Driver assistance functions for safety inland vessel navigation

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Inland shipping is an important pillar of the European transport system, however due to dense traffic, reduced visibility and increasing ship dimensions it is very challenging. About 20 to 30 collisions per year, mainly caused by carelessness, lead to damages on waterway infrastructures like bridges, damages on the vessel or even injured people. This fact demonstrates the necessity of driving assistance functions for inland vessels.

The project LAESSI (Guiding and assistance systems to improve safety of navigation on inland waterways) was focused on the developments of different driver assistance functions like bridge collision warning systems, mooring assistance, conning display and automatic guidance system to support the skipper during its task. The basis for these functions is the provision of reliable and precise navigation information like position, heading and velocity as well as integrity information. For this approach the phase-based GNSS technique Real Time Kinematik (RTK) has to be introduced, which requires phase and code observations on the vessel side as well as precise and monitored correction data coming from the shore-based side. To use the available infrastructure on inland waterways the communication between these two components was realized via the standardized Automatic Identification System (AIS) and as a backup the Global System for Mobile Communications (GSM) channel was used.

This contribution will give an overview about the concluded project LAESSI which includes the requirements for accuracy, integrity and time to alert for the different assistance functions as well as the description of the complete overall system setup like shore-based and board equipment. A main topic in this project was the first realization of the new communication concept based on VHF Data Exchange System (VDES) the next generation of the AIS communication which will also present here. A challenge in this communication concept was the limited data capacity for transmitting all necessary phase and code corrections for every observation in every epoch.

Important for safety critical applications is the provision of not only precise, but above all reliable results. However caused by station dependent effects like signal interferences, signal losses or multipath impact the GNSS signals which hamper or falsify ambiguity fixing and finally the position results. To prevent the provision of such faulty results a three step integrity concept based on statistical evolutions, sensor redundancies and information from the shore-based was developed in this project.

The positioning and integrity algorithm were validate in real-time measurement scenarios e.g. bridge passing scenario, in different environment and on different vessels. The provision of reliable and precise navigation information was possible over 90% of the travelling path which includes bridge passages and locks. These navigation information combined with other sensors (e.g. laser scanner), waterway or map information form the basis for the driver assistance functions which will relieve the skipper in the future. The promising results of LAESSI will help to make inland shipping easier and safer and are a first step into autonomous vessel.

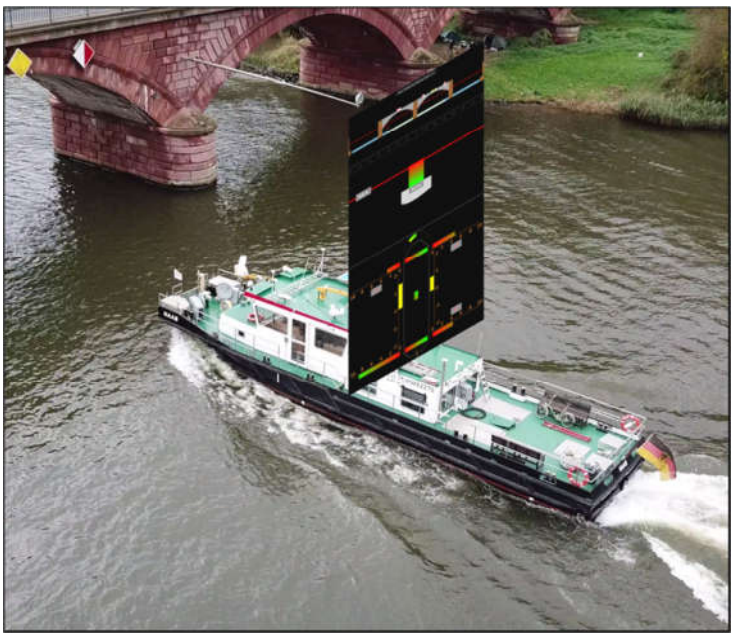

Figure 1: Bridge collision warning system