Press Release

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Bosch begins data collection on Kanto expressways for "Road Signature" vehicle localization technology for automated driving

Redundant vehicle localization from Bosch

- Map data for expressways in the Kanto Region to be completed by the end of 2020
- Road Signature: combined use of video and radar to provide redundancy and reliability
- Vehicle Motion and Position Sensor: Absolute position localization using corrected satellite data and inertial sensors
- Redundant system integrating services, hardware, and software
- Vehicle localization technologies at Tokyo Motor Show: Bosch Booth S3402

Yokohama — Since October 2019, Bosch has started data collection with its test vehicle on expressways around the Kanto region, such as the Tomei Expressway, the Chuo Expressway, and the Kan-etsu Expressway, for the Road Signature vehicle localization technology to create highly precise 3D maps for automated driving. Bosch plans to complete collection of data that can be integrated into highly accurate 3D maps by the end of fiscal year 2020.

Road Signature is a service that localizes a vehicle by comparing two types of data set; first, information of stationary features detected by radar and video sensors mounted on an automated vehicle while driving and, secondly, information of stationary features in a previously generated localization layer (map elements based on location data of stationary features detected by series production vehicles). By comparing these two data sets in real time, the service can constantly determine the relative position of the vehicle on the highly precise 3D map.

The company has been active in development of Road Signature towards commercialization in Japan since 2017. In 2018, Bosch succeeded in generating a highly precise 3D map which integrates maps provided by Dynamic Map Platform Co., Ltd.,* and Bosch's localization layer. In testing automated driving on public roads using this highly precise 3D map, Bosch confirmed that Road Signature is an effective localization service.

Safe automated driving with redundant vehicle localization concept
Automated driving can be realized when vehicle locations can be determined in the decimetre range. To achieve this, Bosch is developing vehicle localization technologies with redundancy that integrate services, hardware, and software.

Road signature: feature-based localization service for the relative position of the vehicle
With Road Signature, data captured by radar and video sensors mounted on the vehicle is transmitted to a cloud by an on-board communication module. Based on this data, a localization layer is generated on Bosch's cloud. Since it uses radar as well as video sensors, the system is highly robust also at poor weather conditions. Bosch's expertise gained from in-house development of radar and video sensors and deep knowledge of their respective characteristics is an advantage in developing Road Signature. Another feature of the service is its dynamics in data. Under the Road Signature concept, data is obtained from series production vehicles and service provider fleets. This enables changes in road status such as lane changes due to constructions and traffic accidents to be recognized, and a localization layer that reflects the changes can be provided.

VMPS: sensor for the absolute position of the vehicle
Bosch has developed a sensor that allows automated vehicles to precisely determine their position: the Vehicle Motion and Position Sensor (VMPS). The VMPS contains a receiver unit for global navigation satellite system (GNSS) signals which are essential for estimating the absolute position of an automated vehicle. However, inaccuracies in GNSS signals due to ionosphere and layers of cloud in the troposphere must be corrected. The VMPS is able to specify the absolute position of the vehicle using a corrected GNSS signal that satisfies the conditions for automated driving. GNSS signals are not the only information the vehicle motion and position sensor receives: thanks to an interface for receiving information from inertial, wheel-speed, and steering-angle sensors to determine the movement of the vehicle and intelligent software for processing this information. In cases where the GNSS signal is unstable, these on-board sensors assist with vehicle localization. If the satellite connection is lost, for instance when the vehicle enters a tunnel, the VMPS can continue to determine the vehicle’s position for several seconds by using information about the vehicle's direction and speed obtained from the on-board sensors to calculate from the position where the GNSS signal was last received.

However, Japan has environments where GNSS signals cannot be received for a longer period due to long tunnels, streets lined with skyscrapers, and multi layered expressways. Even in such challenging situations, redundancy provided

by the complementary technologies VMPS and Road Signature contributes to reliable automated driving.

Key technologies for automated driving at Tokyo Motor Show 2019

Bosch will present key technologies for automated driving, including vehicle localization technologies, at Tokyo Motor Show 2019. In addition to vehicle localization technologies, Bosch will introduce its wide-ranging portfolio such as surround sensing, on-board computers, in-cabin monitoring, redundant brake systems, and cyber security.

Tokyo Motor Show 2019

Press Briefing

Date and time:	October 24 (Thursday) 8:45 a.m. ～ 9:00 a.m.
Location:	Bosch booth (South 3/4 hall, booth S3402)
Speakers:	Board of management member, Robert Bosch GmbH Chairman of the Mobility Solutions business sector Dr. Stefan Hartung Board of management member, Robert Bosch GmbH Dr. Markus Heyn

Tokyo Motor Show highlights will be featured on a special website and the Bosch Japan Twitter feed.

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Additional information is available online at
http://www.bosch.co.jp Bosch Japan Website (Japanese)

https://twitter.com/Boschjapan Bosch Japan Twitter (Japanese)
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Mobility Solutions is the largest Bosch Group business sector. In 2018, its sales came to 47.6 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 fascinating, 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.

The Bosch Group is a leading global supplier of technology and services. It employs roughly 410,000 associates worldwide (as of December 31, 2018). The company generated sales of 78.5 billion euros in 2018. 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 460 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. The basis for the company's future growth is its innovative strength. At nearly 130 locations across the globe, Bosch employs some 68,700 associates in research and development.

Additional information is available online at www.bosch.com, iot.bosch.com, www.bosch-press.com, twitter.com/BoschPresse