Cost effective track maintenance and operational safety requires accurate and reliable track geometry data.

The Balfour Beatty Rail Digital Track Geometry System is a combined hardware and software application that derives track geometry parameters compliant with EN 13848-1:2003 and is an enhanced version of the original BR and LU systems, with a rationalised transducer layout using modern sensor technology.

The system can be installed on a variety of vehicles, from dedicated test trains, service vehicles and road rail plant.

Unlike some systems, our solution is designed such that voids and other vertical track defects are identified through the wheel/rail interface when the track is fully loaded.

The compromise of taking measurements away from the wheel could produce under-measurement of voided track with an error that increases the further the measurement point is away from the influences of the wheel.

The system uses bogie mounted non-contacting inertial sensors complemented by an optional image based sub-system, to measure rail vertical and lateral displacement.

The system is designed to operate over a speed range of approx. 5 to 160 mph (8-250km/h). However, safety critical parameters such as gauge and twist will function at zero.

Geometry parameters are calculated in real time and during operation real time exception and statistical reports are generated.

Principal measurements consist of:
- Twist
- Dynamic Cross-level
- Cant and Cant deficiency
- Vertical Profile
- Alignment
- Curvature
- Gauge
- Dipped Joints
- Cyclic Top
Vehicle Ride Measurement

As an accredited testing organisation we are well versed in capturing and processing acceleration measurements to national/international standards in order to obtain Ride Quality information in accordance with, for example ENV 12299 “Railway applications – Ride comfort for passengers – Measurement and Evaluation”.

Our Track Geometry System already includes the necessary band pass and physiological weightings for ride quality assessments. As an option, BBRTL would offer a subsystem that measures body accelerations, using Tri-axle accelerometers, so that their outputs can be combined, in accordance with ENV 12299 to generate Vibration Dose Values [VDV], and weighted root mean square [RMS] values.

Data Location

Location of data is achieved by embedding a GPS reference alongside recorded track geometry data. Improved accuracy may be gained by integration with our in-house location system which utilises a combination of machine readable signals from accurately surveyed “wayside” points placed at salient points within the network. Further improvements in accuracy may be gained by utilising our infrastructure asset mapping software.

System Transducers

**Laser Sub-System**

The measurement of the gauge point on the rail utilises precision laser optics in combination with high-resolution digital cameras and machine vision software techniques. The system is differentiated from others by its unique calibration process, that guarantee the quality of its performance and the ease with which it can be installed, commissioned, verified and calibrated. In addition to gauge measurement, rail profile can also be captured.

**Rate Gyroscope Sensors**

The system uses state of the art fiber optic gyros to sense the vehicle roll and heading rotations. This information is used to make corrections to the measurements of the accelerometers due to track curvature. The devices have no moving parts and are noted for their stability, accuracy and dependability, avoiding much of the maintenance and calibration problems of traditional mechanical gyros.

**Accelerometers**

Accelerometers are used for sensing the acceleration induced into the vehicle as the track geometry changes. They provide signals that are used in the calculations of Crosslevel, vertical and horizontal Alignment and Gradient parameters. The inertial sensors selected provide excellent bias, scale factor, and axis alignment stability.

**Displacement Transducers**

Vertical displacements are measured using robust Linear Variable Differential Transformers [LVDT] that are designed for heavy industrial environments and are used to reference the primary displacement of vehicle to the track. Optionally, the vertical displacement measurements can be obtained from the laser sub system.
The software is run on a proprietary PC running a standard Windows operating system, utilising standard equipment for the analogue and digital conditioning of signals. All data filters are implemented digitally using faster filter algorithms and the resulting geometry data has been approved by Network Rail.

Geometry data is captured at a mean longitudinal spatial resolution of 200mm, although finer intervals can be used at the expense of larger data files. A facility to capture ‘Raw’ transducer and/or Track Geometry data to disc and to replay this data permits complete regeneration of the track data.

System outputs are compatible with decision support and vehicle modelling tools such as Vampire, NUCARS, TrackMaster® and T-SPA.
Operation

The system is designed to operate in either a ‘manned or unmanned’ manner.

For ‘Manned Operation’ the system displays track parameters on a multi-channel distance based chart mimic screen that can be printed via a standard printer and / or stored as bit map images. The parameters displayed are user selectable utilising a screen configuration file. ‘Real time’ Exception, Standard Deviation, Cyclic and Action reports are generated, referenced to the location that are stored and / or outputted to reporting printers.

For service trains, an ‘Unmanned Operation’ version using the same core geometry processing software is available. The system automatically records data for the duration that the vehicle is ‘powered’ and moving. Frequently recording track geometry on service trains, together with an ability to register runs accurately against a location, means that that you get to see genuine trends. Track defect exceptions can be E-mailed automatically to relevant recipients. Data retrieval facilities allow automatic electronic transmission of the stored data from the vehicle to a base station where it can be validated and correlated to sub metre accuracy.

Data transmission: Vehicle to Base Station

Track geometry data generated on-board the vehicle is automatically transmitted via a radio network to a receiving station. The system detects the presence of the radio network and once contact has been made, the data is transmitted to the receiving station. As the on-board system has the capability to store data captured over several weeks it is tolerant of remaining outside radio contact for long periods of time.

Enhancements

The system can be stand-alone or the outputs integrated with other on-board measurement systems such as Overhead Line, Corrugation or Rail Profiling.