MODEL RAILWAYS

RAIL DEVELOPMENT SCHEMES ARE USING THE LATEST LASER SCANNING AND DIGITAL MODELLING TECHNIQUES, ENABLING THE USE OF VIRTUAL MODELS THROUGHOUT PLANNING AND CONSTRUCTION. MARTIN DAVIES REPORTS

Laser scanning provides point cloud data that can be output in multiple formats, used to extract wire frames and construct 3D models. Accurate virtual railway models with simulated signalling can be used by the infrastructure owners, their contractors and the train and freight operating companies throughout the life cycle of development projects; from design, through to signal sighting and on into driver training and simulation.

Collecting data from mobile sources provides a detailed and highly accurate view across all track and lineside assets. Positional point cloud data can be used for a number of applications such as locating and tagging assets, accurate relative measurement and precise positional detail without needing to construct highly detailed 3D models.

Following decades of development from laser scanner manufactures, the accuracy and density of point collection has greatly improved. As data compatibility and software has continued to improve, data collection methods have also improved, enabling rail operators to work with surveying and modelling providers in a more efficiently and cost-effectively. Even so, laser surveying encounters practical challenges when capturing accurate data scans from the rail environment, occasionally requiring multiple data sources to be combined in complex environments.

Mobile laser scanning (MLS) used for ground level mapping provides detailed data for multiple railway tracks and is especially useful for modelling structures and building facades. Airborne laser scanning (ALS) has advantages for ground-point extraction in large areas, building roof reconstruction and tree detection. With mobile scanners mounted to vehicles and UAVs, both methods are advantageous in keeping personnel from having to enter the potentially dangerous live rail environment.

Current industry techniques

My company, Track Access Services, has used MLS to produce datasets of tracks and the surrounding infrastructure. Working to support driver training and redevelopment schemes, we have collected data using the compact Topcon IP-S3 laser scanner – a positioning system that integrates an inertial measurement unit (IMU), GNSS receiver (GPS and GLONASS) and a vehicle odometer.

The rotating LiDAR sensor captures surrounding environments with a rate of 700,000 pulses per second. 32 internal lasers cover 360º around the system, each from a slightly different viewing angle, minimising gaps in the point cloud that may arise from obstructions and removing the need for multiple scans. The scanner can receive and process several return signals from a single pulse and analyse each signal with respect to specific attributes such as reflectance. Laser scanners are mounted externally to the front of an engine, providing an optimum perspective of the rails. The operator's equipment is stored in the cab, as well as a

mounted camera system and IMU, capturing video footage and inertial data simultaneously.

Geospatial accuracy is maintained by aligning the laser scan to fixed reference points throughout the scanned area. These can be from a previously installed control network using fixed targets, or from collecting fixed data scans at regular intervals alongside the route. Data scans are collected after the initial laser survey to suitable points identified within the point cloud and provide accurate points of reference.

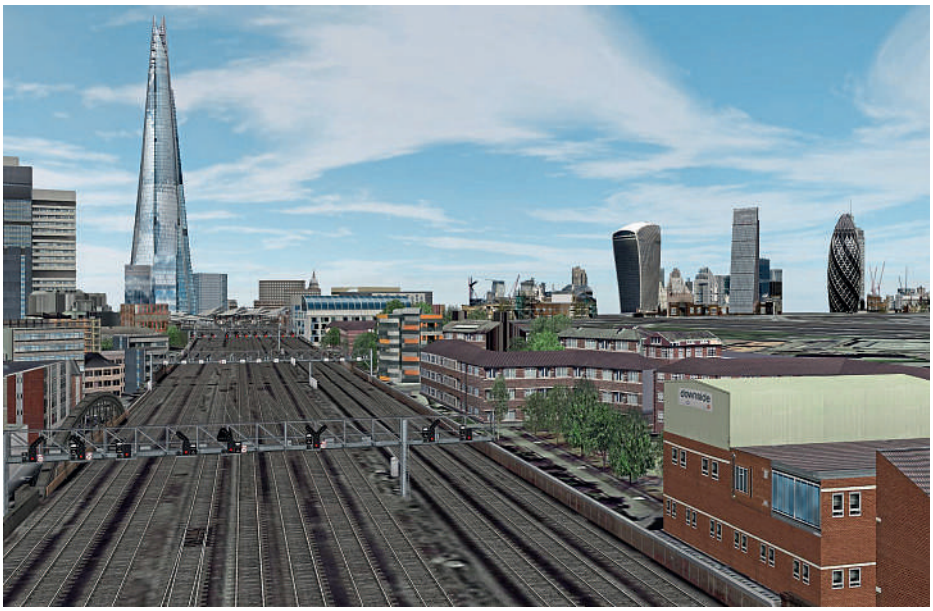
Geo-referenced in-cab video data, collected along with the laser survey, can be viewed within Bentley's MicroStation 3D CAD package to provide the user with valuable context to help inform design and engineering decisions. The laser survey data is extracted to produce a wireframe model that is synchronised in view to the video footage so the two datasets appear in the same space. The position and dimensions of assets can be taken from the 3D point cloud, with accuracies of <10mm when relative to other points in the same cloud. This coordination of datasets allows structures such as signals, OLE and lineside equipment to be installed, discussed and refined virtually as a scheme progresses.

Point cloud data to virtual modelling

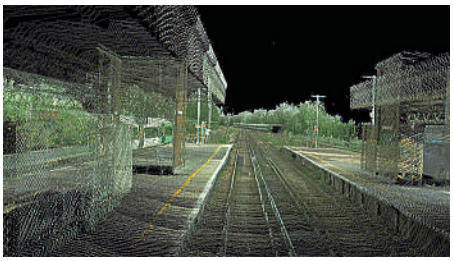
Topcon data processing software can be used to review accuracy and extract an RGB coloured point cloud in LAS format, providing the data for wireframe creation and asset tagging. We have developed bespoke software for interrogating and analysing datasets, applying corrections and merging clouds from separate scans. Extracting a wireframe model and trackside assets from point cloud data provides a base survey model for scheme developments. Wireframe models can be supplied as an accurate representation of site data or enhanced further to become fully surfaced virtual models.

Point cloud datasets and wireframe models can be imported to CAD systems, such as Bentley MicroStation, for visualisation and texturing. Virtual railway models are created to support phases of enhancement and can be used for simulations or embedded into online driver training material. Virtual models are developed in conjunction with CAD designers and constructed directly from CAD drawings, signal sighting forms and scheme plans to ensure all objects are modelled with precise dimensions and locations.

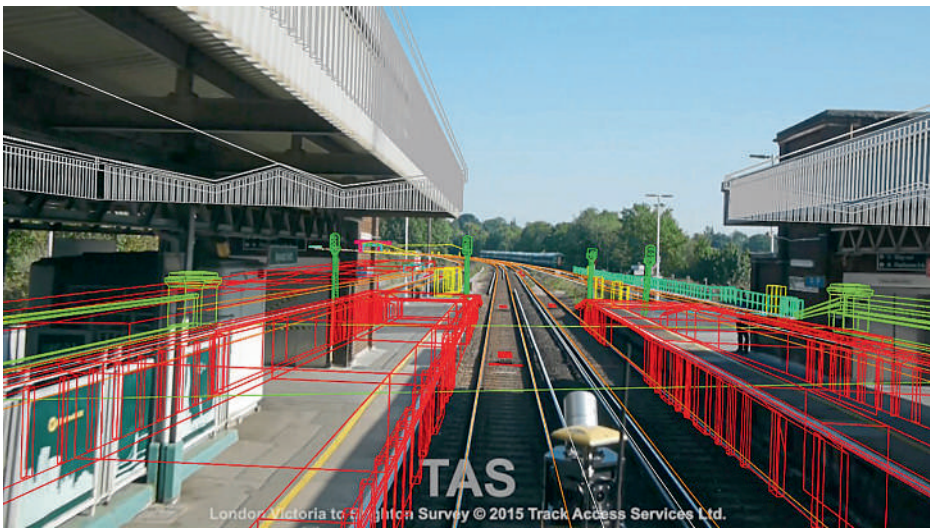
Environments and structures are enhanced with textures obtained from photogrammetry and video surveys, including station features, platform objects, foliage and surrounding buildings. Virtual railway models are developed in low polygon OpenFlight format and can be viewed and explored in the World View real-time simulation package. World View is our desktop package, offering the ability to view, explore and simulate routes and lines of sight within 3D virtual models.



Virtual railway modelling



In-cab video alongside point cloud data



In-cab video with wireframe overlay

Conclusion

Laser scanning the rail environment provides operators and contractors with data that can be used for wireframe extraction and detailed digital modelling. Point cloud data collection and image based modelling techniques enable the supply of highly accurate, multi-purpose datasets and virtual models that are used throughout a project's lifecycle. Adapting to technological advances in this way has enabled us to take on new projects, delivering accurate data scanning and modelling as required by designers, engineers and operators.

LASER SURVEYING ENCOUNTERS PRACTICAL CHALLENGES WHEN CAPTURING ACCURATE DATA SCANS FROM THE RAIL ENVIRONMENT

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