By-wire replacing mechanical systems

**Chassis & Materials**

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**TIM Moran**

**AUTOMOTIVE NEWS EUROPE**

By-wire systems can eliminate some of the jumble of hydraulic and mechanical links in the car, replacing them with an electric architecture controlled by microprocessors. A big benefit is that by-wire requires fewer mechanical parts. That gives automakers greater flexibility in a vehicle’s design. For example, the driver could be positioned anywhere inside the car. Even in the back seat.

Here’s why: Drive-by-wire technology uses sensors to translate steering or braking movements by the driver into electronic signals. Onboard computers interpret the movements and relay them to electric motors and actuators connected to the moving parts of the car. The systems respond more quickly than today’s controls and can give feedback to the computer as they operate, allowing the car to deliver precise performance.

By-wire systems already have replaced direct links in one area. “Most cars nowadays don’t have a mechanical linkage between the accelerator pedal and the fuel injection system. It’s done electronically, and most people don’t even realize there’s no mechanical linkage,” says Steven Brown, director of North American Programs for SKF Automotive’s drive-by-wire business unit.

**Little fanfare**

While General Motors demonstrated drive-by-wire on its Autonomy and By-wire fuel cell concept cars in 2002 and 2003, more progress has happened with less fanfare in recent years — especially in European-built vehicles. Brakes, transmissions and safety systems are bringing by-wire technology into the vehicle in small steps.

Electric parking brakes such as those on the BMW 7 series, Audi A8 and Renault Vel Satis are examples.

**ELECTRIC POWER STEERING**

Electric power steering removes the need for hoses and pumps, and offers fuel savings over hydraulic steering.

**HOW IT WORKS**

A battery-driven electric motor provides the drive on the steering system rather than a hydraulic device operated by the engine. The solution also disconnects the steering system’s power needs from the engine resulting in better fuel economy than hydraulic steering in a typical small car.

**WHERE TO FIND IT**

Electric power steering is most common in Europe and Japan but can also be found in the US. Globally, about half of all new cars are expected to have electric power steering by 2010. The majority of the new small cars in Europe and Japan now have the technology. The 2005 Volkswagen Passat is the first volume car above the lower-medium segment in Europe to get the technology. In North America, electric power steering is standard on Chevrolet Malibu. The technology also is available on the new Lexus GS and typically is found in hybrid cars.

**OBSTACLES**

For suppliers, the cost of electric power steering is still relatively high, said Peter Rieh, head of advanced engineering at Continental Automotive Systems. As a result, he said, “OEMs [are] very keen to have extra functions when they have

**Delphi supplies its column-drive electric power steering to the Opel Meriva. The electric motor is mounted on the steering column (circled).**

Delphi, Koyo, NSK, Showa, TRW Automotive, Visteon, ZF Lenksysteme.

**By-wire adaptation stumbled when promised 42-volt electrical systems failed to become an industry standard, but new dual-voltage systems offer promise of enough power for high-force uses such as braking and steering. A European consortium called SPARC – short for Secure Propulsion using Advanced Redundant Control – and organized by DaimlerChrysler and Fiat is working on by-wire accident-avoiding truck and car demonstration vehicles.**

** Losing the link**

Primary suppliers of by-wire solutions:

- Bosch
- Continental
- Delphi
- Denso
- Johnson Controls
- Hitachi
- Magneti Marelli
- Magna Steyr
- Mitsubishi Electric
- Motorola
- Siemens VDO
- SKF
- Toyota
- TRW
- Valeo
- Visteon

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ELECTRONIC STABILITY CONTROL

Electronic stability control helps prevent skids and swerves that can happen in an emergency. This makes ESC especially effective in combating rollover accidents.

HOW IT WORKS

The electronic control unit at the heart of the ESC system brakes each wheel individually and decreases engine torque to maintain a stable direction of travel. ESC continuously monitors key inputs such as yaw rate and wheel speed.

WHERE TO FIND IT

The overall installation rate in 2004 was about 40 percent in western Europe. It took antilock brakes twice as long to achieve a similar level, according to data from German supplier Robert Bosch.

A law adopted in August 2005 requires US regulators to develop standards aimed at preventing rollover crashes. Even without the new law, the US National Highway Traffic Safety Administration appeared headed toward adoption of an antirollover rule. Automakers also have been increasing installation rates for electronic stability control systems in the US. As a result, installation rates should grow to about 50 percent of all passenger cars in North America by 2009.

TRW Automotive has cooperated with Goodyear to develop ESC that can be linked to the characteristics of the tires. New tires are often fitted with identity tags. Using those tags “we can tailor the ESC software to suit different tires and wheels,” says Phil Cunningham, product business director for chassis systems at TRW Automotive. “For examples, components align differently, rendering it thicker or thinner as needed. A computer controls the coil to provide very fast reaction to road inputs based on input from sensors that monitor body and wheel motions. Others, including ZF Sachs of Germany, use a valve control mechanism for damping. Continuous valve control uses a combination of acceleration, displacement and steering sensors to help an electronic control unit choose a damping level for the suspension. An electronic valve on each shock or strut reacts to the computer commands by restricting or enlarging the channel that oil flows through.

CONTINUOUS DAMPING CONTROL

Continuous damping control is an electronic system that can adjust the tension in a shock absorber to create a more dynamic ride quality for the vehicle. The technology includes the use of magneto-rheological fluid that can be made syrupy or water-like depending on a mild electrical current. Other suppliers use electronics to continuously vary the valves that control fluid flow within the shock. Both systems let the shocks adjust to road input for maximum stability, handling and comfort.

HOW IT WORKS

In US supplier Delphi’s system the oil normally used in shock absorber struts is replaced by a magneto-rheological fluid, which surges through special orifices to dampen axle motion. When an electromagnetic coil inside the damper’s piston is activated, the fluid’s pressure monitoring systems or electronic stability control because it offers fewer clear-cut benefits to the consumer. The main issues are cost and maintenance. Shocks are a high-wear item, which means replacement could be expensive. Also, integrating electrical, mechanical and hydraulic components in an exposed underbody location increases the complexity of diagnostics.

PRIMARY SUPPLIERS

The main suppliers are Delphi, Tenneco Automotive, ZF Sachs, Continental Teves and many other shock absorber makers.

Sensors for acceleration, displacement and steering help an electronic control unit (ESC) choose a damping level for the suspension in ZF Sachs’ system.

PLASTIC PARTS

Suppliers are substituting super-strength plastic for steel in some components such as front-end modules and instrument panels. It’s a trend that began in Europe and is finding its way into North American vehicle programs.

HOW IT WORKS

Injection molded plastic is mixed with glass fibers to create high-strength structural frames and carriers for components. These structural parts are stronger than standard plastic parts.

WHERE TO FIND IT

Faurecia of France announced in July 2005 that it won a contract with the Chrysler group, which includes Chrysler, Dodge and Jeep, to make what it calls High Integrated Module door systems in the US using a carrier made with an injection molded long-fiber thermoplastic. The module consists of a single structural plastic part that includes mechanical functions such as the window lift unit, internal and external handles, speakers and electrical harness. In addition, ArvinMeritor recently introduced what it terms as its Highly Integrated Plastic door module, which also uses a thermoplastic composite to replace a steel inner structure.

OBSCTACLES

Although the price of steel is high, the resins used to make high-strength plastics may cost more per pound than steel.

PRIMARY SUPPLIERS

Faurecia, ArvinMeritor, HBPO (a joint venture with Hella, Behr and Plastic Omnium), RheTech Inc., Owens Corning.

– Rhoda Miel, Chaz Osburn

WHERE TO FIND IT

This technology is mainly seen in high-end and sports cars, but that is starting to change. “Now it’s moving into medium-class cars,” said Thomas Kutsche, head of development of variable damping systems at ZF Sachs. “There’s a general trend in this direction.” In 2004, ZF Sachs provided continuous damping control to 175,000 vehicles. For 2005, it will supply about 225,000 vehicles. The new Ford Galaxy large minivan will have Ford’s new continuous damping control.

OBSCTACLES

This technology is moving slower into mass-market vehicles than others such as tire pressure monitoring systems or electronic stability control because it offers fewer clear-cut benefits to the consumer. The main issues are cost and maintenance. Shocks are a high-wear item, which means replacement could be expensive. Also, integrating electrical, mechanical and hydraulic components in an exposed underbody location increases the complexity of diagnostics.

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– Alex Graham

WHERE TO FIND IT

Cunningham, product business director for chassis systems at TRW Automotive. “For

WHERE TO FIND IT

The modulator (1) and electronic control unit (2) are at the heart of Continental’s second-generation electronic stability control system. The system provides individual wheel braking to keep a vehicle from sliding out of control.

little or no cost, we can increase the performance of the ESC.”

OBSCTACLES

Consumer and dealer awareness of ESC remains relatively low, especially in North America. As a result, Bosch in particular has put considerable effort into holding events to raise awareness among consumers. ESC systems are increasingly required to interact with a number of other systems in the vehicle – such as steering, adaptive cruise control and tires – increasing the risk of electronics problems.

PRIMARY SUPPLIERS

Adics, Bosch, Continental Teves, Delphi, TRW Automotive.

– Alex Graham

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