RILA™ GEODETIC BACKBONE FOR RAIL INFRASTRUCTURE

Fugro’s train-borne RILA solutions enable track and associated assets to be recorded and analysed with unprecedented accuracy so your railway asset management is future-proof and significantly more cost-effective.

Smart maintenance – clever surveying.
This article describes the philosophy of applying spatial Geo-data for track maintenance; in particular, Fugro’s RILA™ technology, which provides geodetic-accurate spatial data. RILA’s high level of accuracy creates the basis for track maintenance and project applications.

RILA technology has been used in the UK since 2013 and in that time Fugro has surveyed 76,825 miles of track, from which 4320 miles of data have been delivered to Network Rail. The data comply with the Network Rail standard TRK/3100 series, Band 1a, and are used as design input for many projects including High Output Track Renewal, Midland Main line, Intercity Express Programme and Northern Hub, Manchester.

Applying RILA technology on a project is proven to increase safety performance: the amount of boots on ballast for obtaining the same type of data is reduced by 97%.

It also improves project lead times and significantly reduces costs.

**ACCURATE LOCATION OF ASSETS**

Engineers Line Reference (ELR) and mileage are commonly used to identify assets on or near the railway. However, a mile along a railway is not necessarily 1760 yards, nor is a mile post positioned at the mile it is indicating, so an ‘exact’ location is never exact. For linear assets, such as rail or overhead line wires, defining the location is even more complex. Today’s buzzwords are Big Data, data-mining, machine-learning and artificial intelligence. Data techniques try to combine all relevant information of an asset to define its status. However, the asset data are usually stored in different databases, and linking disparate information is difficult because the location description varies widely. Data analysts typically spend 70% of their time data-cleansing due to inaccurate positional data; accurate geodetic survey of assets avoids this problem. Instead of, or in addition to, ELR and mileage, XYZ coordinates identify an asset uniquely. A XYZ coordinate relates to a National Survey grid, which is defined for every country and across many different disciplines.

Surveyors use GPS-supported surveying tools to obtain their position within the National Survey grid, the XYZ of the location. This type of survey is also known as a terrestrial survey and can be combined with lidar data. The disadvantages of terrestrial surveys within the railway environment are safety (surveyors need to be on or near the track), long lead times (as track possession and survey resources are limited), and cost.

1As stated in an independent report commissioned by Network Rail and undertaken by Specialist Project Integration in 2016.
RILA™ TECHNOLOGY

Fugro’s innovative RILA technology enables accurate geodetic XYZ coordinates of assets to be obtained in a safe and affordable way. Both standalone assets (signals, overhead line masts, etc.) and linear assets (rail, overhead line wires, platforms, etc.) can be surveyed using the RILA system.

The RILA system is attached to revenue-earning trains (passenger or freight) to survey the track and its surroundings at line speed. This removes the need for track possessions or additional train paths, which is a huge advantage of RILA. For smaller surveys, and additional flexibility, RILA can be attached to a road-rail vehicle (RRV) to survey parts of the network such as loops, receptions and sidings over which a host train would not normally pass.

The RILA system houses three positional sensors: a GPS, in combination with continuous operating reference stations (CORS) and inertial technologies (IMUs), a lidar sensor, and video cameras. Together, these produce a geodetic-positioned digital twin of the railway corridor with a positional XYZ accuracy of around 10 mm. It is this geodetic positioning that makes RILA unique.

DIGITAL TWIN

The RILA Digital Twin consists of two sets of merged point clouds draped with video footage; to clarify, the points of a point cloud are recorded laser dots (points) that reflect when hitting a surface or object. The rail scanners produce a scan of both railheads at an accuracy of 0.3 mm. If a train travels at 90 mph, a cross section is produced every 8 cm. A lidar scanner rotates approximately perpendicular to the track to produce a 360° point cloud of the track and its surroundings. The relative position between the individual points as measured by the lidar scanner is approximately 5 mm. This is insufficient for relative track parameters, which is why the lidar-scanned rails are merged with the rail point cloud of the rail scanners. By doing so, relative track parameters such as track gauge and super elevation (cant) obtain an accuracy of better than 1 mm. Because the three video cameras are connected to the other scanners, the video footage is positionedly merged with the processed point cloud. This provides an immersive view of the track corridor, with the added possibility of taking measurements directly in the footage.

The next step is feature extraction, whereby assets are defined and extracted. As the shape, location and position are now known, feature extraction groups the points which are part of an asset. When the data are updated after a sequential survey run, any change or movement (removal, repositioning or displacement etc.) of the asset can be detected and reported using artificial intelligence and machine-learning applications. These technologies can now perform faster as only a small dataset needs to be searched: the XYZ coordinates of the asset!

With everything now in XYZ, it is easy to calculate the mileage position of assets by merging Enterprise Resource Planning (ERP) databases that are based on ELR and mileage. The result? When a user clicks on an asset in the video or point cloud, all the relevant data of this asset are displayed and available.

SURVEY FREQUENCY PHILOSOPHY

Many different sensors and systems are available for track surveys. At one end of the spectrum, sensors permanently fixed to passenger trains record accelerations and provide insight into potential rough-ride areas. At the other end are the big measurement trains owned and operated by Network Rail, which provide information on track safety parameters such as track gauge, twist, rail integrity, OHL wire condition and condition of fasteners.

However, none of these systems provides the engineering data that maintenance teams need to execute measured corrective actions such as tamping, OLE wire adjustment, repositioning of assets (platforms), level crossing adjustments, etc. Of course, engineering data need to be both current and accurate. This means that the survey frequency of these systems should be: daily, to quickly prevent potential track geometry incidents; bi-monthly, for asset trend analysis and restoration/repair activities; and finally, half-yearly or yearly, for safety surveys via dedicated measurement trains. The frequency of the dedicated measurement trains will very much depend on the risk profiles associated with the importance of the different routes. The three survey methodologies are complementary and provide mutual calibration platforms.

APPLICATIONS

The geodetic digital twin created by Fugro, especially when linked to an ERP system, is a powerful tool from which many different types of information can be extracted. The basic application is location awareness: video footage of the track and surrounding area show all the details at that location, much like Google Street View but for railways.

More specific applications are:

1. RILA absolute track position in XYZ coordinates: both horizontal and vertical. This dataset allows track designers to optimise or create new track alignments and is often used on projects such as track renewals;
2. RILA relative track parameters: versines of level and horizontal chords at variable chord lengths, super elevation, twist and track gauge;
3. Gauging profiles, which are SCX (six foot), SCO (structure gauging) or SCP (platform gauging), can be determined at high levels of positional accuracy. The Intercity Express Programme and Crossrail project used Fugro’s RILA data to support new trains entering service;
4. Overhead line management: details such as height and stagger of the contact wire or detailed cross section at an OHLE span. Large electrification projects use this information to validate or redesign the routing of the wires;
5. Vegetation management: trees and shrubs growing into the track clearance profile. The video data allow the type of tree and shrub to be determined and then combined with vegetation growth rates to determine the optimum time for pruning.

Many more sophisticated applications are available, including but not limited to ballast profile management, tamping management, BIM applications, dynamic gauging, work instruction documents, and safety briefings. For more details on the potential applications, please visit: www.fugro.com/raildata.