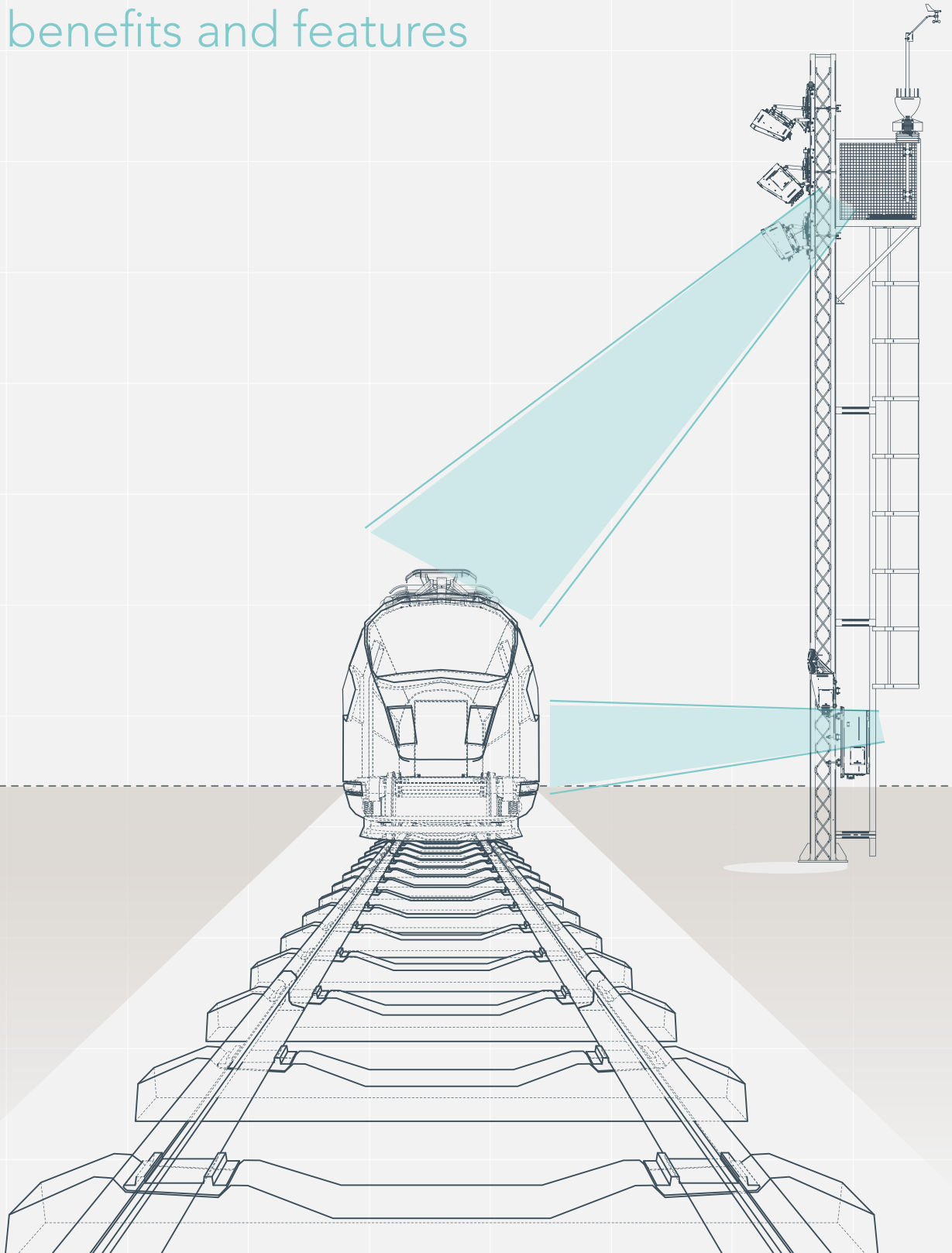




camlin rail

Pantobot 3D: Predict, Prevent & Maintain

Unique benefits and features



PANTOBOT 3D

PANTOBOT 3D is an industry first in pantograph monitoring by adopting a fully automated machine vision system based on stereo vision. Railways are getting busier and as more demands are placed on the infrastructure there is a need to

deploy automated tools to help drive operational performance. PANTOBOT 3D provides the railway operator with a unique and cost-effective tool set combined with advanced analytics to improve operational decision making.



1. Wayside Approach

PANTOBOT 3D is a modular system which can be configured for a WAYSIDE (vertical poles at either side of the tracks) or portal (overhead) application. PANTOBOT 3D is the only system available in the market which can be deployed in this manner. Wayside means reduced installation costs (no heavy machinery required to install the acquisition system) and reduced whole life costs (system maintenance) as the system can be accessed during normal train operations. If the railway prefers overhead mounting (portal) then this is also possible due to PANTOBOT 3D's modular platform.



2. Light and Modular

PANTOBOT 3D is a lightweight system at less than 183kg. This helps to reduce overall installation costs for the railway by ensuring lighter steel supporting structures can be deployed combined with a modular design to simplify installation and maintenance requirements. Each elevated PANTOBOT module weighs less than 23kg which means it can be man-handled by two people.



3. Cost

PANTOBOT 3D has been design to be a cost effective pantograph monitoring solution when compared to the market. The sytem when combined with the wayside and mounting strategy, further savings can be realised with reduced steel work, heavy machinery and civil requirements. Camlin have also thought carefully about the whole life costs of PANTOBOT 3D by using 'COTS' (commercially off the shelf) components combined with a modular platform for ease of servicing and maintenance.



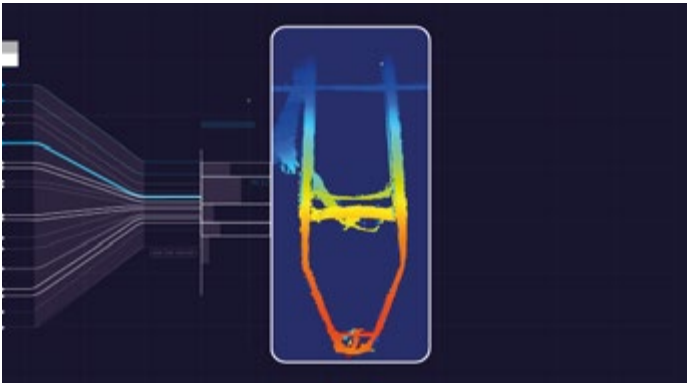
4. Safety and redundancy

A key benefit of PANTOBOT 3D is the fact it does not use any high-powered lasers as a light source during pantograph acquisition meaning the system is eye safe.

PANTOBOT 3D utilises an LED array as a light source due to the high availability and reliability of LED's. Furthermore, should an LED fail, PANTOBOT 3D can still acquire images successfully with an automated alarm raised in the unlikely event of LED failure. Competitive systems reliant on single light source for acquisition cannot operate should the light source fail.

5. Image Quality Over Speed Range

PANTOBOT 3D uses single shot from the stereo cameras to maintain a consistent image resolution with train speed up to 300 km/h.



6. Quantitative Analysis

PANTOBOT 3D measures multiple parameters based on an extremely accurate 3D reconstruction of the pantograph head (please note PANTOBOT 3D feature list).

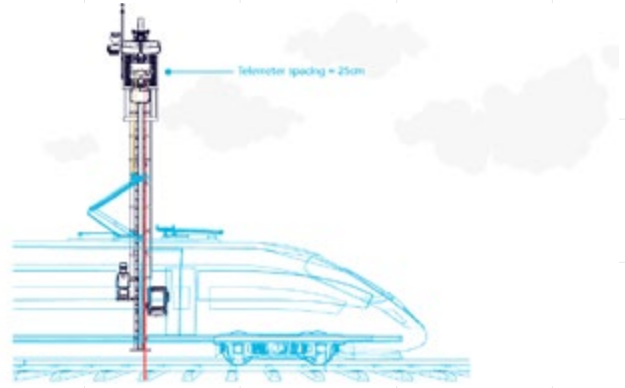
7. Pantograph Recognition and Classification

PANTOBOT 3D utilises a technique called machine learning to automatically recognise and classify different pantograph models operating on the railway. Furthermore, should new pantograph models be added to the train fleet, these would be automatically detected as 'new' and notification raised.



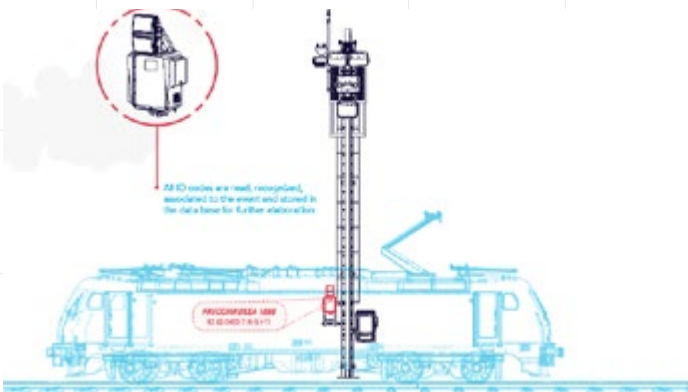
8. Pantograph Uplift

An inherent cost benefit of stereo vision means PANTOBOT 3D can automatically measure the uplift the pantograph is exerting on the contact wire without the need for any external sensors or equipment.



9. Train (pantograph) Detection

PANTOBOT 3D uses two Class 1 laser telemeters mounted within the acquisition enclosure to measure train speed and direction. This also acts as the trigger for the system to operate. No additional track mounted equipment required for train detection is required.



10. Train Identification

In the event a damaged pantograph is detected railways need to be able to link this information to the train. PANTOBOT 3D can provide two options for ease of train identification 1) RFID and 2) Machine Vision. Our machine vision solution provides railways with a cost effective solution if RFID tagging is not feasible by automatically scanning the side of the train set and detecting the trains serial number from each carriage.



11. Analytics and Reports

Accurate and reliable data becomes even more effective when used as a trending tool. Camlin's advanced analytical engine means railways can trend key parameters (i.e. train speed, pantograph model, orientation, uplift, train company etc) to allow more effective decision making. Reports will collate the data obtained by PANTOBOT 3D and present it in clear and concise manner to allow ease of circulation to key stakeholders within your business.

PANTOBOT 3D

FEATURES LIST

Developing predictive and preventative maintenance strategies through three dimensional pantograph monitoring

The standard feature list of a PANTOBOT 3D twin track system is as follows:



Real time three-dimensional monitoring of two tracks in any direction up to 300km/h



3D model re-construction of carbon strips



Automatic real time pantograph model recognition and multipara metric analysis



Automatic classification of (multiple) pantograph models



Fully automated alerts (e-mail notification) for different pantograph models. Alarm thresholds can be set for: pan head tilt, roll, yaw, wear and horns.



Analyse the degree of wear and chipping of the contact strip



Analyse horn structure for defects (missing or damaged)



Automatic check if the structure of the pantograph is in correct contact with the catenary



Measure the degree of uplift (no additional modules required)

PANTOBOT 3D Measurements Performance

| | |
|--|---------------------------------------|
| Carbon Thickness Accuracy (2σ) | ± 3 mm over speed range 5 to 300 km/h |
| Pantograph Uplift (2σ) | ± 5 mm |
| Pantograph Head/Strip Orientation/ Horn analysis (2σ) | ± 3° |

PANTOBOT 3D Environmental

| | |
|--------------------|------------------------------|
| Temperature | -40 to 50 oC |
| Operating humidity | 5 – 95% RH, (non-condensing) |
| Protection Class | IP55 |

PANTOBOT 3D Power & Communication

| | |
|------------------------------|---------------------------------|
| Power Supply per track | 90-260V AC at 50 or 60Hz |
| UPS | Yes (to support safe shutdown) |
| Power Consumption per track | 1.4 KW |
| Communication Link per track | 3G/4G Ethernet |
| HMI | Web browser (Chrome, Firefox) |

PANTOBOT 3D Weights

| | |
|----------------------------------|--|
| Max module weight | 41Kg (processing enclosure) |
| Wayside Weight per track | COMPLETE WAYSIDE ELEVATED SYSTEM WEIGHT: 97.5KG GROUND LEVEL SYSTEM WEIGHT: 69.5KG |
| Overhead system weight per track | COMPLETE OMF ELEVATED SYSTEM WEIGHT EST: 157KG Inclusive of Overhead support structure (I beam) GROUND LEVEL SYSTEM WEIGHT: 69.5KG |

PANTOBOT 3D Trigger System

| | |
|-------------------------|---------|
| Technology | Optical |
| Track Mounted equipment | None |



