Title: Digital Maps for Highly Automated Driving

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The use of new maps for automated driving applications is presented. Attention is focused on new requirements for maps and their implementation in automated driving functions.

New driver assistance systems will gradually path the way towards autonomous driving – a revolution in mobility. According to the WHO, more than 1.2 million people die annually in traffic accidents. The EU plans to reduce the number of deaths in traffic by 50 % by 2020. Automated driving will contribute to the reduction in people killed in traffic accidents.

Increased computing power of electronic control units, novel sensors and the ability to exchange information in networks are critical enablers for automated driving. The latest examples of driver assistance system provide evidence of this technological progress. Radar sensors detect other vehicles and initiate emergency stops if necessary. Stereo cameras detect pedestrians before a driver can detect them. Those are only a few examples to illustrate the progress made in sensor applications. However, sensors have physical limitations. They are limited in their visibility due to other vehicles and the course of roads, they dependent on weather conditions and their physical detection range has limits.

Limited perception of the vehicle's surroundings greatly impacts the trajectory planning of an automated vehicle. Real time situation analysis relates detected objects to the trajectory of the vehicle before the trajectory planning module computes the next move for the vehicle. A reliable understanding of the vehicle environment is key to making decisions about the classification of objects and planning of the vehicle trajectory. Thus, automated driving requires a flawless understanding of the vehicle surroundings, for example, traffic rules, detailed lane information or the course of the path ahead. While sensors have a limited detection range depending on environmental conditions, a digital map offers completely new possibilities to provide environmental information complementing existing sensors.

The information in such new digital maps will go behind conventional navigation maps – with respect to accuracy and precision as well as the scope of information they contain. Maps for autonomous driving require accurate information about lanes, their shape, the location of traffic signs and the position of traffic lights. The accuracy and reliability of those maps has to be in the range of ten centimeters to meter. New localization technologies are required to utilize these maps. Because GPS localization accuracy is not sufficient, novel vehicle localization techniques are needed. Recognizing landmarks is one approach to precise vehicle localization. The maps themselves then require new content such as landmark information.

A number of questions have to be resolved to permit successful commercialization of new maps for automated driving. New standards, technologies for efficient mapping and update strategies have to be defined. The consideration of a dynamic map layer to include information on, for example, temporary lane closures will add further complexity.