Optical Non–Contact Railway Track Measurement with Static Terrestrial Laser Scanning to Better Than 1.5mm RMS

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SUMMARY

The railway industry requires track to be monitored for a variety of reasons, particularly when any type of physical works take place within the vicinity of the asset (e.g. demolition, construction and redevelopment works). Terrestrial laser scanning (TLS) has considerable potential as a survey method for rail measurement due to its non-contact nature and independence from physical targeting at track level. The consensus from recently published work using static terrestrial laser scanning is that rail measurements to the order of 3mm RMS are routinely possible. Such measures are appropriate for extracting the gauge, cant and twist parameters required by the rail industry, however engineering specifications designed to ensure safe and comfortable running of the trains ideally require measurements of better quality. This paper utilises standard design rail profiles from the UK industry to optimise the way in which TLS point cloud data are fitted to the rail geometry. The work is based on the use of off the shelf phase-based TLS systems each capable of delivering single point measurements of the order of 5mm to cooperative surfaces. The paper describes a workflow which focuses the fitting process onto discrete planar rail elements derived from the design rail geometry. The planar fitting process is improved through understanding how data from these scanners respond to rail surfaces. Of particular importance is the removal of noisy data from the shiny running surfaces. Results from a sequence of multi-station TLS surveys of the same set of double tracks taken from platform level highlight the capability to obtain fits to the rail model of better than 1.5mm RMS. Whilst fitting can be carried out on a single side of a rail, the paper highlights the challenge of obtaining an accurate TLS registration necessary to extract both sides of each rail to the same level of accuracy. This configuration is proven over inter-TLS instrument separations of the order of 30m and demonstrates the TLS network coverage necessary to achieve such results even in the presence of an occluding electric third rail.