



**A new approach
to rail asset management.**



CENTRAL ALLIANCE

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Geotechnical and structural monitoring via satellite for the rail industry.

With mounting pressures on the UK's ageing infrastructure networks from ever increasing numbers of service users and unpredictable weather conditions, asset owners are looking for cost-effective solutions to provide a long-term view of network conditions to prevent future failures. The rail industry specifically needs to be able to effectively monitor activity to understand the environments in which they operate and be prepared to deal with complex challenges in terms of:

1. Monitoring and potentially extending the service life of assets
2. Minimising asset management costs
3. Ensuring the maximum availability of assets

In order to meet these challenges, access to accurate and reliable information is critical to monitor and analyse assets within specific geographical areas so the industry can take a more holistic approach - only then can renewal strategies become truly effective and benefit the whole rail network.

Utilising satellite monitoring to further industry understanding of the degradation and movement of assets

We believe in utilising the best technology available to enable you to manage assets efficiently.

Recent advances in space technology by industry leaders Airbus Defence and Space mean that satellites are now capable of monitoring movements of the ground, or structures to a millimetric level.

The health and safety benefits are clear. This kind of remote monitoring involves no personnel access to site - satellites are positioned to capture images every 11-16 days and sophisticated processing enables us to provide accurate movement monitoring results. The satellite orbits the earth at around 514km in a polar orbit. As a result we can easily monitor very large areas, so it is perfect for managing linear assets like railways. Each image can capture a large number of structures, problematic earthworks and the permanent way itself all in one go.

Central Alliance can interpret the data and provide recommendations for more conventional surveying and investigation.

Satellite monitoring services from Central Alliance use post-processed satellite imagery but also rely on our interpretation skills to deliver specific geo-information (e.g. surface movement analysis) and provide recommendations, if required, for further investigation and monitoring. Services include:

- A completely tailored data service built around the area of interest in terms of frequency of data capture, post-processing and reporting
- Instant access to all relevant information to run your activity and make informed decisions
- Remotely accessed information reducing the need for on-site surveillance
- Access to current information and historic data. We may already hold images including site areas that are a priority with regard to asset degradation which will enable a rapid evaluation of ground movements over time.

Satellite monitoring can provide an early warning mechanism and help direct preventative action and mitigate risk in the following areas:

- Stability and monitoring of civil engineering structures such as bridges, embankments, cuttings etc.
- Stability of the track bed itself
- Monitoring of railway infrastructure and station buildings
- Impact of large scale terrain deformation on rail-infrastructure: settlement, subsidence, landslides, mining, differential settlements at hard/soft interfaces (eg bridge/viaduct abutments).
- Performance monitoring of maintenance work.

“Recent advances in spaceborne technology providing high resolution interferometric synthetic aperture radar images of the earth allows highly accurate surface movement monitoring to be undertaken. Central Alliance provides the essential geotechnical expertise and sense checking from UK based engineers with extensive rail experience - this gives the satellite data real commercial value for the rail sector ”.

Richard Pidcock,
Group Technical Director, Central Alliance

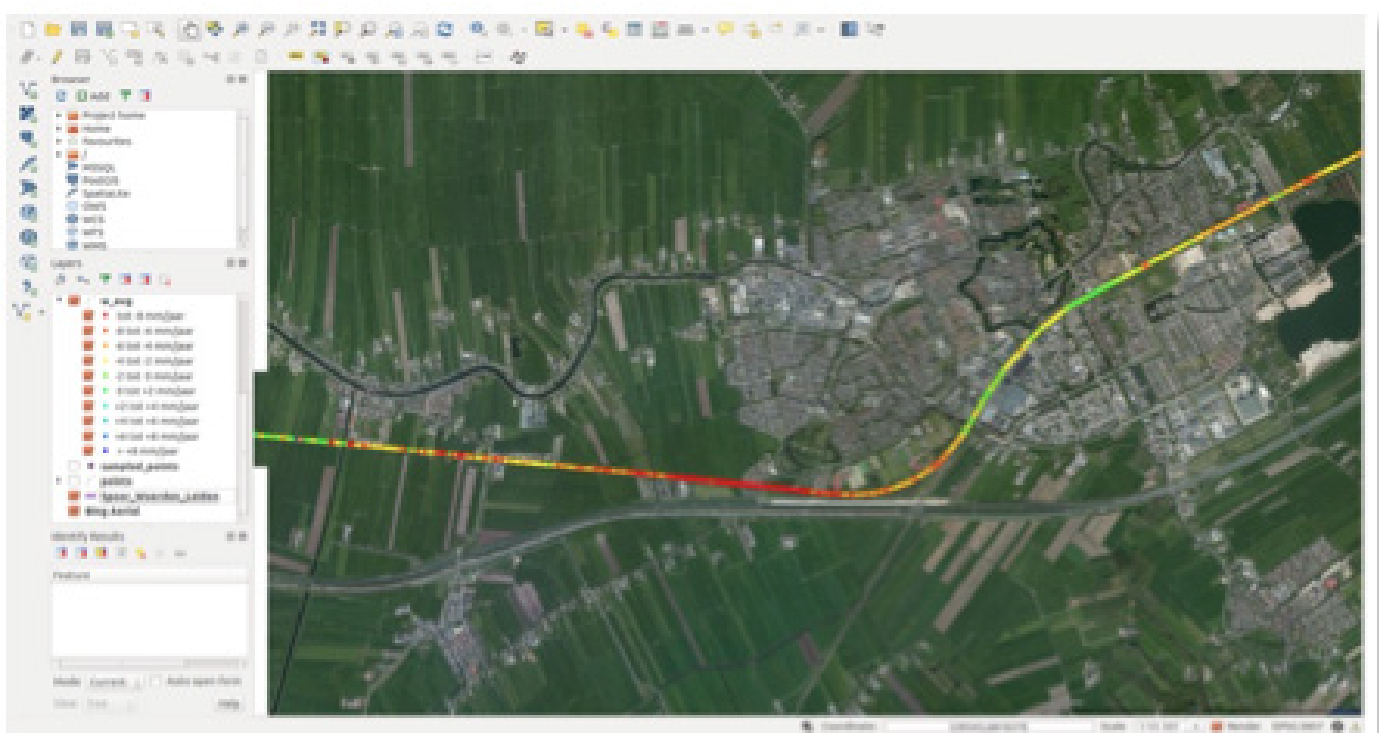


Satellite images and actual examples of how the data can be interpreted to help inform wider maintenance and asset management issues

Post-processing - satellite images can highlight important information regarding the stability of infrastructure. Areas of subsidence and heave can be easily identified and further post-processing allows differential movements to be established. Movements of all types of structures including viaducts, bridges and lineside structures can be monitored along with the permanent way itself whether running along earthworks or at grade.

Data can be collected from a wide area, including land outside of the infrastructure boundary. This enables more general ground movements to be picked up which may be causing problems to the infrastructure as well as identifying rail specific problems. Typically we would look at a strip 20 to 30m either side of the railway though this can be tailored to suit specific sites.

Subsidence Profile

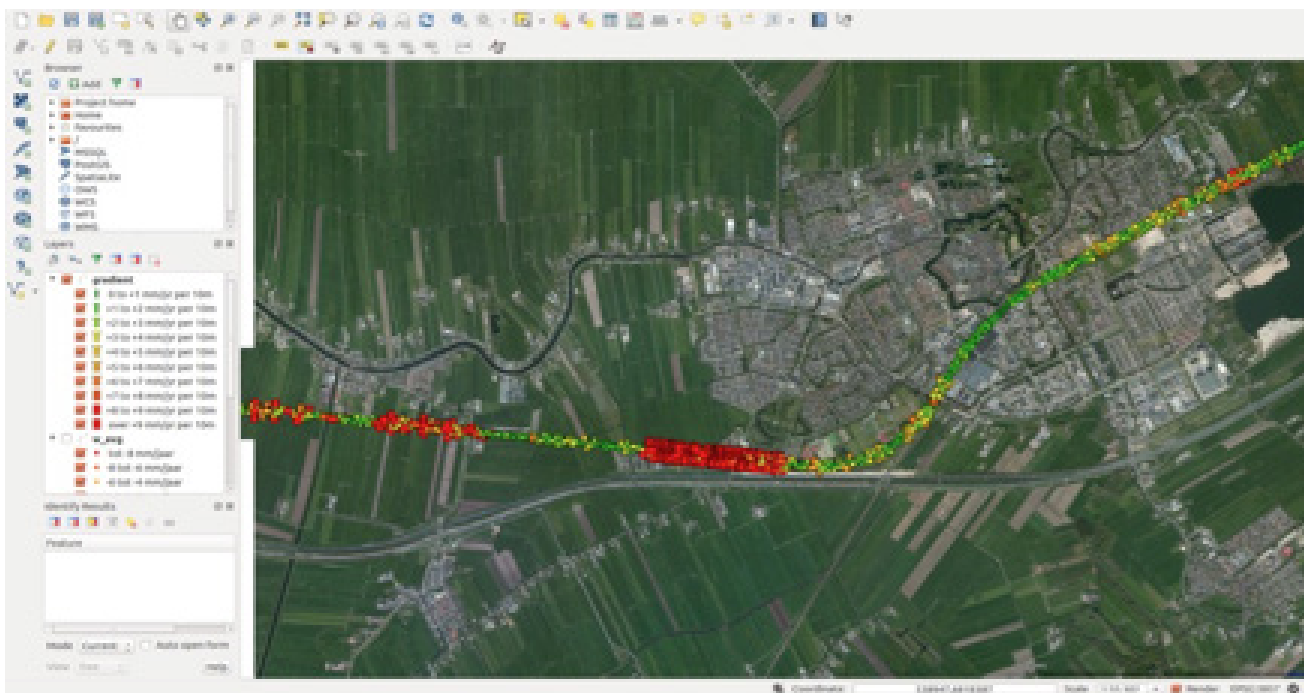


Colour keyed data points clearly highlight areas of subsidence and heave.

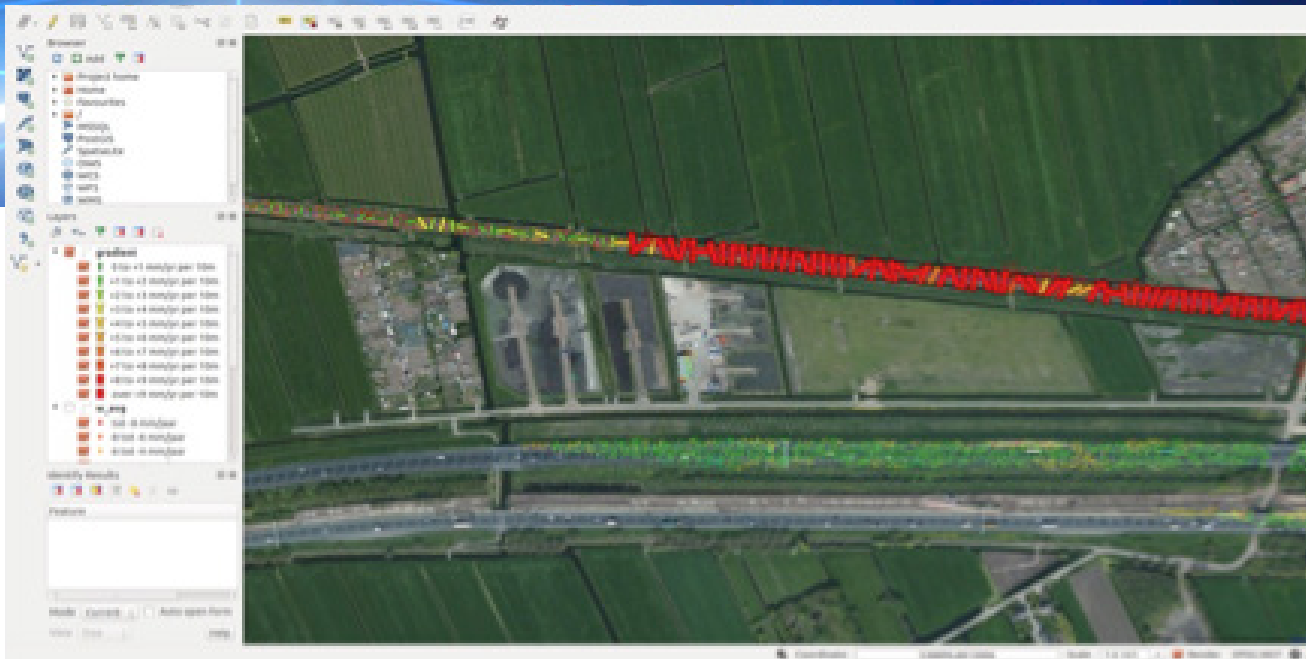


Example time series graph for each data point accessible through a web portal.

Shift Profile



Zoomed in Shift Profile



Further post-processing of data allows differential movements to be established.

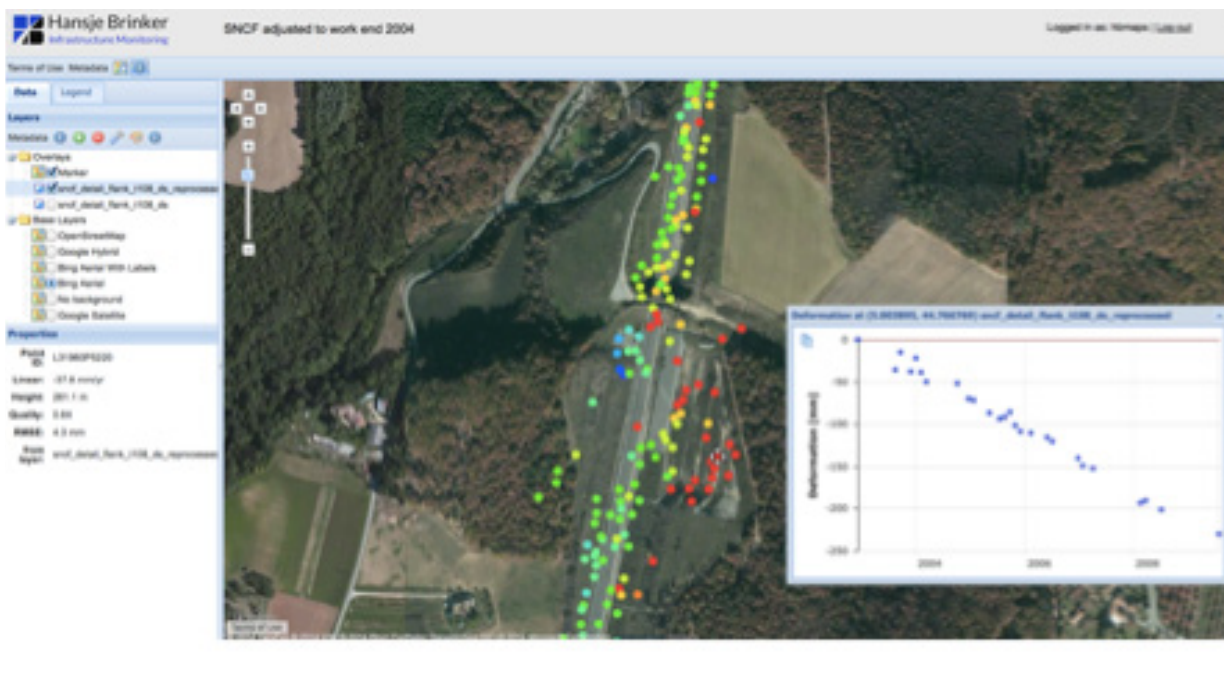
Monitoring of landslide - post remedial works



Post remediation images

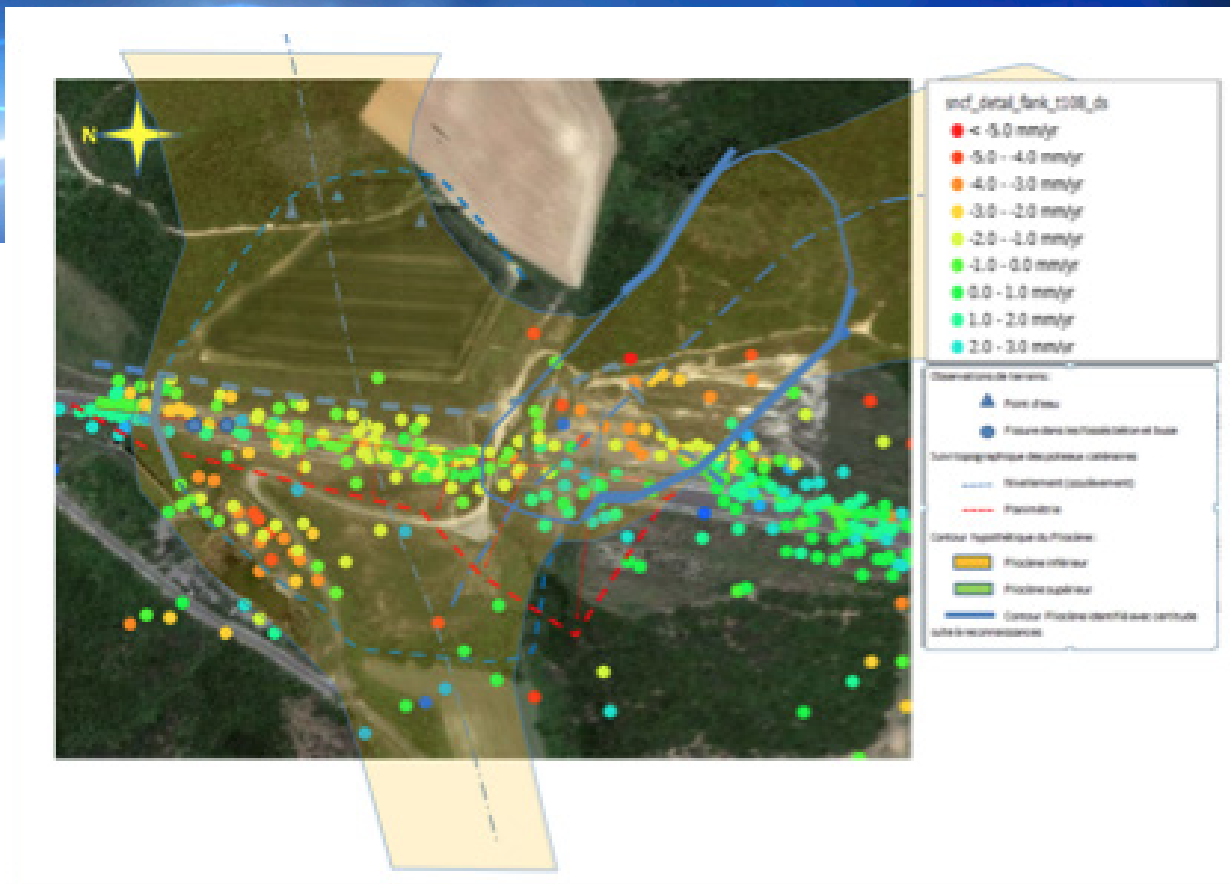


Overall asset management review post remediation



Key information that can identify areas to prioritise for urgent or preventative maintenance over time.

Post processing showing total movements of data points over time



Satellite data - technical information

Measurements from space

- Once every 4-30 days (typically 11, 22 or 30 days)
- Independent of time, clouds, etc
- Each satellite high resolution image ~ 30 km x 50 km enabling wide data capture

Historical and new data

- Possibility of historical (forensic) analysis from 1992
- New data can be ordered tailor made

Processing algorithms

- Vertical deformations 2-3 mm per measurement point
- <1 mm/year accuracy in trendline estimation
- Horizontal accuracy ~ 1 metre (sub-pixel)

About Central Alliance

The rail transport network is set to dramatically increase in importance over the next few years with the HS2 project and rail upgrades countrywide. Central Alliance appreciate that in no other sector is experience more important than on the railways. We have a history of working in rail environments - adept at managing all pre-construction services to ensure customers' needs and expectations are met.

Innovation in Investigation

Ground investigation is at the core of our business. We specialize in ground investigations on the railway and our experts have a wealth of experience in tackling difficult projects in difficult environments. We instinctively understand what is required and why, which enables us to work efficiently with consultants, contractors and clients. Our experience is in investigating earthworks with slope stability problems and other geotechnical issues which cause problems to the permanent way including settlement, groundwater issues and subsidence related to mine workings.

We own and operate our own drilling rigs and have developed a reputation for bespoke manufacturing of equipment to meet individual project needs and we can access sites without the need for possessions, isolations and road rail plant, saving significant time and money. In addition to conventional rotary, dynamic sampling and cable percussive rigs, we have modular dynamic sampling rigs and platform mounted dynamic sampling and rotary rigs enabling us to access steep and otherwise inaccessible slopes. We can install instrumentation to directly monitor ground movements and groundwater. We are also experienced in structural investigations on the railway and have pioneered methods for successfully investigating voided structures.

Surveying Solutions

We provide a comprehensive range of railway surveying, measurement and inspection solutions and we also like to use technology where we can in order to supply our clients with better results. We carry out topographical surveys using Unmanned Aerial Vehicles (UAV's), RTK's and GPS with a full understanding of the requirements of designers, so we can pick up all the required detail. We also use laser scanning technology to gain high accuracy point cloud data for structures and other significant rail features.

In high risk environments like the railway we encourage our clients to minimize the health and safety risks as well as the risks for stakeholders by using utility surveys, in fact, members of our team pioneered the use of Ground Penetrating Radar (GPR) for utility surveys in the UK.



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