Track condition monitoring – Below Ballast Scan (BBS) – utilizing Fiber Optic Sensing (FOS)

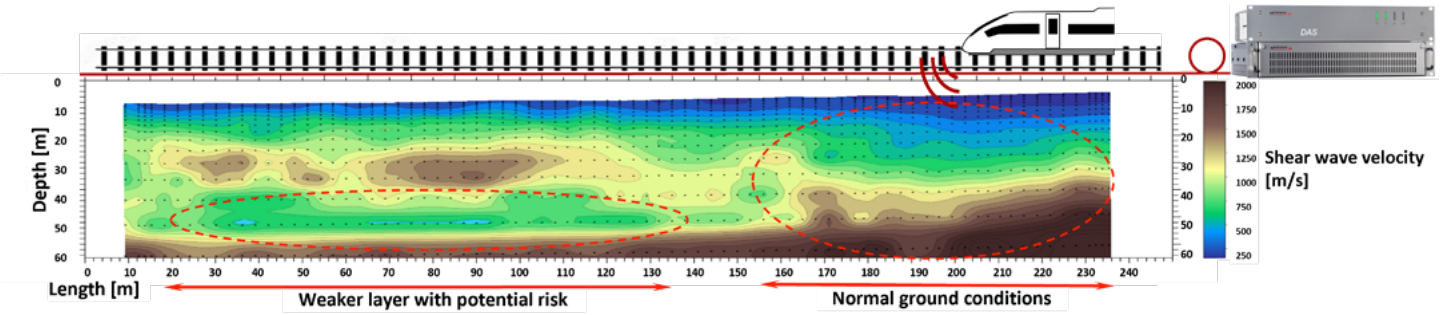
The Challenge

Continuous rail track monitoring allows planning of preventive and scheduled maintenance procedures and mitigating risks, caused by insufficient railway conditions. The trackbed ballast and subgrade directly affect the integrity of the track. Various techniques are used to evaluate both of these track components, such as ground penetrating radar (GPR) installed below inspection trains. This monitoring approach is an effective tool, but it mainly focuses on evaluation of the uppermost layer rather than the deeper layers across the network. Underground geological processes may form destructive cavities and sinkholes, which may lead to catastrophic events, including derailment and loss of life. The lack of subsurface geological characterization, especially in remote areas, or in areas where karst processes or unstable layer conditions are actively developing can be critical. Hence railways should include an element of on-demand or permanent below-ballast monitoring.

The Innovation

The latest developments in Fiber Optic Sensing (FOS) enable widespread use of this technology to monitor various critical infrastructures. Most railways already have fiber optic cables running parallel to the rail network. Important track conditions can be monitored in real-time by connecting a single fiber to a FOS system. AP Sensing's Distributed Acoustic Sensing (DAS) technology measures the acoustic frequency range, generated by each moving train and by the interaction between train and rail along the entire distance. It automatically locates and classifies various events in real-time, such as train position, speed and integrity, as well as different defects like flat wheels or broken rails.

Part of the energy of a moving train is transmitted into the ground in the form of seismic surface waves, which are an ideal source for underground condition assessment, providing insights into various geological processes that occur during the lifecycle of a track. In collaboration with our partner Sercel we perform an online ground condition assessment. The data acquired by DAS systems is used to provide geophysical imaging under the railroad bed, which gives insight into the development of risk zones and the identification of zones for remedial work (cavities, sinkholes or ground subsidence).



BBS solution in action: 2D shear velocity profile is presented under the rail track, with normal ground conditions on the right and zone of potential risk on the left.

World-class Systems

AP Sensing's monitoring solution utilizes acoustic measurements from our world-class, phase-based DAS system on standard fiber optic cables. The unique 2P squared technology features stable signal linearity and high sensitivity over long distances enabling it to detect important acoustic events.

Sercel's structural monitoring solution based on data acquired by DAS provides the understanding of underground geological conditions. It can be adopted according to the needs and used both for quick ground condition evaluation and long-term ground monitoring in real-time with no impact on operations.

Innovation for Condition Monitoring

The world's first BBS is the result of technical collaboration between AP Sensing with its unique DAS technology, and Sercel with its complete geophysical solution for near surface evaluation. Together we provide insights into understanding of the roadbed and underlying geology to help our customers to manage geotechnical risks.

The BBS provides critical data needed for safe railway operations and is an important complement to existing techniques and procedures, taking conventional GPR to the next level. The use of already existing fiber optic cables makes this joint solution of AP Sensing and Sercel very cost-effective. Assessment of rail track subsurface does not interfere with traffic, allows change monitoring for more predictive planning of maintenance operations, especially in the areas with complex geological conditions.

Why AP Sensing?

- Industry-leading monitoring solution comprising DTS, DSS, DAS and software for system configuration and data acquisition that offers excellent performance.
- Various solutions for integration into third party software or custom cloud-based solutions provide real-time access to your data.
- Our experience, network of regional partners and experts, and proven deployment in all regions in the world.

Why Sercel?

- Industry-leading seismic monitoring solution provider.
- Detection and monitoring of near-surface instabilities and cavities.
- Automated data processing system allows early warning of near surface degradation in risk areas
- Shear-wave velocity structure imaging under the railroad bed, which gives an understanding of the risk zone development and identifies zones for remedial work (cavities, sinkholes or ground subsidence).

For more information:
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