Protecting Railway Transport: Advancements in Autonomous and Automated Geodetic Deformation Monitoring

Lidija Špiranec (Switzerland)

Key words: Deformation measurement; Engineering survey; Positioning; Professional practice; Standards; automated monitoring; autonomous; railway; innovation; safety; reliability; resilience

SUMMARY

The growing demand for fast and sustainable transportation within cities and across countries stimulates continuous modernisation in railway transportation to improve safety and security, achieve operational excellence, enhance the passenger experience and reduce carbon emissions. Technology trends in the rail sector span from autonomous train systems supporting efficient and reliable railway transportation, to modern railway mobile communications systems enhanced with 5G technologies, to high-speed rail and robotic systems for infrastructure maintenance.

Employing faster trains at a higher traffic frequency, however, causes additional strain on the railway infrastructure. Age, geological instability and nearby construction work can also contribute to track geometry vulnerabilities, potentially endangering the safety of passengers and everyone in the rail vicinity, as well as creating economic losses for railway and metro-urban operators.

Deformation monitoring of the railway and supporting structures helps mitigate these risks and enhances safety. Railway tracks, the main infrastructure element, can be monitored using several measurement techniques and methods providing different data, measurement frequencies, automation levels and required human presence on the tracks.

Surveying has always been crucial to railway construction and operation, including manual monitoring methods to calculate displacements. However, the path from raw total station measurements (i.e., angles and distances) to information about twist and alignment as parameters of track geometry is long and paved with configuration and computation parameters. Each of these can be a point of error, leading to incorrect or missing results and ultimately affecting the safety of railway transport. Therefore, the fewer manual steps are in that path, the higher the rate of accurate, successful measurements, and the more complete the data.

Transforming manual data acquisition into autonomous collection and automating data processing is a significant advancement toward providing dependable data to stakeholders and decision makers. The latest innovations in Leica Geosystems' monitoring solution ensure highly resilient and autonomous data acquisition with continuous and uninterrupted dataflow. Automated measurements minimise the time surveyors need to be on the tracks- and a recently released railway computation feature makes error-prone manual track geometry configuration and computation a thing of the past. Altogether, these advancements minimise errors and produce rich, comprehensive data used to maximise safety through timely and informed interventions.

Railway transportation has never been faster and more reliable, yet the stakes for its safety have never been higher. Utilising innovative deformation monitoring systems which continue to advance alongside railway technologies delivers crucial information that railway operators can rely on to keep high-speed, high traffic rail transport safe.