SKF makes by-wire business case

Even without a full by-wire vehicle in series production today, a maker of seals, bearing units, and lubrication systems makes a case for staying focused on the development work needed to make a drive-by-wire vehicle a mass-production reality.

SKF helped change the commercial aircraft industry in the 1980s by offering electromechanical systems as a replacement for hydraulic control devices. A similar massive technological change could transpire in the automotive industry if a Swedish-based company can further refine an assortment of by-wire technologies including steering, braking, and transmission controls.

The Novanta concept showcases by-wire technologies. SKF helped pioneer the development of commercial aircraft fly-by-wire systems, then in 1995 began to re-engineer that technology for vehicle applications.

Novanta's human machine interface employs a handle mechanism that is integrated into the driver's door. Once the driver is seated, the mechanism swings from the door to form a controls pod for the driver.

"The by-wire activity here certainly has been the most active area in the past three or four years in terms of actual patents issued to support the technology," said John Rumierz, Materials Group Manager at the North American Technical Center for SKF, who serves as the company's North American representative on the patents committee.

Mechanical, electrical, testing, materials, software, automotive, and aerospace engineers are among the various technical disciplines within SKF's Drive-By-Wire Business Unit. "We've learned a lot," said Steven Brown, Director of North America Programs for drive-by-wire, citing SKF's participation on by-wire concept vehicles: **General Motors**' Hy-wire, and others such as the Filo and Novanta.

The Novanta, developed in conjunction with **Bertone**, features several SKF-developed systems including steer-by-wire, brake-by-wire (done in collaboration with **Brembo** SpA), as well as transmission control and throttle interfaces. "Novanta is intended as a vehicle to get people to think about what could be," said Brown.

While showing the possibilities has gotten the industry's attention, SKF officials want to focus on the near-term prospects. "We're going to do more now with individual systems—like steer-by-wire—to further refine the feedback algorithms as well as further develop individual systems to get those systems ready for series production," said Brown, adding, "Steer-by-wire is still the most difficult application from a safety and a complexity standpoint."

Although the industry could opt for any number of by-wire technologies to get the next production application nod, steer-by-wire may be one of the last by-wire technologies to go mainstream. Brown expects that a hybrid brake system—described as having hydraulic actuation in the front and electromechanical in the rear—will be a near-term production entrant, likely reaching such status by the end of this decade.

SKF's by-wire endeavors emphasize the use of smart electromechanical actuating units (SEMAU), which means SEMAU activities will influence future SKF business, including sealing solutions for engines, transmissions, drivetrains, steering, and wheel-end systems. "Even though we're sealing up something completely different than what we've done in the past, sealing for air or impurities would be needed for by-wire applications," said George Dettloff, President of SKF North America's Automotive Division.

In 2000, it looked as though by-wire technologies were going to make a fairly fast progression to the marketplace. That has not been the case, "but we certainly haven't given up on by-wire technologies. We're convinced it's coming," said Dettloff. Added Brown, "It won't be the technologies that hold us back, it will be people's acceptance of the technologies."

Kami Buchholz

GM vehicles talk the talk

Rather than fitting cars with multiple sensors, the ability to equip roadway cruisers with simple technology is being touted as a cost-smart way of delivering vehicle-to-vehicle communication in a 360° safety net.

General Motors researchers envision two types of vehicle-to-vehicle (V2V) applications: passive and active. V2V in a passive application means a vehicle fitted with a transponder can communicate its presence to other transponder-equipped vehicles within a 0.25-mi (0.4-km) distance. In an active application, V2V means a vehicle is fitted with an antenna, a transponder, as well as a global positioning system (GPS).

"The active system also has a driver-

GM vehicles equipped with vehicle-to-vehicle technology can detect the position and movement of other vehicles.

Technology from GM uses one sensor to provide traffic information about other vehicles.

vehicle interface to provide warnings to the driver," according to Patrick Popp, Director of GM's Electrical and Controls Integration Lab, adding, "Active devices do not just broadcast information, they also use the information to warn and actively assist the driver."

By sending and receiving information about vehicle position, speed, as well as the direction vehicles are heading, the concept of V2V avoids unnecessary complexity. "In the future, we see this as a way to dramatically simplify the system," Popp said. In contrast, vehicles today can be fitted with a litany of sensors—such as long-range scanning sensors for adaptive cruise control, forward-vision sensors for object detection, mid-range blind-spot-detection sensors, and long-range lane-change-assist sensors. But those sensors require a clear line-of-sight.

GM recently demonstrated V2V communication to members of the media at its Milford, MI, proving ground. During the demonstrations, V2V technology provided a safety alert—an amber light in the side mirror—during a lane change when a vehicle was detected in the blind spot. Forward collision avoidance was provided via chimes, visual icons, and haptic seat vibrations when a potentially serious problem was detected. And automatic braking occurred when an immediate danger of a collision was predicted.

GM's work with V2V communications requires a precise response based on the information about moving and nonmoving vehicles on the roadway, so "the mathematics behind this is pretty sophisticated and pretty important," said Larry Burns, GM Vice President of Research & Development and Strategic Planning. "The information processing requires continuous calculations," added Popp.

Systems engineering and testing/validation are the next steps in the development process as is "identifying a cost-effective deployable solution for large-scale deployment," noted Popp.

In related news, a vehicle safety communications project—addressing development aspects of vehicle-to-vehicle and vehicle-to-infrastructure technologies—was completed in 2005 by the Crash Avoidance Metrics Partnership (CAMP), a group that includes GM and other automakers. Another CAMP project on vehicle safety communications is likely.

Kami Buchholz

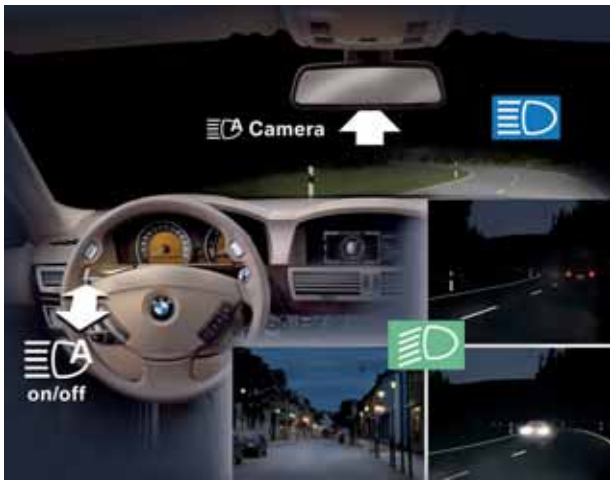
While a vehicle is visible in the rearview mirror, an amber-colored alert indicates that a vehicle is in the blind zone of the right side of the vehicle.

Looking ahead with BMW

BMW is now offering Night Vision and High-Beam Assist technology on 5, 6, and 7 Series models in Europe. No timetable is published for the introduction of either technology to the U.S.

Night Vision is a far infrared (FIR) system, developed with help from **Autoliv**, that can "illuminate" any heat-emitting objects up to a range of 300 m (985 ft) ahead of the car. It presents an image on the car's iDrive screen and is said by BMW to be particularly effective on long stretches of unlit roads.

BMW's Night Vision uses far infrared technology developed in conjunction with Autoliv.



Gentex worked with BMW to develop its High-Beam Assist technology.

The R&D program for Night Vision involved both near infrared (NIR) and FIR being considered. NIR uses a source of infrared light and an infrared camera mounted on the front of the car. Infrared light reflected from objects is collected by the camera and processed into an on-screen image. FIR uses a thermal imaging camera to directly register heat radiated from objects, with an image displayed on screen.

Evaluation work using both resulted in BMW's decision to opt for FIR. Several factors were in its favor: no necessity for another light source to be projected from the car, so fewer components would be necessary; FIR was found to offer a greater area of coverage; unlike NIR, FIR could not be affected by the lights of oncoming vehicles, traffic lights, or highly reflective road signs.

Night Vision is activated by a button close to the headlight switch, and there is iDrive-selectable adjustment for brightness and contrast of the image, which can be displayed in full or split-screen mode. The camera has a wide-angle lens and a digital zoom-in/out function.

BMW developed High-Beam Assist for production following research work that indicated that high-beam headlights could—and perhaps should—be used on 75% more occasions than they are. And when drivers do select high beam, they may fail to dip the lights again sufficiently quickly to avoid dazzling oncoming vehicles. The system is based on SmartBeam from **Gentex**, and is offered in conjunction with Xenon headlamps.

High-Beam Assist uses a light-seeking camera positioned in the rearview mirror housing to monitor the road 1000 m (3280 ft) ahead of the vehicle. The system is activated when the headlight switch is in the "automatic" position with the dip/high beam stalk in the high-beam position. Headlamps are automatically returned to low-beam status when either headlamps or taillamps of other vehicles are detected.

Bi-Xenon headlights are able to illuminate the road 150 m (492 ft) ahead of the car. Another option on the 7 Series is dynamic bend lighting from **Hella**. The lamp module is swiveled according to the radius of the bend being negotiated, and reacts according to driving speed. The area illuminated by the low beam when entering a bend is almost doubled, according to the company.

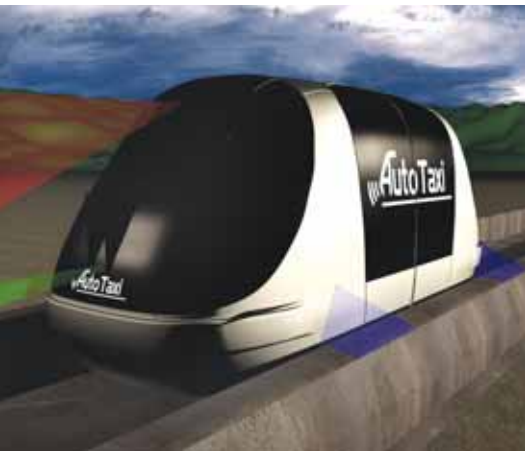
Stuart Birch and David Alexander

AutoTaxi focuses on sensing

"Developing cars that do things which are second nature to the average driver is a hugely complex process," said Alastair Buchanan of **TRW Conekt** and Manager of the UK's **SMMT** (Society of Motor Manufacturers and Traders) Foresight Vehicle project called AutoTaxi. "The vehicle has to be able to sense and interpret the vast array of information in all driving conditions. AutoTaxi will help identify the best combination of sensor technologies that may take this concept a step closer to reality."

The Foresight project has seen the involvement of some 400 companies and universities studying the future of the automobile and every aspect of the direct and indirect technology associated with it.

Sensor technologies are a central element of the "thinking" car. The AutoTaxi



The Foresight project's AutoTaxi: a vast multi-discipline program would be needed for effective, wide-ranging autonomous vehicle operation.

aspect of the Foresight Vehicle project is to develop safety-critical sensors and systems and to interpret critical information about a vehicle's local environment (the road ahead), the presence and movement of vehicles, and other obstacles on it. The SMMT believes the work to be integral to paving the way to future autonomous vehicles.

Sensors already have roles in modern vehicles including for radar-based adaptive cruise control (ACC) and electronic parking aids. "Many research projects are using sensors to help develop the transport systems of tomorrow," said an SMMT spokesperson. "Advanced Transport System's Urban Light Transport (ULTra) is an example of a project that has developed driverless vehicles which run on dedicated tracks."

The AutoTaxi research work has included the application of current automotive sensors to ULTra vehicles at ATS' test track. Starting with simple assessments on a figure-eight roadway, the tests have been developed to investigate more complex scenarios including the simulation of real-world driving conditions such as vehicles approaching from side roads.

Phase one of the project linked TRW's video lane guidance and ACC radar with lidar (which uses light to measure distance and speed), together with ultrasonic sensors. These were fine-tuned with the addition of stereo video sensors and an LED rangefinder. The trials indicated particular potential for an LED rangefinder system.

But autonomous vehicles are likely to be way into the future. Buchanan said that aside from the cost of such technology, a vast cooperation program would be needed, enabling communication between vehicles together with a fully integrated road infrastructure.

AutoTaxi partners also include **Praxis High Integrity Systems** and the universities of **Bristol** and **Warwick**.

Stuart Birch