Balfour Beatty
Rail

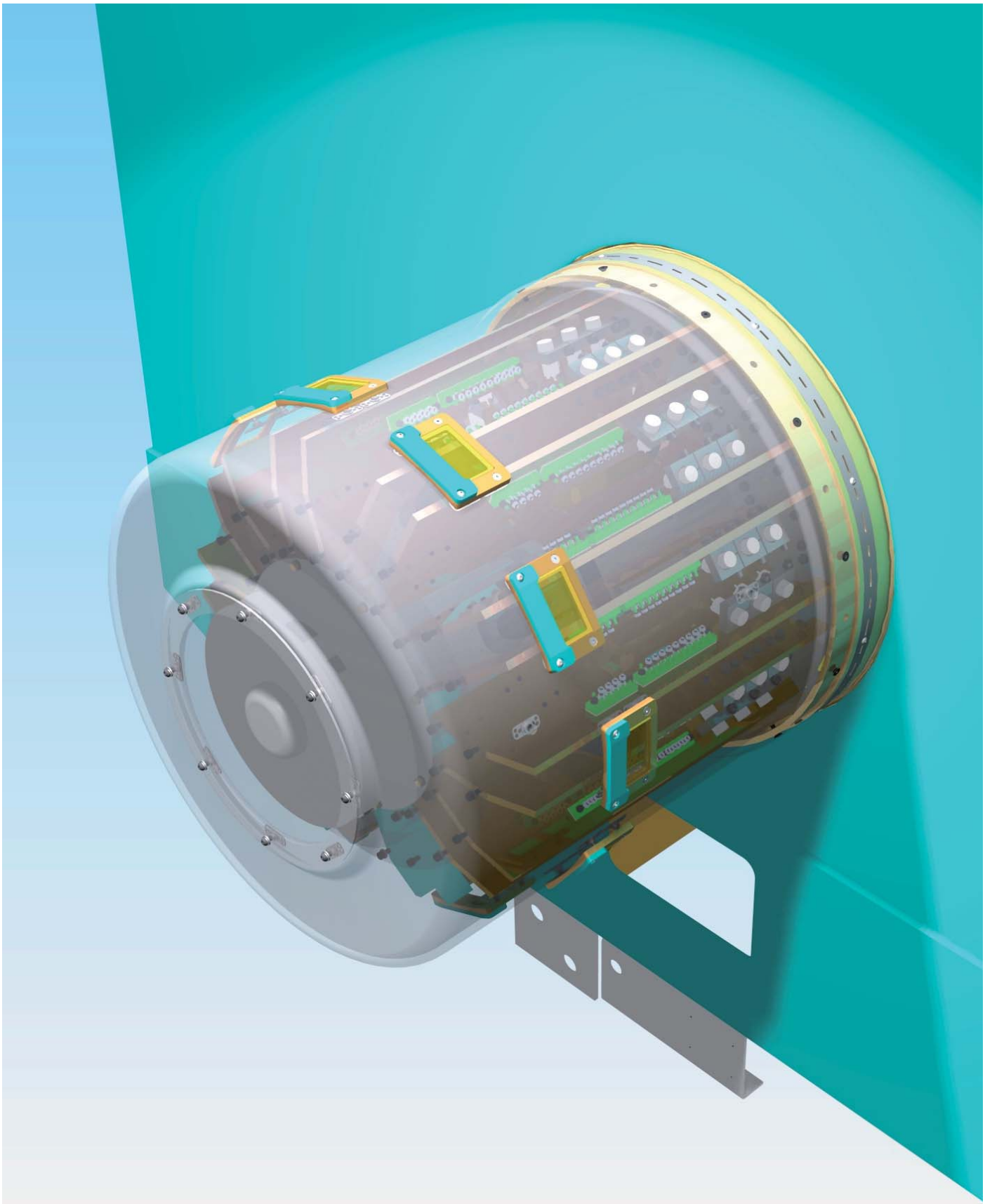
LaserFleX™

New Generation of High Performance Infrastructure Measurement System

LaserFleX™ Introduction

LaserFleX™ is the modular railway infrastructure and track measurement system and clearance tool from Laser Rail Technologies. The system combines ultimate performance - in terms of accuracy, configurability and ease of use - with versatility of data output. It supports a range of vehicle platforms from trolley through road-rail vehicle to train mounted at speeds up to 120km/h. LaserFleX can be configured for all-weather use and is intended primarily for night operation.

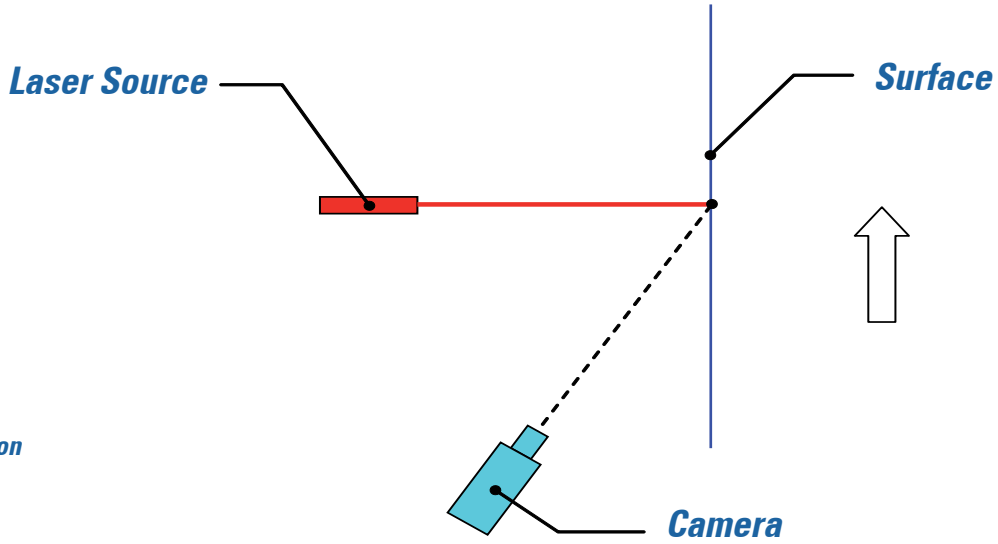
LaserFleX™ combines the functionality of a measurement train into a single, condensed, easily mounted, product. The modularity enables the system to be configured to customer requirements.



Features

LaserFleX™ exploits the full potential of triangulation based systems using lasers and cameras, while fully observing rules for laser safety.

Rather than use a rotating laser in "time-of-flight" or "phase difference" mode as in scanners, a triangulation system uses a static laser slice to illuminate the structure, which is then viewed obliquely by cameras such that the shape and position is measured.



Principle of Triangulation

Features and functions include:

- High accuracy structure profile measurement over 360 degrees with 800 -12000 data points depending on configuration
- Profiles acquired at up to 1 kHz (typical longitudinal spacing 20mm).
- Track geometry measurement (curvature, alignment, gauge and cross-level)
- Video imaging of infrastructure
- Vehicle-to-structure static and dynamic clearance analysis
- Monument recognition and measurement to give absolute track position and geometry
- "Six-foot" track interval measurement
- Ballast profile measurement
- Overhead line measurement
- Range of tachometer-based location systems
- 3-D imaging of data, including export to CAD
- Interface to suite of Laser Rail Technologies modular database and analysis software
- Data displayed in Information Management viewer and analysis tools
- Data output in open .xml format
- Data input available from Laser Rail Technologies or third party track geometry system
- Data output for gauge and alignment

Benefits

The combination of features and functions in a single measurement product enables LaserFleX™ to provide value and benefits through:

- ***Reduced cost compared with multiple measurement systems***
- ***Ease of installation and maintenance of system***
- ***Collection of comprehensive range of data in a single measurement survey***
- ***Elimination of labour-intensive data collection***
- ***Streamlining of data process through intrinsic noise rejection and decimation***
- ***Full asset information to support the planning and resourcing of renewal and maintenance processes and activities***
- ***Ability through desk-top applications to perform trend analysis to predict and interpret asset behaviour***

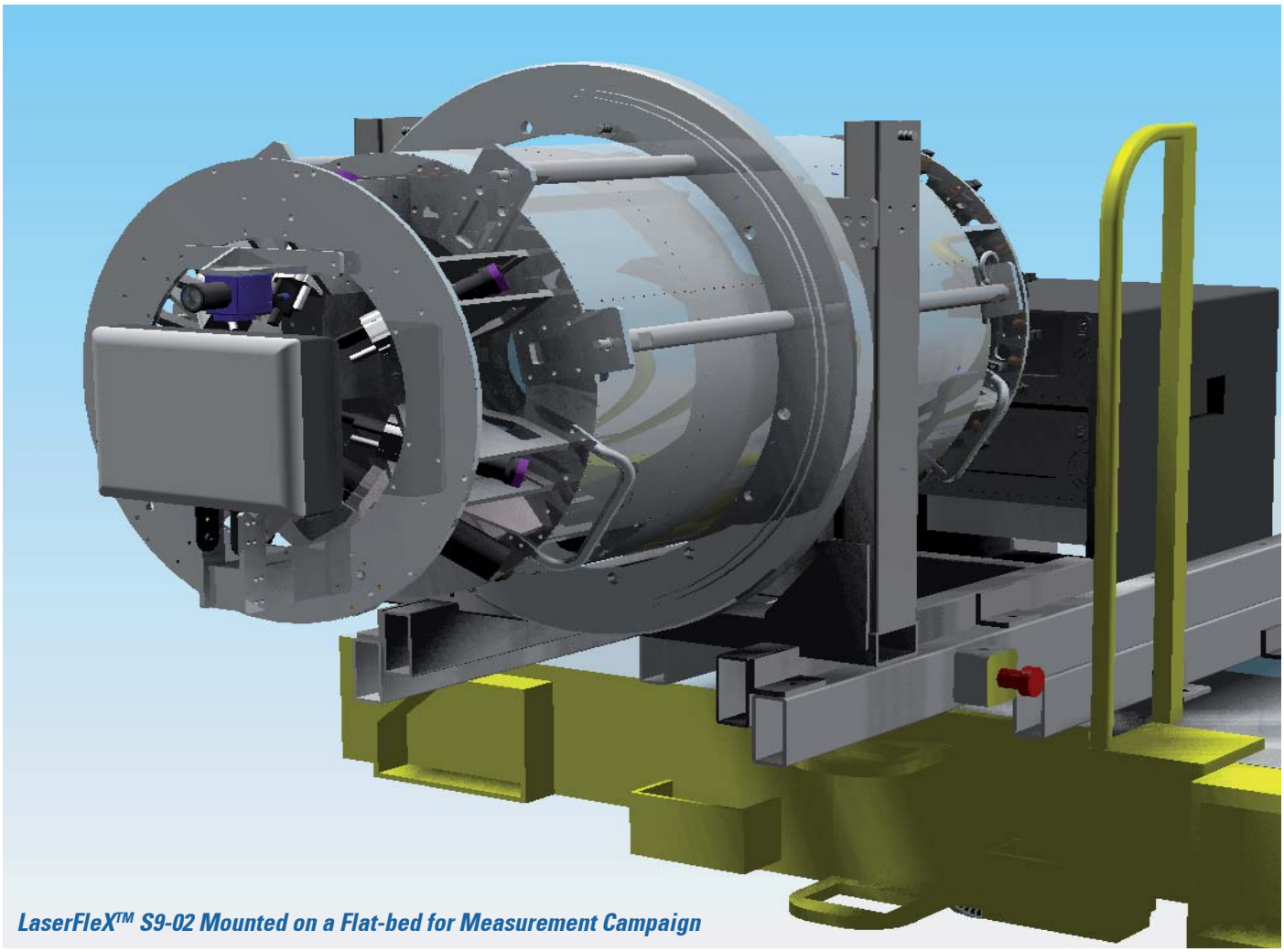
LaserFleX™ Technology

Format and Modularity

LaserFleX™ is implemented in two formats: standard (S) and compact (C). The former is intended for temporary installation on vehicles for measurement campaigns, and the latter for permanent installation on trains, and for trolley or road-rail vehicle mounting.




LaserFleX™ features a rigid structural module housing arrays of lasers, cameras and inertial transducers. The mechanical precision and stability of this integrated module enables this new generation of triangulation system to be both more accurate and less bulky than previous systems. LaserFleX™ provides intense (but safe) illumination using continuous or pulsed, line or dot lasers depending on application. LaserFleX™ configurations provide for seven, eight, nine or ten cameras (including two rail cameras). In addition four cameras associated with track geometry modules can be accommodated by the system. The digital cameras incorporate real-time data processing to achieve speeds up to 1 kHz.



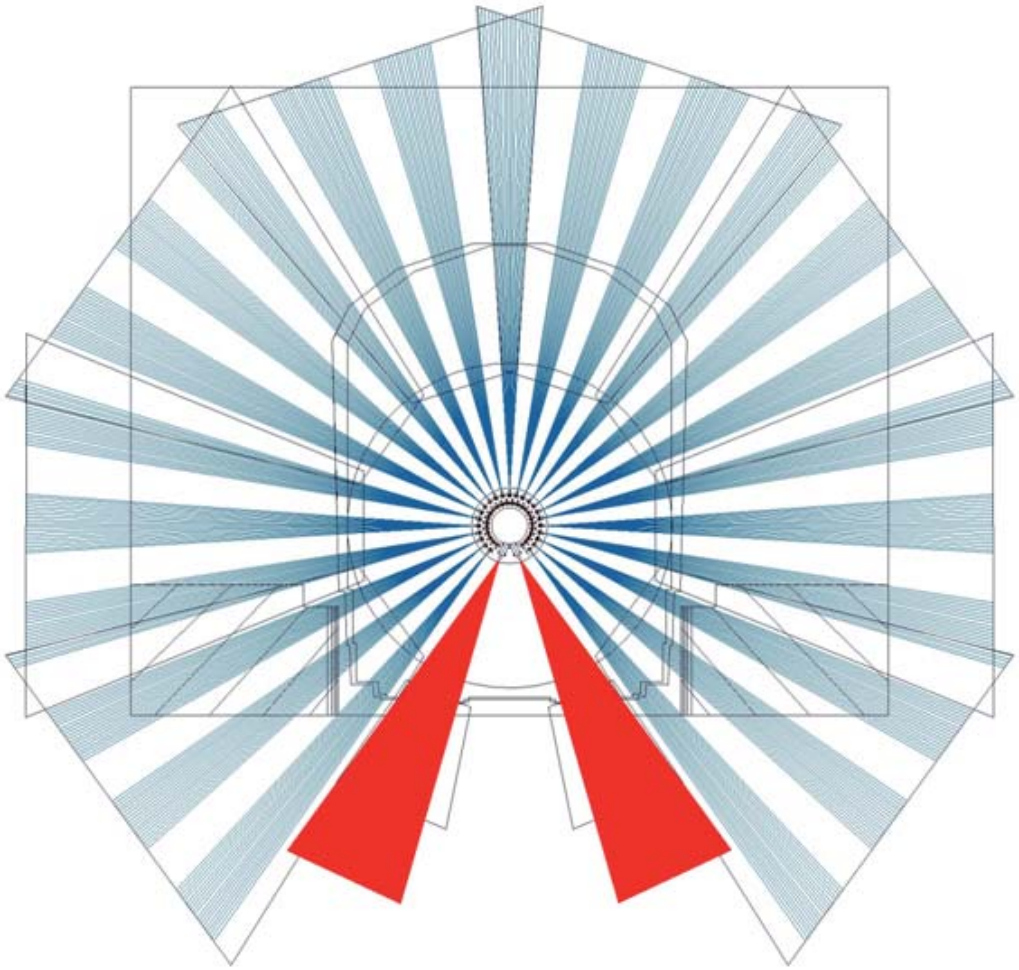
LaserFleX™ S9-02 Mounted on a Flat-bed for Measurement Campaign

For train mounting the compact measurement module is enclosed within a weather-proof cover. For high speed applications (H) dot lasers are used to provide particularly intense (but still safe) illumination, for example on the compact high-speed ten-camera product (CH10-01) being supplied to Network Rail for the Structure Gauging Train.

For both formats the mounting includes provision for rotating LaserFleX™ about its axis to facilitate calibration using a built-in rotary encoder and portable linear encoder. The use of large static calibration frames is thereby avoided, so the system can be calibrated in-situ anywhere in the world.

Field of View

The ability of LaserFleX™ to dispose pixels where they are needed is defined by the bespoke field of view and "pixel map". The field of view is controlled by selection of S or C module, number and disposition of cameras, and selection of lens focal length for each camera. Tighter views are arranged for rails and monuments to enhance accuracy for these datums. An example field of view is given below for LaserFleX™ C10-01 (SGT).



Field of View of LaserFleX™ CH10-01

Comparison with Scanners

LaserFleX™ fully exploits the advantages of laser triangulation systems over laser scanners. These are:

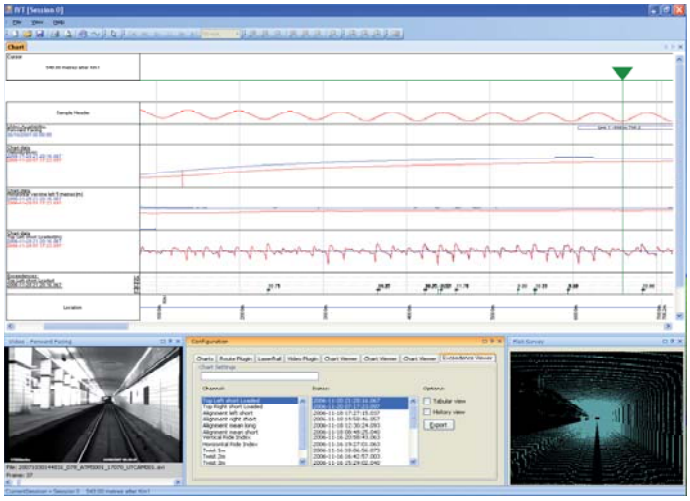
- ***Better inherent accuracy (particularly on surfaces with low reflectivity)***
- ***Bespoke distribution of data points to give greater resolution of rails and monuments***
- ***Simplicity (no moving lasers) leading to better reliability***
- ***Intrinsically safe laser beams requiring less elaborate safety precautions***

The performance of UK Network Rail's Structure Gauging Train (SGT) was transformed when high speed scanners were replaced by a Laser Rail Technologies triangulation system.

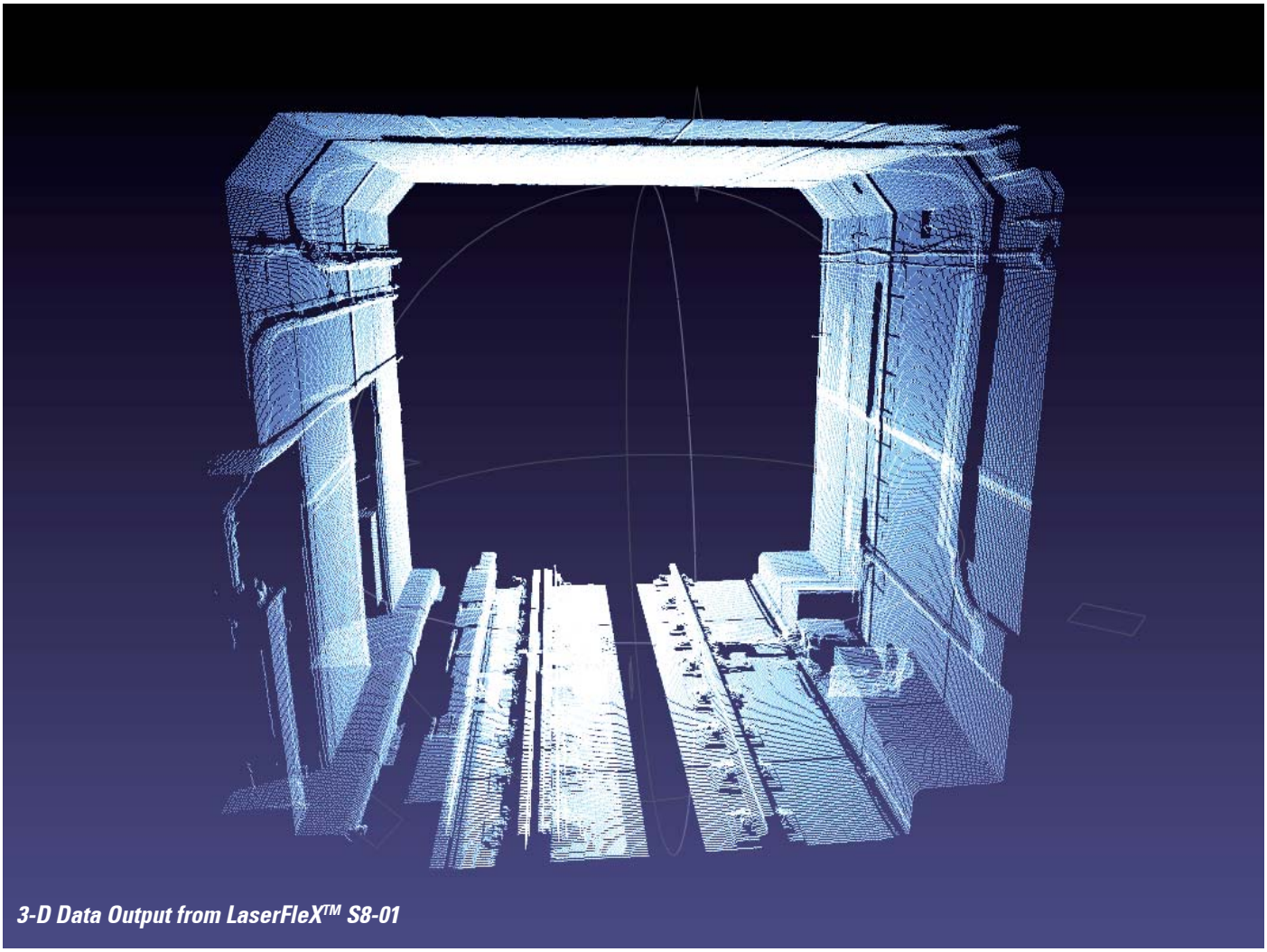
Data Acquisition and Information Management Software

LaserFleX™ includes software for control and data capture, operated via a GUI. Working with the large volume of stored data the LaserFleX™ post processor enables output to be tailored to customer requirements including the generation of decimated composite profiles for clearance purposes.

Provision is made for input of third party track geometry where available. LaserFleX™ interfaces with and is supported by the modular range of Laser Rail Technologies database and analysis software including Unified Editor™, ClearRoute™, HyperRoute™ and Information Management viewer. Output is available in open .xml format for subsequent use in customer-written software.



Information Management Viewer Desktop Software System



3-D Data Output from LaserFleX™ S8-01

Key Features of LaserFleX™ Software

- *Rail-finding algorithms proven on real track (negotiating the complexity of S&C)*
- *Compensation for measurement plane tilted to track*
- *Presentation of data relative to rail datum*
- *3-D visualisation including curvature and cross-level*
- *Attribution of monuments, and presentation of 3-D data in absolute coordinates*

Application of LaserFleX™ Technology

North American Projects

In support of the introduction of new fleets of subway cars Laser Rail Technologies was commissioned in Canada and the United States to undertake the measurement of several networks for the purpose of assuring clearances. The LaserFleX™ standard module was used fitted with line generating lasers.

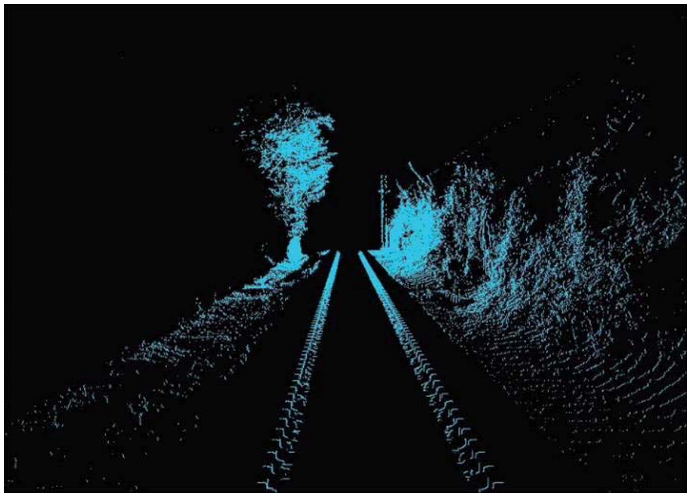
LaserFleX™ S9-02 in operation in North America (left) 3D Data output (right)

Project Attributes

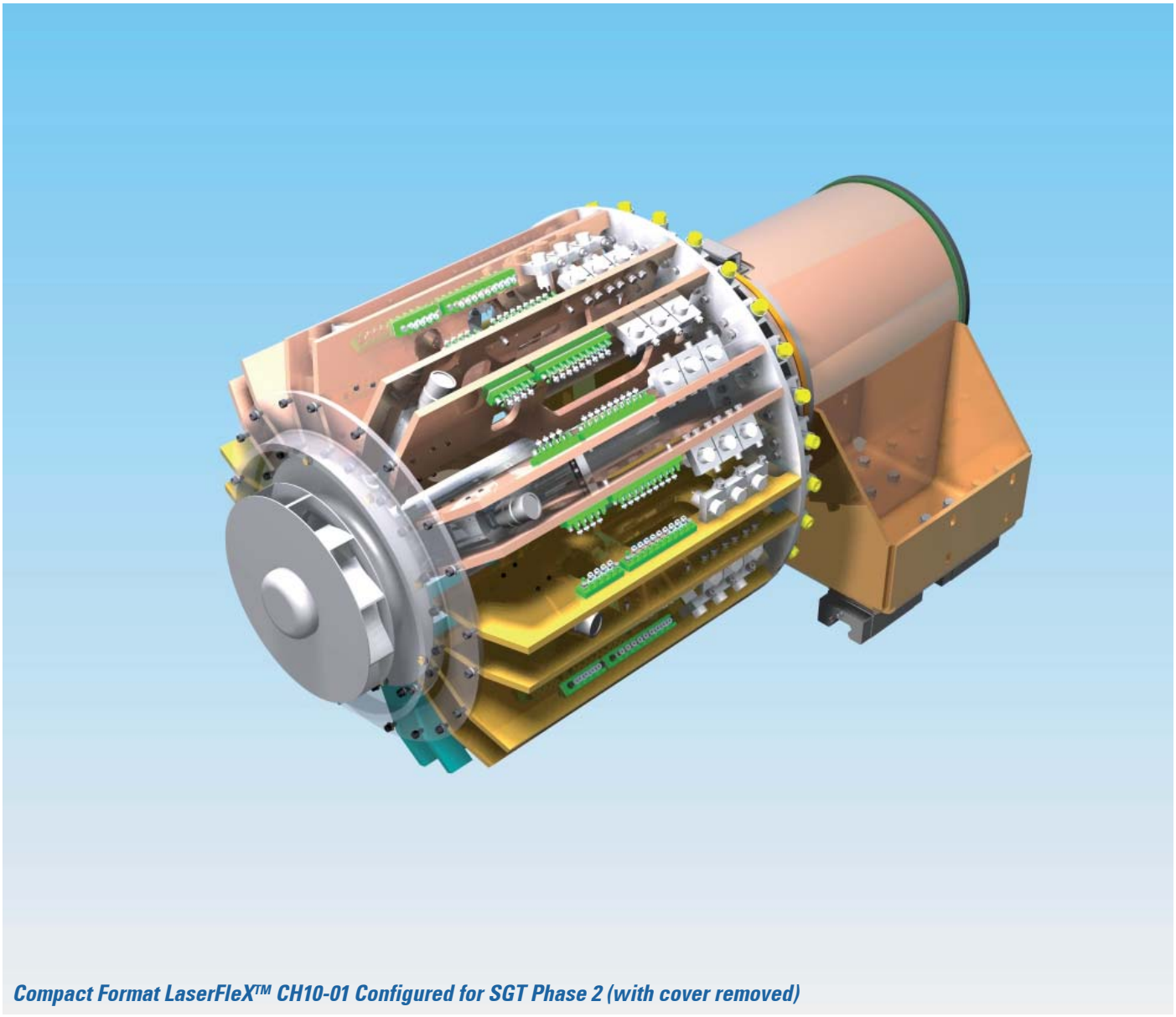
- ***In Canada LaserFleX™ was mounted on a standard subway car without requiring any modification of the vehicle***
- ***In the United States LaserFleX™ was able to locate and measure tiny monuments installed 100 years ago, thereby allowing outputs to be reported in absolute coordinates in 3-D and imported into CAD, as well as the conventional 2-D clearance process***

UK Network Rail Structure Gauging Train

The implementation of a high performance triangulation system on Network Rail's Structure Gauging Train is in two phases. In 2006 a Laser Rail Technologies camera system operating with the existing white light source was installed and the high speed scanner decommissioned. In phase two an integrated LaserFleX™ system is being installed in the space envelope vacated by the scanner. The compact high-speed module LaserFleX™ CH10-01 is configured for the Phase 2 implementation. The emphasis for Network Rail is on accuracy, reliability and freedom from data noise so that post processing can be streamlined.



The Structure Gauging Train and 3-D image from Laser Rail Technologies' Phase 1 Triangulation Implementation



Compact Format LaserFleX™ CH10-01 Configured for SGT Phase 2 (with cover removed)

Brilliant and Safe Laser Illumination Delivers High Speed and Noise Rejection

For structure measurement an array of 45 lasers produces a total of 855 micro beams, each with a peak pulse power of 2.6mW and pulse length of 0.9ms (average power 1mW). Each of the eight cameras sees 125 laser dots. At far field of view the laser dot is designed to fall within one camera projected pixel 2mm square, maximising the signal received by the camera (12 times that from a laser line of equivalent safety). Viewed through the 20nm wide camera filter the dots are brighter than directly viewed artificial lighting or sunlit surfaces. This also opens up the prospect of daylight operation.

Real-time Digital Image Processing

Digital processing within each camera operating at a speed of 900Hz selects the laser dots and rejects noise, enabling the high speed download to PC. Then within PC memory mini-composite profiles are produced for each camera in which points are overwritten by nearer points and saved at 50 Hz.

Please contact us for further information: ***Balfour Beatty Rail Technologies***
Laser Rail Technologies Fitology House, Smedley St East, Matlock, Derbyshire, DE4 3GH, UK
Tel: +44 (0)1629 760750 / Fax: +44 (0)1629 760751
info@laser-rail.co.uk / www.laser-rail.co.uk

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