

Algorithms in action: Bosch Vehicle Motion Management revolutionizes the driving experience

Vehicle Motion division provides solutions for even better safety, dynamics, comfort, and driving enjoyment

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- ▶ Hardware-agnostic software controls vehicle motion in all directions.
- ▶ Vehicle Motion Management makes innovative, cross-domain functions and simplified vehicle architectures possible.
- ▶ “eBrake to zero” software function ensures smooth, jolt-free braking.
- ▶ Bosch supplies act-by-wire solutions and has extended its braking portfolio to include a by-wire brake actuator.

Renningen, Germany – Aiding the transformation of mobility, shaping the vehicle motion market with integrated chassis solutions, and in this way making driving even safer, more dynamic, and more convenient – those are the aims of the Bosch Vehicle Motion division. Since the start of 2024, this new unit has brought together expertise from the domains of braking, steering, vehicle motion software, occupant protection systems, and vehicle dynamics sensors under one roof. Aside from braking and steering actuators, the division is developing solutions to meet the requirements of software-defined vehicles and by-wire technologies, as well as hardware-agnostic control software such as Vehicle Motion Management and the services to go with it. Its product portfolio encompasses both hardware components and embedded software as well as standalone software solutions. In this way, Vehicle Motion makes not only innovative, cross-domain functions and simplified vehicle architectures possible for automakers, but also completely new interior designs. At the Bosch Tech Day 2024, Vehicle Motion will be premiering the latest solutions from its product portfolio to an audience of international media representatives:

Vehicle Motion Management

Vehicle Motion Management is a cross-domain software systems solution. It controls vehicle motion in all six degrees of freedom, coordinating braking, steering, powertrain, and suspension. Hardware-agnostic software features optimize vehicle dynamics, handling, and efficiency. In addition, Vehicle Motion

Management helps make the complexity of new vehicle architectures manageable. Its systems-integrating software on central vehicle computers controls the diverse actuators of the various vehicle domains. Vehicle Motion Management also includes data-based services that enhance safety and convenience.

eBrake to zero

This software function prevents the irksome jolt that occurs shortly after a vehicle comes to a stop. For vehicle occupants, braking in stop and go traffic is made significantly more pleasant and comfortable, and motion sickness can be prevented. The function also noticeably improves vehicle noise during braking. By optimally controlling an electric vehicle's motor and braking system, the function ensures that the electric motor brings the vehicle smoothly to a standstill without any need for the hydraulic brake to intervene. If the hydraulic brake is needed, occupants will not notice the transition from motor brake to hydraulic brake.

Data-based services

Vehicle Motion Management's portfolio of cloud- and data-based services includes a "road perception" service. This uses the vehicle's sensor data to generate information about the state of the road and road-friction coefficients. In the cloud, this sensor data is merged with information from other vehicles as well as with data from weather services to give drivers advance warning of hazards such as aquaplaning, ice, potholes, and speed bumps. These data- and cloud-based services can also be used to automatically adjust vehicle dynamics in bends, for example, as well as the driving strategy of the safety and assistance systems. The result is greater safety and a more comfortable drive.

Act-by-wire

Act-by-wire technologies replace the mechanical connections between the steering wheel and brake pedal and the respective actuators of the steering and braking systems with electrical signal lines. On the one hand, this makes new solutions possible that not only provide assistance in critical driving situations, but can also avoid such situations altogether. These solutions also enhance comfort and vehicle agility. On the other hand, they open up new space for interior design: act-by-wire technologies permit greater standardization in braking and steering actuators, allow a crash optimized installation, and take up less installation space. The vehicle's noise and vibration behavior is improved. The classic brake pedal can be replaced by new designs in which pedal travel distance is reduced or even eliminated altogether. Combining brake-by-wire with steer-by-wire reduces the number of variants for left-hand- and right-hand-drive vehicles. For safety purposes, redundancy is included in the design of the

braking and steering actuators, power supply, and communication of act-by-wire systems. For optimum control of by-wire actuators, Vehicle Motion Management software can be used.

Brake-by-wire

Comprising a by-wire brake actuator and an ESP®, the new robust and efficient Bosch braking system does away with the mechanical connection between brake pedal and braking system. Via redundant signal lines, braking request is transmitted from an electronic brake pedal to the by-wire brake actuator and the ESP®. The interplay of these two components means that the brake-by-wire system brakes more dynamically in all conditions. In the event of an error, both the by-wire brake actuator and the ESP® can build up the required braking pressure at all four wheel brakes. Doing away with the mechanical connection between brake pedal and braking system opens up new possibilities for the design of the human-machine interface and of the vehicle interior.

By-wire brake actuator

Based on a technology that has proved its worth millions of times, the new brake actuator translates the driver's braking intention into action. It is light and can be installed very flexibly in the vehicle without fixing it to the firewall. This makes it easier to design the vehicle so that it behaves better in the event of a collision. The brake pedal and by-wire brake actuator are connected by electrical lines. Consuming little energy, the actuator sets the hydraulic system pressure at all four wheel brakes. With its very rapid pressure build-up, smooth operation, and precise control, it is especially suitable for executing the braking requirements of the driver assistance functions and the emergency brake assistant, and for a smooth transition from motor to hydraulic braking. As the second brake actuator, the ESP® assumes the role of controlling individual wheels to stabilize the vehicle if necessary.

By-wire brake pedal

The introduction of brake-by-wire technologies and the elimination of the mechanical connection between brake pedal and braking system opens up new possibilities for the design of the human-machine interface and of the vehicle interior. The classic brake pedal is replaced by a redundant by-wire brake pedal that detects the braking request via sensors and transmits it to the braking system as an electrical signal. But innovative interior design is not the only benefit of its simple and flexible integration. The Bosch by-wire brake pedal also helps make the driving experience safer, more relaxed, and more personalized.

Steer-by-wire

In a steer-by-wire system, the mechanical connection between steering column and steering gear is done away with. The new system combines a steering-wheel actuator and a steering-rack actuator. Using precise sensor technology, the steering-wheel actuator detects the driver's steering request and transmits it digitally to the steering-rack actuator, which then steers the wheels accordingly. The steering-wheel actuator also creates steering feel by giving the driver feedback about driving state and road surface. Here, specific signals such as those from ruts or potholes can be partially or completely filtered out, damped, or even amplified, depending on the automaker's wishes. Furthermore, the steering-wheel actuator makes it possible to position the wheel to suit the individual driver or – in the case of highly automated vehicles – to stow away the steering wheel completely for a limited time.

Press photos and infocharts are available on the Bosch Media Service at www.bosch-press.com.

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The Bosch Group is a leading global supplier of technology and services. It employs roughly 429,000 associates worldwide (as of December 31, 2023). The company generated sales of 91.6 billion euros in 2023. Its operations are divided into four business sectors: Mobility, Industrial Technology, Consumer Goods, and Energy and Building Technology. With its business activities, the company aims to use technology to help shape universal trends such as automation, electrification, digitalization, connectivity, and an orientation to sustainability. In this context, Bosch's broad diversification across regions and industries strengthens its innovativeness and robustness. Bosch uses its proven expertise in sensor technology, software, and services to offer customers cross-domain solutions from a single source. It also applies its expertise in connectivity and artificial intelligence in order to develop and manufacture user-friendly, sustainable products. With technology that is "Invented for life," Bosch wants to help improve quality of life and conserve natural resources. The Bosch Group comprises Robert Bosch GmbH and its roughly 470 subsidiary and regional companies in over 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. Bosch's innovative strength is key to the company's further development. At 136 locations across the globe, Bosch employs some 90,000 associates in research and development, of which nearly 48,000 are software engineers.

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