Electronic horizon
- efficiency, comfort and safety with map data

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The majority of driver assistance systems currently on the market or in the development phase would benefit from anticipatory map data. The electronic horizon, which is based on extremely precise and detailed maps, is indispensable to highly automated driving.

Today’s standard vehicle sensors, whether they are ultrasound, radar or camera-based, have all a relatively short action radius and limited information content. That is why map data from navigation systems has been used as an additional ‘long-range sensor’ since 2004. Initially, navigation system information was used to enhance radar-based distance control systems at locations such as motorway entrances and exits. Since then, the so-called electronic horizon has evolved into a supporting component in a wide range of vehicle comfort, efficiency and safety functions.

The initial scenarios still involved a proprietary protocol for transfer of electronic horizon information from the digital map to the function. This prompted the ADASIS Forum (www.ertico.com/adasisforum) to develop a standard protocol and interface specification. Vehicle manufacturers, ECU suppliers, navigation system & map specialists, and software companies are collaborating closely to develop a specification with reference implementation which can meet the increasingly complex requirements.

The Advanced Driver Assistance Interface Specification (ADASIS) ensures the problem-free interaction of the various components which are necessary to generate and use a continuous electronic horizon. In modern vehicles, map data relating to the route is sometimes used by more than ten different functions. These functions run in various ECUs, all of which have entirely different requirements for the electronic horizon. For example, an energy-saving function needs a very long route preview with uphill and downhill gradients and intersections, while predictive curve light systems process the curve radii just tens of metres ahead of the vehicle. In light of the fact that map material, navigation systems and ECUs from different manufacturers are used, a standard specification considerably simplifies the interaction between all these different elements. A global standard such as ADASIS opens up a new field of activity for tool providers. Sophisticated tools prevent potential errors and enable OEMs and Tier1 suppliers to assign their experts to function development rather than to development tool provisioning, support and error diagnosis.

Elektrobit offers a comprehensive ADASIS tool chain for Windows PCs. The core components – the ADASISv2 Horizon Provider and the Horizon Reconstructor – are implemented as target-capable code. Both modules can be used for ECU integration immediately after successful simulations or positive prototype tests. The EB Assist ADASISv2 Horizon Reconstructor ensures compliance with the ISO 26262 functional safety standard for road vehicles which is frequently demanded in driver assistance projects.

EB Assist ADTF is used as the development environment. It offers tools for simulation and data playback, as well as for recording test drive data. The EB Assist ADASISv2 Map Information Toolbox makes a series grade navigation solution available within EB Assist ADTF and generates electronic horizon data as per the ADASISv2 specification. The EB Assist ADASISv2 Reconstructor Toolbox is sent regular information updates from the provider via CAN bus, which it then sorts into the data structure. The driver assistance function retrieves the relevant data from the interface defined by the ADASIS-Forum.

Control of the entire ADASISv2 tool chain is simply realised with an iPad and the EB Assist Car Data Recorder Toolbox. Electronic horizon data and algorithm variables can be displayed and analysed during a test drive. Any conspicuous system behaviour or malfunctions can be noted by touch and voice commentary during the recording process. The iPad’s high resolution screen clearly displays the ADASIS data structure content on the Reconstructor page. In the 3D view, the test driver can see the road geometry at a glance.
The electronic horizon can be conveniently viewed and analysed on an iPad during the test drive.

In addition to the EB Assist ADTF Toolboxes by Elektrobit, dSPACE provides the ADASIS v2 HR Blockset for Simulink. Driver assistance functions developed in Simulink access the ADASIS data via standard API. After a desktop simulation, the ADASISv2 Reconstructor and the application can be transferred to dSPACE Prototyping Systems such as MicroAutoBox in one step. The EB Assist ADASISv2 Map Information Toolbox can be used as provider in this process. It transfers the electronic horizon data to the dSPACE Prototyping System via CAN bus or Ethernet interface. Many sophisticated tools covering every phase of the development cycle are available for the development of driver assistance functions with electronic horizon.

The electronic horizon in practice

Digital map data relating to a route can enhance or facilitate a range of driver assistance functions, such as algorithms that reduce energy consumption. The software can only optimise acceleration or deceleration if it has route data relating to longer distances, including corners, uphill and downhill gradients and intersections. Ancillary systems (heating, air-conditioning, air pressure, oil pressure) offer additional scope for consumption optimisation through adjustments to speed and gear changes. For example, an air-conditioning system can be turned down before the vehicle enters a tunnel. There is enough cold air still in circulation to keep the car air conditioned until it enters the tunnel. Active air-conditioning isn’t necessary inside the tunnel because there is no sunlight entering the car. Just before the vehicle reaches the end of the tunnel the air-conditioning system can be gradually turned up again to counteract the heating effect of the sunlight when it emerges. The tunnel entrance and exit markers in the map data are sent via ADASISv2 protocol to the air-conditioning system’s ECU long before the vehicle reaches the tunnel. Heavy vehicles such as trucks and coaches profit even more than cars from advance data on the route. As a result of their considerable weight, even small adjustments such as minor deviations from target speed of just a few km/h have a measurable effect on fuel consumption. The investment for installing an additional module in the vehicle can be amortised in less than two years, depending on what the vehicle is used for.

Further examples of driver assistance functions that are possible as a result of the electronic horizon are curve speed warning, predictive curve light and energy management in hybrid and electric vehicles. Driver assistance functions that are enhanced by electronic horizon are ACC (Adaptive Cruise Control), SLI (Speed Limit Info) and Traffic Sign Recognition. The functions mentioned above also work without map data. However, with the help of electronic horizon, they are even more reliable and convenient.
Image processing algorithms for Traffic Sign Recognition with maximum speed limit work surprisingly well. They even deliver excellent recognition rates in bad weather and at night. However, there are also scenarios in which a camera simply doesn’t have a chance - when the sign is blocked by another vehicle, for instance. Context also often plays a role. A 60km/h sign at a motorway exit only applies to the slip road. With the map data it is easy to identify this. The blending of information sources, i.e. data from the electronic horizon, image processing data and vehicle data such as speed and indicator, makes it possible to display the maximum admissible speed practically constantly.

There are also different solution concepts on the provider side. Initially, the head unit supplier can upgrade the navigation system with an ADASISv2 provider and distribute the data to the ECUs in the vehicle via a CAN bus. However, to install driver assistance functions that require map data, a head unit is essential. So the customer has no option but to buy the on-board navigation system, even if he prefers to use his smartphone.

Alternatively, it is possible to install a self-contained module that generates electronic horizon data independently of the head unit. A navigation core without user interface and map display is used to generate and send electronic horizon data along the so-called “most probable path (MPP)”.

This is the preferred system architecture in the truck segment. However, even in the car segment, where there is a wide range of navigation solutions for low to high-end cars in the US, European and Asian markets, an independent electronic horizon provider simplifies model policy.

All of the applications described up to now use static map data. Up-to-date information about traffic, road condition or road works with narrow lanes, for example, are not currently provided by the electronic horizon. This is about to change with the revised version of the ADASIS specification (Version 3). ADASISv3 transfers the high precision and up-to-date map data from the cloud to the ECUs to make the electronic horizon fit for highly automated driving.

Detailed information of the EB Assist Electronic Horizon Solution is available on our website.

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