projects Agency, run by the United States Department of Defense) Urban Challenge race in 2007 and from Dr. Thrun’s own Stanford University team that came in second, built a fleet of eight driverless vehicles. By October, the fleet of seven Priuses and one Audi TT had already logged a total of 140,000 miles on California public roads with only occasional human control. One thousand of those miles were driven with no human intervention at all.

The Google cars employed a lot of the same technology used by vehicles entered in the DARPA Urban Challenge. The roof of each vehicle was fitted with a one-foot-tall rotating laser scanner made by California-based Velodyne Lidar.

A forward-looking video camera was attached to the rear-view mirror; a precise wheel-speed sensor was externally mounted to a rear wheel. Three forward-looking and one rearward-looking radar sensors were also employed, along with a GPS receiver and an inertial sensor.

But the Google cars exemplify tremendous advancements in the state of the art of autonomous vehicle engineering since the 2007 DARPA Urban Challenge. New image recognition software lets the vehicles read traffic signals and detect pedestrians and bikers. The speed with which computing decisions are made about where to steer and when to accelerate, coast or brake is now fast enough that these vehicles can keep up with normal traffic.

While the Urban Challenge entrants had to obey traffic rules, pass slower-moving vehicles, handle intersection crossings, make left turns across traffic, park and execute U-turns, they did not encounter pedestrians on the 55-mile closed course. The winning Urban Challenge vehicle from Carnegie Mellon and General Motors completed the course at an average speed of just 14 miles per hour; the Google vehicles can negotiate public roads at the speed limit.

Google’s Big Investment

On the Google team along with Dr. Thrun is Chris Urmson, an assistant research professor on leave from the Robotics Institute at Carnegie Mellon, where he led the team that built the DARPA Urban Challenge winning vehicle. According to Raj Rajkumar, professor of electrical engineering and computer science at Carnegie Mellon, who worked on CMU’s DARPA Challenge vehicle and whose lab is helping to build a new vehicle.
NHTSA’s Distracted Driving Guidelines Coming Soon

U.S. Transportation Secretary Ray LaHood’s personal crusade against distracted driving has carmakers and their suppliers wondering what the U.S. government might do to limit car electronics. Distracted driving is responsible for at least 5,500 deaths and 450,000 injuries in the U.S. every year, an “epidemic” that Mr. LaHood has said is compounded by electronics, not only the portable devices brought into the vehicle but also embedded infotainment systems.

“Carmakers are adding technology in vehicles that lets drivers update Facebook, surf the Web or do any number of other things instead of driving safely. But facts are facts: Features that pull drivers’ hands, eyes and attention away from the road are distractions. Period,” said Mr. LaHood in a speech last year.

This fall, instead of August 2011 as planned, NHTSA will publish and seek public comment on voluntary guidelines covering visual-manual interfaces, the first of three planned distracted driving guidelines. A guideline covering portable devices is due in 2013; a voice interfaces guideline is due in 2014. “Drawing on our extensive research, we are now developing voluntary guidelines to help reduce the driver workload from in-vehicle systems,” said NHTSA Administrator David Strickland in a statement to The Hansen Report.

Numerous human factors guidelines covering driver interactions with electronics already exist. Guidelines and standards publishers include the University of Michigan Transportation Research Institute (UMTRI), SAE, JAMA, the Alliance of Automobile Manufacturers (AAM), and the Commission of the European Community. The International Standards Organization (ISO) has also published some standards and is working on others. The International Telecommunications Union recently began work on car communications guidelines aimed at portable devices.

Despite—or because of—the many existing guidelines, carmakers can get into trouble. Ford dropped from fifth to twenty-third in customer satisfaction in the 2011 J.D. Power and Associates Initial Quality Study, due in part to its advanced multimedia control system MyFord Touch. According to J.D. Power, some vehicle owners reported that the system is not intuitive and/or does not always function properly. Consumer Reports magazine has found MyFord Touch and MyLincoln Touch to be cumbersome and distracting to use, causing several Ford vehicles to be recalled.

Turn to NHTSA, page 8

Laser Sensor’s Future Unclear

Five of the six teams who finished the 2007 DARPA Urban Challenge, as well as the self-driving test cars developed by Google, relied on a one-foot-tall by eight-inch diameter rotating lidar (laser radar) sensor mounted to their vehicle’s roof. Manufactured by Velodyne Lidar, of Morgan Hill, California, these high-speed, highly accurate sensors list at about $80,000 each.

The Velodyne sensor employs 64 vertically aligned lasers that scan from +2 degrees to about –25 degrees across the vertical horizon. Each laser fires at approximately 20,000 times per second. The entire unit spins, allowing it to capture roughly 1.3 million data points per second. The 3D data points produced, accurate to within 2 centimeters, are placed into a map that can show the vehicle not only exactly where it is, but also the location of all the objects—cars, curbs, poles, etc.—within 120 meters.

According to Bruce Hall, president of Velodyne Lidar, a vehicle’s ability to self-localize is crucial to truly autonomous driving. “GPS is notoriously inconsistent. The errors are measured in meters. If you want to do autonomous driving you can never be wrong,” he said. To self-localize, the vehicle must first capture and store a map of the environment it is about to navigate. Mr. Hall explained: “As you go through that environment, you need to capture data with enough precision that you can then identify key features and compare them to the map you just captured and are using to navigate. Once you can reconcile and understand the persistence of fixed objects you can begin to self-localize. Then you can move through complicated traffic situations.”

While ideal for military and industrial applications, the Velodyne sensor will never be commercially deployed in a passenger vehicle. Not only would its moving parts have to be reliably maintained, but laser sensors can’t always see through rain, snow or fog. The sensor’s large size and location on the rooftop are also big negatives.

Volkswagen used a laser scanner from Ibeo Automotive Systems GmbH in its Temporary Auto Pilot demonstration vehicle, which can drive automatically at speeds up to 130 kilometers per hour on motorways. “If you look at the pictures of that vehicle, you hardly notice the sensors; they are well integrated into the vehicle,” said Volkswagen Group head of research, Jürgen Leohold. Last December, Ibeo signed an agreement with the French auto parts supplier Valeo to bring laser scanner technology to the high-volume automotive market.

However, Peter Rieth, vice president of advanced engineering at Continental Automotive, doesn’t necessarily see a future for laser scanners in the auto industry: “I don’t see it as essential. It is far too expensive, too complex. And its range is limited compared to radar.” More likely, future autonomous systems will rely instead on camera, radar and V2V (vehicle-to-vehicle communications) sensors. V2V further lengthens the field of view up to 500 meters and sees around corners.
autonomous vehicle prototype with General Motors, the 15-member Google car team from last October appears to have grown to about 25 people.

Keeping this level of talent on the project is likely no small expense for Google. We estimate the cost of each fully equipped autonomous vehicle is in the range of a few hundred thousand dollars. Each Velodyne HDL 64 laser scanning sensor alone costs between $80,000 and $85,000. From our perspective, it looks like Google is investing roughly $7 million to $8 million dollars per year into the project.

Google’s multimillion dollar investment in driverless-vehicle research is big even by automotive standards. While almost every carmaker is investing in driver assistance systems, including those with semi-autonomous features, no carmaker has been nearly as aggressive with fully-autonomous research as Google, at least publicly. With $30 billion in sales and a $2.8 billion R&D budget, Google could comfortably invest considerably more in the technology.

Google’s driverless car development investments are continuing. Responding to lobbying efforts by Google, on June 23, 2011, the Nevada state legislature passed a bill requiring the state’s department of transportation to develop rules that would permit testing of self-driving vehicles on Nevada’s roads. More autonomous vehicle testing on public roads by Google is likely.

What is Driving Google?
Google’s interest in driverless cars is part altruistic and part business. “It’s about making cars safer and more efficient,” said Jay Nancarrow, Google’s global communications and public affairs manager, in an email to The Hansen Report. “Automation could save many lives, reduce the nation’s energy consumption by several percentage points, free up substantial time every day (52 minutes per working American), triple the capacity of the highway system, and enable entirely new models of car sharing.”

The vast majority of traffic accidents are due to driver error: 95% of all severe accidents can be attributed to driver deficiencies, according to research from Volkswagen. Google clearly believes that machines, which stay completely alert, don’t panic or get distracted, can do a much better job than human drivers, and it believes Google has a commercial role to play.

What role? Clearly Google won’t be building cars or car parts. Google’s corporate mission is to organize the world’s information and make it universally accessible and useful. Providing data services to enable driverless cars is in keeping with that mission. “This problem is all about computer science and information: how to get the right information to cars at the right time,” said Mr. Nancarrow. “That’s made possible by our data centers, which are able to process the enormous amounts of information gathered by these cars when they are mapping terrain.” According to the Google blog entry by project leader Sebastian Thrun, “Any [driverless car] test begins by sending out a driver in a conventionally driven car to map the route and road conditions. By mapping features like lane markings and traffic signs, the software in the car becomes familiar with the environment and its characteristics in advance.”

Dr. Thrun helped develop the technology used to create Google Street View, which supplements Google Maps and Google Earth pictures with 360-degree views of what can be seen at ground level. Google collects Street View images by manually driving vehicles on the world’s streets with 15 cameras taking photographs. To remove the overlap and create a continuous 360-degree image, Google stitches the images together using image processing algorithms. GPS receivers and laser distance sensors are used to precisely link the collected images to their map positions. Google is almost certainly creating the 3D maps used to guide its driverless vehicles with some of the same processes it uses for Street View.

Google could reasonably supply carmakers with 3D map services that support autonomous driving. “It would take some load off the vehicle’s sensors, but the challenge with any map database is to keep it up to date,” said Jürgen Leohold, executive director, Volkswagen Group Research. Such maps of streets and parking lots could include detail on road markings, curbs, traffic islands, bridge abutments, toll booths and even construction zones.

Just as up-to-date traffic information comes from vehicles acting as probes, the data from which 3D maps are kept current could come from any manually driven vehicle equipped with the right sensors and a communications link to the cloud.

In a speech given on June 30, 2011, Bernd Bohr, chairman of the Bosch Group’s Automotive Technology business sector, suggested that the Internet generation’s acceptance of driver assistance systems, along with economies of scale making such things as radar sensors more affordable, “will lead to autonomous driving within the next two decades.”

The Bosch view that it will take 20 years before autonomous vehicles are sold to consumers is a pretty good representation of the conventional wisdom. But Larry Page, the 38-year-old CEO and co-founder of Google who supports the driverless car project, is anything but conventional.

Mr. Page graduated from East Lansing (Michigan) High School and holds a Bachelor of Science degree in computer science from the University of Michigan. According to a March 18, 2011, article from Wired.com, “as an undergraduate at the University of Michigan, he became obsessed with an elaborate monorail system, providing a futuristic commute between dorms and class rooms.”

He has a Master’s degree in computer science from Stanford University, the same school where Google Car team leader and driverless car champion Sebastian Thrun taught, so he surely has a personal connection to the Google car project. Another link to the auto industry is Mr. Page’s investment in the electric vehicle developer Tesla Motors. The Wired.com article describes Mr. Page as “idealistic ... a true corporate radical ... someone willing to champion big—sometimes quixotic—ideas.”

The Google driverless car project has already piqued general interest in the technology and advanced the state of the art. Where Google takes it from here, probably not even Google knows for sure.
Pioneer Corp.

**The Company Profile...**

**Headquarters:** 1-1, Shin-ogura, Saiwai-ku, Kawasaki-shi, Kanagawa 212-0031, Japan; www.pioneerjp

**FY 2011 Sales:** ¥457.5 billion ($5.70 billion)

**Interest Expense:** 0.8% of sales

**R&D:** 7.2% of sales

**Capital Expenditures:** 4.8% of sales, an annual decline of 14.7% since FY 2007

**Operating Margin:** 3.5%

**Net Cash Flow from Operating Activities:** ¥37.5 billion ($467 million)

**Working Capital:** ¥27,182 million ($339 million) as of March 31, 2011

**Short and Long Term Debt:** ¥54,201 million ($675 million) as of March 31, 2011

**Total Equity:** ¥88.5 billion ($1,102 million) as of March 31, 2011

**Market Capitalization:** ¥135.3 billion ($1.686 billion) as of July 26, 2011, an annual decline of 16% since 2007

**Employees:** 26,785 as of March 31, 2011

**Sales per Employee:** ¥17.08 million ($236,571)

**Largest Shareholder:** Sharp Corporation, 9.34%

**Background**

Pioneer is a smaller company than the one we profiled in 2007—in terms of sales, headcount, manufacturing facilities and product portfolio. Sales have decreased 13% per year from ¥797.1 billion in FY 2007 to ¥457.5 billion in FY 2011. Pioneer’s sales have not fully recovered from the 28% drop they suffered in FY 2009 as a result of vehicle production cuts, reduced consumer spending following the global economic crisis, and Pioneer’s exit from the plasma display and plasma TV markets.

The steadily appreciating yen has also played a role in tempering Pioneer’s performance. In FY 2011 the yen increased 8.3% against the dollar and 15.9% against the euro, which makes products produced in Japan expensive to the rest of the world. Already in FY 2012, the yen has gone even higher, rising another 4% just in July. In FY 2011, 87% of Pioneer’s production was done abroad; the company plans to bring overseas production even higher in this fiscal year, to 93% of the total.

Along with Home Electronics, which produces mainly home audio-video products, DJ equipment and set top boxes, Car Electronics is a core Pioneer business. Most of the Car Electronics segment’s revenue comes from OEM and aftermarket audio and navigation systems. A third core business may evolve from Pioneer’s capital tie-up with Mitsubishi Chemical Corporation, with whom it is developing OLED (organic light emitting diode) lighting applications.

**Restructured Twice Since 2005**

Although its Car Electronics business showed good operating margins for six consecutive years between FY 2002 and FY 2008, Pioneer began a major restructuring program in December 2005 after sustaining losses in its Home Electronics segment. Among the restructuring measures taken were:

- Cutting the number of worldwide manufacturing facilities to 30 from 40
- Reducing employment by 2,000
- Reducing R&D from 8.5% of sales in FY 2006 to less than 7%
- Cancelling plans to mass produce active full color OLED display panels

In December 2007, Pioneer issued 30 million new shares of common stock to Sharp Corporation for ¥41.6 billion, making Sharp the company’s largest shareholder, with 9.3% at the close of FY 2011.
In FY 2009, on the way to an operating loss of 9.8% of sales, including a 4.2% operating loss in Car Electronics, Pioneer embarked on an even bigger restructuring program, which the company described as “drastic.” In this round, Pioneer made major changes in its business portfolio and sought significant cost reductions. To raise funds it issued 116 million new common shares, raising the number outstanding to 321 million. Along with an international stock offering, Pioneer sold a piece of the company to alliance partner Mitsubishi Electric, who owned 2.34% of Pioneer’s outstanding shares as of March 31, 2011, and to Honda Motor Company, a customer, who now holds 4.57% of shares. The stock offerings netted roughly ¥34.9 billion ($435 million) in proceeds.

These actions were also part of the 2009 restructuring plan:
◆ Pioneer withdrew from its unprofitable plasma display business.
◆ Between October 2009 and March 2010, Pioneer reduced its workforce by 8,699 workers, bringing the total down to 28,226 employees. In March 31, 2011, employment stood at 26,785.
◆ The number of manufacturing facilities was reduced from 27 in October 2009 to 14 by March 2010.

Until 2011, when it delivered a 2.3% net margin, Pioneer had suffered seven straight years of net losses. The restructuring efforts appear to have worked, at least for now.

Infotainment Extremely Competitive
Pioneer’s Car Electronics business serves the infotainment (car audio, navigation and telematics) market, probably the auto electronics industry’s most competitive product category. In addition to the major suppliers such as Harman, Aisin Seiki, Denso, Clarion, Alpine, Panasonic, Bosch and Continental, there are numerous lesser players such as Delphi, Visteon, Fujitsu Ten, Mitsubishi Electric, Kenwood, Magneti Marelli, Hyundai Mobis and Sony.

Not only does the industry already have too many incumbent suppliers, but new entrants from the aftermarket, such as PND (portable navigation device) suppliers Garmin and TomTom, are making inroads into the OEM side of the business. And as software has become the most significant and potentially distinguishing part of infotainment systems, large software companies such as Microsoft, Google and RIM, and smaller ones such as Elektrobit, Bsquare and Tweddle Group Technologies are also squeezing into the picture. The wide adoption of smartphones, which can substitute for many infotainment features, is another competitive difficulty. With too many suppliers, the infotainment industry is ripe for consolidation.

Shift to Outsourcing
Pioneer has been a vertically integrated company, choosing to manufacture and develop in house the components that comprise many of its product offerings. It produces its own CD and DVD playback mechanisms and speakers. Pioneer’s subsidiary Increment P Corporation produces digital maps of Japan. The company provides OLED displays for aftermarket and OEM automotive devices. The 2008 head units made by Pioneer for Scion were fitted with OLED displays made in house by Tohoku Pioneer Corporation, a subsidiary.

But the company’s difficulty in turning a profit has forced it to aggressively lower its costs. Pioneer will increasingly rely on
alliance partners with whom it will share the fixed costs of new product development. Pioneer will also use more outside engineering firms and contract manufacturers to design and produce its products.

**Emerging Markets**

Like almost all its competitors, Pioneer has been taking steps to expand business in the emerging markets of China, Brazil and India. Among a number of initiatives is Pioneer's plan to introduce affordable new aftermarket products tailored for the region where they will be sold.

Pioneer is particularly interested in the Chinese market for car navigation, which it expects will continue to grow at an annual rate of 36%, from just over one million units in 2010 to 2.75 million units in 2013, exclusive of PNDs.

Believing that the Chinese market for navigation equipment is undeveloped, Pioneer is targeting both OEs and the aftermarket. For example, in 2009 Pioneer entered into a joint venture with Shanghai Automotive Industry Corporation (SAIC) through which it hopes to expand its OEM navigation business. According to Pioneer, SAIC has a 20% share of the Chinese auto market. Pioneer is also aggressively seeking business with other Chinese carmakers. Pioneer plans to introduce at least ten new navigation products for the Chinese aftermarket.

Despite its efforts thus far, Pioneer’s navigation and audio business in China has not yet expanded. Rather, in fiscal 2011 it shrank.

**U.S. OEM Business Down**

In May 2007 when we last profiled Pioneer, Ford was one of its biggest infotainment system customers. Pioneer navigation systems were used in 23 different Ford, Lincoln and Mercury models. Since then, almost all of that business has gone to Clarion, a competitor; though Pioneer says it continues to produce some non-navigation head units for Ford as well as some audio products.

By 2010 Pioneer’s U.S. OEM business had declined to the point where only one of the 83 vehicle models that offered navigation had a unit that was built by Pioneer, the Acura TL.

The company has secured new OEM navigation business for applications in Japan, China and South America.

**Strategic Alliances**

- **Honda Motor Co.**
  The move to allocate stock to Honda goes along with Pioneer’s intention to strengthen its business relationships with key customers. Honda, which has purchased audio and infotainment systems and components from Pioneer, is one of Pioneer’s top OEM Car Electronics customers. Now that Honda owns a significant piece of Pioneer, the carmaker will likely be more motivated to source Pioneer products.

- **Mitsubishi Electric**
  Pioneer and Mitsubishi Electric will jointly develop software and hardware platforms for infotainment systems. Increasingly complex, embedded infotainment systems have advanced to the point where development costs now run in the tens of millions of dollars for each customer. The bulk of that investment goes into software. Pioneer expects the alliance will yield a decrease in its development cost of about 30% for each co-developed model. The new platforms’ middleware including APIs is intended for reuse, according to Steven Moermer, president and COO of Pioneer Automotive Technologies. The operating system will be based on WinCE from Microsoft. Aimed at the low- and mid-priced navigation market segments, the hardware platform is the SH7777 (SH-HaviJ3) system-on-chip from Renesas.

  The alliance partners intend to develop information services by combining Mitsubishi Electric’s ability to develop platforms and technologies to interact with vehicle data together with Pioneer’s server and digital map capabilities. Further, Mitsubishi Electric will get access to Pioneer’s Smart Loop vehicle probe data gathering service.

- **NTT Docomo**
  In October 2010, Pioneer and Japan’s largest cellular phone carrier, NTT Docomo, agreed to collaborate on a business to provide smartphone-based navigation services to drivers. The agreement pairs Docomo’s high-quality Japan-wide communications network and services with location-based services, software and hardware from Pioneer. Among Pioneer’s several contributions is a navigation engine designed for Android smartphones, its vehicle probe data, and up-to-date server-based digital maps.

  To accommodate the customer’s smartphone, Pioneer has developed the Smart Cradle, which can mount to either the dashboard or windshield. Equipped with an enhanced GPS receiver, accelerometer and gyro, Pioneer’s cradle enhances the location accuracy of the smartphone.

  The Smart Cradle has built-in speakers and a Bluetooth communications link for hands-free calling, music and voice-based route guidance via the smartphone. The device automatically adjusts audio volume according to driving speed. It also includes a color-coded LED that indicates eco-friendly driving.

  Launched in April 2011, Pioneer expects Smart Cradle sales to benefit from

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Data: Pioneer Of course, Mitsubishi Electric will get access to Pioneer’s Smart Loop vehicle probe data gathering service.

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Launched in April 2011, Pioneer expects Smart Cradle sales to benefit from
unprecedented growth in the Japanese smartphone market. (Please see chart on page 6.)

To complement the Smart Cradle, this fiscal year Pioneer says it will introduce an audio/display peripheral and next year a smartphone-compatible head-up display. Pioneer and Docomo are exploring future expansion of their smartphone alliance to markets outside Japan.

◆ SAIC Group

In December 2009, Pioneer announced a joint venture with China’s largest carmaker, SAIC Group. Known as Anyo Pioneer Motor Information Technology Co., the joint venture is 49% owned by Pioneer and will mainly serve SAIC’s affiliated companies Shanghai General Motors and Shanghai Volkswagen. With Pioneer contributing its manufacturing, software development and map database editing expertise, the JV is developing an extremely low cost line of navigation systems for the Chinese market. Anyo Pioneer is also developing traffic information systems to help customers navigate around China’s increasingly severe traffic congestion.

The joint venture is targeting $75 million in sales for FY 2012 and $200 million in FY 2013.

CD Mechanism Market Decline

Pioneer first developed CD players for the car in 1984 and since then has been among the leading suppliers of CD players worldwide. In 2008 alone Pioneer shipped nine million car CD players to aftermarket customers. But as consumers worldwide have turned to portable music players such as the iPod and iPhone, the demand for CD players has waned. According to Pioneer, the consumer market for CD players will decline from 32 million units in fiscal 2008, to about 24 million units in 2013.

In response Pioneer says it will aggressively sell lower cost car CD players especially in the emerging markets, where it believes demand is not yet declining.

Fixed Navigation Aftermarket Flattening

With navigation by means of smartphones on the rise, the market for portable navigation devices has peaked. The global aftermarket for fixed (in-dash, non-portable) navigation systems will peak at about 1.6 million units in fiscal 2012 and decline from there, according to Pioneer.

Despite these headwinds, Pioneer is forecasting an increase in its own aftermarket sales of fixed navigation units, from roughly 610,000 units in FY 2011 to more than 900,000 in FY 2013.

To achieve that growth Pioneer will bring down the cost of its navigation units and dramatically improve its share in the developed markets. Pioneer expects its share of the Japanese market to grow from 28% in fiscal 2010 to 40% in 2013. In the same time period it expects to take its share of the North American market from 39% to 55%; more modest share growth is predicted in Europe, from 25% to 27%.

New Products

◆ HVT Speakers

A world’s first, Pioneer has developed speakers that use horizontal-vertical transforming (HVT) technology to achieve rich bass sounds in a very thin, lightweight speaker. HVT speakers save space by employing a linkage mechanism inside that transforms the horizontal movement of the voice coil into vertical movement of the diaphragm. While the company sees potential for the speakers in flat panel TVs and elsewhere in the home, the first HVT speakers were released as car speakers in January 2010. Not inexpensive, a pair of HVT speakers costs ¥29,380 ($366) retail.

◆ Zypr

Pioneer’s U.S. operations in San Jose and Long Beach, California, will soon introduce Zypr, a new voice-controlled Internet services platform, formerly known by its in-house name, PAIS (Platform for Aggregation of Internet Services). With Zypr onboard each connected device—be it a vehicle head unit, television, smartphone or tablet—consumers will be able to access their favorite Internet services using the same simple voice commands, regardless of the device they are using.

“The idea for Zypr was started about three years ago at Pioneer headquarters in Japan,” said Lou Brugman, vice president of product planning at Pioneer Auto-
Autonomous...

vehicle, more lives will be saved, more injuries will be prevented and traffic flow will improve, saving everyone time and money. Industry experts agree, however, that reaching full autonomy will be a step by step process that will take at least two more decades to complete.

“There are hardly any technical issues left,” said Jürgen Leohold, executive director of Volkswagen Group Research. “So our aim is to support the driver, not only in the complicated situations he can no longer control, but also in the monotonous driving situations such as driving for hours at high speed on a straight highway with very little traffic, or in congested stop and go traffic at low speeds.”

In June 2011, Volkswagen demonstrated its Temporary Auto Pilot (TAP) system at the conclusion of the European research project HAVEit (Highly Automated Vehicles for Intelligent Transport). TAP was designed to relieve the driver from monotonous driving by combining adaptive cruise control and automatic lane keeping. The vehicle sensor platform consisted of what Volkswagen calls “production-level” radar, camera and ultrasonic sensors supplemented by a lidar sensor from Ibeo Automotive Systems, a German company aligned with Valeo. Dr. Leohold believes it is possible to deploy a system like TAP within this decade.

Peter Rieth, Continental’s vice president of advanced engineering, agrees that the features that will precede fully autonomous driving, such as temporary piloting, at least at low speeds, and platooning, could be on the market in the next five years.

Both Stefan Wolfsfried, Mercedes’ vice president of electrical/electronics and chassis, and Martin Haub, group senior vice president for R&D and product marketing at Valeo, suggested some form of automated convoy driving would be a feasible early step.

Challenges Remain

While the future looks promising for intelligent vehicles that can handle complex driving tasks, more development work remains. Computer processing power onboard the vehicle is no longer an obstacle. The cost of radar sensors, once a restricting factor, is low enough that radar-based features are proliferating. The huge market for cell phones has brought the price of camera sensors very low. Laser sensors are also coming down in price, slowly, and they are getting smaller.

Dr. Rieth observed: “We have the cameras and we can fuse different camera images into one picture. We have the actuators, more or less. We have remote control over braking, we have engine control and we can control [electric] power steering. The next step is to bring more functions, and this is very strongly correlated with artificial intelligence.”

Carnegie Mellon professor of electrical and computer engineering Raj Rajkumar believes the biggest challenge remaining, “will be the software and the algorithms that are doing the fusion of the sensing, computing what needs to be done, and then sending that to the actuators and reacting in real time.”

Vehicle to vehicle communications systems also need to be deployed to fill in the gaps where the onboard sensors can’t see, for instance, an accident around the corner in the road ahead. Crucial too is the ability to generate 3D maps from the data the sensors gather as the vehicle moves through its environment.

What may prove to be among the most difficult tasks facing automotive OEMs is getting consumers to acknowledge the safety benefits afforded by these new control systems. In order to gain customers’ trust, autonomous features must function more reliably than a human driver.

“There is still a long way to go to make these systems cost effective and at the same time fulfill automotive reliability and safety requirements,” cautioned Dr. Leohold.

NHTSA...

sink in their ratings as well.

A NHTSA presentation from September 2010 entitled “NHTSA’s Review of Existing Distraction Guidelines,” gives some clues about what its new guidelines might look like. They will likely cover not only “telematics devices,” as the AAM guidelines published in 2006 do, but will also address radios, “due to their increasing complexity.” NHTSA’s guidelines might also restrict or lock out “technologies not intended for use while driving...such as social networking sites.”

Paul Green, a research professor at UMTRI’s Driver Interface Group, who has worked extensively on driver distraction standards, thinks the new guidelines will tighten AAM’s test standards and make them more specific. “There are lots of gaps in the voluntary AAM guidelines. I think the test protocol is going to be revised. ... AAM’s process in developing its guidelines was not an open comment process.” The AAM guidelines were created by the carmakers who sell vehicles in the United States.

There is wide agreement that manually texting from a portable device while driving is deadly. Thirty-four states have already passed legislation prohibiting it. But what about texting via speech? Will that prove less dangerous? There are many variables that need to be taken into account since when and how features are used makes a difference. For example, what is distracting to a 75-year-old driver may not be at all distracting to a 35-year-old. Tasks that would be dangerous while driving at night through rain might not be distracting on a sunny day.

Despite NHTSA’s efforts, confusion about which electronics features are distracting and which aren’t will continue, particularly as embedded systems and carried-in devices become more capable. This problem will confound regulators and keep researchers busy for many years. Regardless, human drivers will always be subject to distraction. While helpful, the ultimate solution to the distraction problem is not regulation; it is taking humans out of the equation. Autonomous vehicles and their precursors are a better answer and they are not very far away.