DEVELOPMENT OF A TRAIN-BORNE POSITIONING SYSTEM FOR THE REGIONAL RAILWAY TRAFFIC
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• Progress reports on current projects
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Abstract:
The precise detection of the position and the safe communication play a key role for the train operation control system. Especially for regional railway lines, which usually have a low traffic density, the positioning onboard of the trains is more cost-effective than having trackside equipment for localisation. A cost reduction may result, since only the onboard-positioning system has to be installed and maintained; maintenance of the numerous elements along the track (e.g. axle counters, track circuits) is no longer needed.

The proposed positioning system determines the position of the vehicle independently from trackside equipment, e.g. balises and tags. The new train-borne positioning system has to have at least the same accuracy, reliability, and availability as the track-side system used so far regardless of weather conditions. An autonomous positioning exclusively with GNSS (i.e. GPS, GLONASS or in the future GALILEO), as it is done for scheduling and logistics, cannot fulfil the requirements for safety-critical applications, such as track vacancy information. Hence, the GNSS-based positioning system has to be extended by at least one additional positioning principle to obtain redundant, diverse pieces of information. By fusing the positioning information of at least two systems a highly accurate, reliable and save positioning through onboard-equipment is possible. The transmission of the positioning data and the communication between the vehicle and the track-side is realized via GSM-R.

At the Institute of Transportation Systems of the DLR a vehicle-borne positioning system is currently being developed, which enables a track-selective positioning. An accuracy of up to 6 m (99%) lengthwise is assumed to be sufficient for regional lines with low or moderate volume of traffic. That means that the positioning system has to reach these values. A road-rail-vehicle, which is called RailDriVE (Rail Driving Validation Environment), is used as positioning system laboratory and is equipped with a variety of positioning sensors, communication equipment and computer technology (see ).

The aim is testing of different combinations of sensors in order to identify suitable combinations, which fulfil the functional requirements and reduce cost. The combination of GNSS, eddy current sensor and digital map emerge as promising. The prototype of the new eddy current sensor is, beside global satellite navigation systems, the only train-borne sensor which allows an absolute positioning. It will also be analysed if a combination of GNSS, digital map, odometer (incremental encoder, radar or optical sensor) and inertial system, which delivers the driving direction in angular degree, offers a sufficiently good position detection while the costs could be below those of the previous system.
In addition to the positioning system itself the RailDriVE will also contain a reference system. The RFID-antenna drawn in reads out the information which is sent out from the RFID-transponders laid in the track bed. In that way it can discretely determine the absolute position of the vehicle. In combination with a precise odometer the RFID-system, which is not purely train-borne, will be used as the reference system.

Apart from the development of fusion algorithms for the various sensor combinations, the map matching of the determined positions and the generation of digital maps of the testing areas are the important aspects when developing a vehicle-borne positioning system.

The presented positioning system is part of an approach showing how low density railway lines can be operated in a cost-effective and flexible way.

Figure 1: RailDriVE – the testing and measurement vehicle of the DLR equipped with potential components of a train-borne positioning system

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Member of the scientific staff at the Institute of Transportation Systems at the German Aerospace Center in Braunschweig. There she belongs to the railway systems group and is responsible for the setup of the mobile positioning system laboratory RailDriVE, which serves for the testing of new vehicle-borne systems both for moving on tracks and on roads.