

The economic use of railway infrastructures demands persistent maintenance as well as checking and inspection of all components. The permanent checking of tracks requires a large number of status parameters. Their spatial attribution is, in any case, central for planning and carrying out of maintenance measures. Modern satellite positioning processes allow for these works to be carried out safely, rapidly, precisely and direct from the rail vehicle.

## Factsheet

# GPS Measurement Runs

Traditionally, positions are given in the form of kilometre-data in the course of individual track sections.

The data refer to the kilometre panels mounted on masts or other structures. The practical application thus requires identifying the next panels and determining the path up to the respective point of interest, e.g. a defective site. This allocation is thus achieved via various different measurement processes direct on the track section. Safety-relevant aspects, quality issues and, finally, economic expense must be considered.

Recent developments in determining precise position data via current satellite processes open up alternative solutions for this requirement. These processes are further developments of the navigation methods based on GPS measurements used in two different areas. The most significant difference vis-à-vis common navigation applications, such as car navigation systems, consist in the integration of fixed reference stations and the use of additional satellite systems such as the Russian GLONASS satellite navigation system. The integration of additional satellites contributes to a distinct increase in reliability of the positioning data as well as to better availability, e.g. in narrow valleys. The use of reference stations allows for greater exactitude of the positioning data up to a few centimetres. For this purpose, ÖBB (Austrian Railways) operate their own reference station service, EPOSA.

### *REFERENCE STATION SERVICE EPOSA (REAL-TIME POSITIONING SYSTEM AUSTRIA)*

*Common commercially available navigation devices for cars or hiking allow for positioning exactitudes of about 5 - 10 m. Many applications, however, require greater exactitudes, achieved on the basis of correction values of the measurements made. ÖBB operates an Austria-wide correction service for GPS and Glonass measurements (EPOSA). It uses continuous measurements of about 35 stations to calculate these correction values and make them available to the users.*

*GPS measurement runs, May 2012*

### Concept

For practical use, it should be possible to determine positions from the driving track vehicle. To this effect, high-quality GPS receivers as well as GPS antennas permanently mounted on the railcar (railway waggon) roofs are used. Depending on the kind of application, other simultaneously recorded measurements may be allocated to these positions, such as the ultrasonic measurements on the ascertainment of the track status in the present test case. With the help of these positioning data, defective sites as, for example, hairline cracks in the tracks can be detected immediately on the basis of the previously calculated coordinates.

The "TwinAnt" concept uses two GPS receivers on one measurement car, recording data simultaneously. This allows for a significant increase in calculation quality. The coordinates are not real-time calculated during the measurement drive but after the fact, with the help of specialised software. It is this "post-processing" that allows for achieving the desired exactitude in the cm-range for positioning data and coordinates of the track axis.

The concept presented enables users to give the spatial position and direction of the "TwinAnt"-equipped measurement vehicle. Following evaluation on the basis of 3D coordinates, the

measured values of all mounted sensors can be interlinked. Thus, the track-axis-relevant data, too, is given as a controlled result covering the entire area recorded.

#### Practical Test

For a practical test of the “TwinAnt” concept, the time-tested measurement set-up of the ultrasonic recording train used by ÖBB Infrastruktur was adapted.

As in the course of these campaigns, the entire Austrian railway network is traversed and inspected, the “TwinAnt” concept could be tested across the entire network. With the help of precise location of the ultrasonic sensors, the defective sites thus detected can be linked with positioning data and thus directly localised for potentially required maintenance measures. The objective is to conduct personnel with the help of a simple hand-held GPS device directly to the detected defective site for the purpose of inspection or maintenance. This part of the project is currently being realised.

An analysis of the “TwinAnt” measurements carried out so far prove the practical usability of the results.

Consequently, the “TwinAnt” concept will be used for universal positioning for the purpose of other measurement set-ups as well as in subsequent research projects. The safely, efficiently, high-quality and reliably determined positions of track axis points and near-track infrastructure are continuously used by numerous technical sections within the Austrian Railways (ÖBB).

#### THE “TwinAnt” CONCEPT

The use of satellite processes such as GPS or the Russian Glonass requires receiving at least four satellites. Interruptions of the respective signal by masts, bridges and, of course, tunnel areas, distort positioning data. In order to be able to detect these effects safely and unequivocally, the “TwinAnt” concept uses a second antenna mounted on the rail vehicle. In order to avoid disturbances on account of the overhead wiring, the antennas are set up diagonally in the corner area. On the basis of the fixed distance between the antennas, comprehensive statistic tests render clear reliability results on each individual position, so that only correct, undistorted position data are further employed.

Safe, as non-contact  
Precise and efficient  
Area-encompassing  
High density of points  
High reliability  
Sophisticated quality-management  
High potential automation and integration in Potenzial Automatisierung und Integration in measuring processes

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