

Safe automated driving from Bosch: centimeters make all the difference Bosch solutions for precise localization

November 27, 2018
PI 59 TW

- ▶ Dr. Dirk Hoheisel: “Only when hardware, software, and services are combined can automated driving be safe.”
- ▶ Precise localization for automated vehicles is critical to safety.
- ▶ Bosch vehicle motion and position sensor reliably determines the vehicle’s exact position.
- ▶ Bosch approach serves as a redundant system for vehicle localization.

Stuttgart, Germany – Automated driving is about more than just sensors, control units, and lots of computing power. It also requires a host of smart services, without which no vehicle will ever be able to drive autonomously. “Services are at least as important for automated driving as the hardware and software,” says the Bosch board of management member Dr. Dirk Hoheisel. “We must pursue all three paths simultaneously to get self-driving cars safely and reliably onto our roads.” Like barely any other global supplier of technology and services in the automotive industry, Bosch devotes significant effort into achieving a breakthrough in automated driving. In these efforts, it is creating integrated solutions. One area that demonstrates this is the safety-critical topic of localization. Self-driving vehicles can drive safely only if they know down to the nearest centimeter exactly where they are at any given time. To achieve this, Bosch offers a globally unrivaled localization package. Taken together, its hardware, software, and services serve as a redundant system for precisely determining the vehicle’s position.

Hardware: Bosch has developed its own motion and position sensor

Bosch has developed a sensor that allows automated vehicles to precisely determine their position: the vehicle motion and position sensor. This new sensor, which will be presented at the 2019 North American International Auto Show in Detroit January 14-17, includes a high-performance receiver unit for global navigation satellite system (GNSS) signals, which an automated vehicle needs to determine its absolute position. The challenge with satellite-based

positioning lies in dealing with inaccuracies in the data. GNSS satellites orbit the earth at a distance of 25,000 kilometers and at speeds of 4,000 meters per second. As their signals make their way to the ground, they must pass through the ionosphere and layers of cloud in the troposphere, which disperse the signals and introduce errors. While the signals are still accurate enough for today's navigation systems, they do not meet the needs of automated driving. This is why Bosch makes use of correction data supplied by various providers, and why it set up the Sapcorda [joint venture](#) in 2017. With the help of a network of terrestrial reference stations whose positions are precisely known, these providers can correct for the inaccuracy of GNSS positioning information. The correction data reaches the car via a cloud or geostationary satellites. GNSS signals are not the only information the vehicle motion and position sensor receives: thanks to wheel-speed and steering-angle sensors, which are akin to the human sense of touch, it knows where the car is headed and how fast. What's more, the vehicle motion and position sensor features integrated inertial sensors – comparable to the inner ear in humans. Just as people can move around with the help of their senses of touch and balance, so the sensor can use this data to tell where the vehicle is going.

Software: smart Bosch algorithms determine the vehicle's position

The vehicle motion and position sensor brings together the GNSS position signals, the correction data, and the information from the inertial sensors, the wheel-speed sensors, and the steering-angle sensor. However, this information alone is not sufficient for the exact localization of automated vehicles. For precise positioning, the data needs to be processed using intelligent software. Only then can an automated vehicle reliably know exactly where it is within an area stretching several meters around it and calculate its driving maneuvers accordingly. An automated vehicle is localized primarily on the basis of the corrected GNSS signals. If the satellite connection is lost, for instance when the vehicle enters a tunnel, the vehicle motion and position sensor can continue to determine the vehicle's position for several seconds. This involves calculating the vehicle's position relative to the last known point for which absolute positioning information is available. If the GNSS signal is interrupted for a longer period and it is no longer possible for the vehicle motion and position sensor to determine the vehicle's position, the automated vehicle can refer to the Bosch road signature for localization information.

Services: Bosch road signature is based on surround sensors

The Bosch road signature is a map-based localization service based on the surround sensors in the vehicles of today and tomorrow. Bosch offers the service alongside its vehicle motion and position sensor-based localization solution.

Bosch meets high safety requirements by combining the satellite- and vehicle motion and position sensor-based approach with the road signature's map-based localization service. Video and radar sensors on board vehicles in motion generate the Bosch road signature by detecting stationary features on and by the road, such as lane markings, traffic signs, and guardrails. In this regard, radar sensors have a major advantage, since – unlike cameras – they can detect road features in the dark or when visibility is poor. Their detection range is also greater. A communication module in the car sends data relating to features on and by the road to the cloud. There, the features are used to generate an independent map level, which in turn forms part of a highly accurate map. For their part, automated vehicles detect the road features around them and consult the map to see whether the traffic signs or guardrails they have recognized match those recorded there. This comparison enables the cars to accurately determine their position in the lane – relative to the highly accurate map – down to the nearest centimeter.

Press photos: #1709800, #1709801, #1709802, #1709803, #1709805

Bosch at NAIAS 2019:

- Monday – Thursday, January 14-17, 2019 at Cobo Center, Room 330A

Contact person for press inquiries:

Tim Wieland

Phone: +1 248-876-7708

Twitter: @timwieland

Mobility Solutions is the largest Bosch Group business sector. In 2017, its sales came to 47.4 billion euros, or 61 percent of total group sales. This makes the Bosch Group one of the leading automotive suppliers. The Mobility Solutions business sector pursues a vision of mobility that is accident-free, emissions-free, and stress-free, and combines the group's expertise in the domains of automation, electrification, and connectivity. For its customers, the outcome is integrated mobility solutions. The business sector's main areas of activity are injection technology and powertrain peripherals for internal-combustion engines, diverse solutions for powertrain electrification, vehicle safety systems, driver-assistance and automated functions, technology for user-friendly infotainment as well as vehicle-to-vehicle and vehicle-to-infrastructure communication, repair-shop concepts, and technology and services for the automotive aftermarket. Bosch is synonymous with important automotive innovations, such as electronic engine management, the ESP anti-skid system, and common-rail diesel technology.

About Bosch

Having established a regional presence in 1906 in North America, the Bosch Group employs nearly 34,500 associates in more than 100 locations, as of December 31, 2017. In 2017 Bosch generated consolidated sales of \$13.7 billion in the U.S., Canada and Mexico. For more information, visit twitter.com/boschusa, twitter.com/boschmexico and www.bosch.ca.

The Bosch Group is a leading global supplier of technology and services. It employs roughly 402,000 associates worldwide (as of December 31, 2017). The company generated sales of 78.1 billion euros (\$88.2 billion) in 2017. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building

Technology. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected manufacturing. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and regional companies in 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. At 125 locations across the globe, Bosch employs some 64,500 associates in research and development.

Additional information is available online at www.bosch.com, www.iot.bosch.com, www.bosch-press.com, [www.twitter.com/BoschPresse](https://twitter.com/BoschPresse).

Exchange rate: 1 EUR = \$1.12968