HD Lidar scanning in active tunnels: challenges, solutions, applications

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**Abstract**

Lidar is a range based imaging technique with diverse applications, including but not limited to detailed hazard mapping, urban development, and mining. Due to recent advancements in the rate of data collection there is now great potential for the use of lidar in an operational tunnel environment. The practical employment of a static lidar scanner for geotechnical assessment in a drill and blast tunnel operation has been demonstrated in the Sandvika tunnel near Oslo, Norway. A tripod setup at the rock face allows for remote, rapid geotechnical evaluation without costly delays and disruption of the construction workflow. Active tunnel construction sites are non-traditional environments for lidar scanning and required unique and adaptable solutions, these are discussed. With correct data interpretation techniques, lidar technology provides a precise 3-dimensional tool for geomechanical assessment of exposed rock in the face and walls. Discontinuity orientation and spacing can be assessed and extracted for further use in kinematic and numerical modeling. The alignment of scans from successive blast rounds is advantageous for identifying and characterizing larger scale structural features visible as lineations in the face. Lidar data may also be used retroactively for quality control of installed tunnel support. Potential applications include: calculation of shotcrete thickness, shotcrete volume, bolt spacing, and regions of potential leakage.

**Keywords:** Lidar; technological solutions to tunnel specific problems; data collection in an operational environment; limitations of tunnel scanning; shotcrete thickness verification; bolt installation verification; potential leakage mapping; structural discontinuity evaluation; discontinuity spacing and 3 dimensional models; surface characterization; analysis of structurally controlled overbreak; projection of structural features in multiple scans.