



## **Sampling and modeling of rock discontinuities by terrestrial laser scanning and photogrammetry in railway environment**

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In order to increase its knowledge of rock slope stability along the French national rail network, the SNCF Engineering Management is developing a new approach for sampling and modeling rock discontinuities. The rock face diagnosis is a follow-up and check operation of the field works. This operation allowed to optimize the rock risk treatment at the best price in respect with safety requirements. These operations require the measurement of orientation and location of rock discontinuities at the surface of the rock mass and is followed by a structural modeling in order to extrapolate the data collected at the surface to the inner part of the massif. At present, this work is completed manually with a compass-clinometer, in a simplified way mainly based on the specialist's experience. The analysis remains empirical, and most of the time restricted to the most fractured zone, whereas safety requirements ask for an exhaustive study on the whole of the site. Filling these gaps, the combined use of dense three-dimensional measurement techniques, associating both terrestrial laser scanning and optical imaging, makes it possible to obtain a more complete structural statement. The data acquisition and processing need protocols adapted to the railway environment for obtaining suitable 3D models. Then the exploitation of these models requires the development of semi-automatic process, with an aim of, to support the geologist's on-site expertise with a digital model exploitation. The geometrical characterization of the rock mass is undertaken thanks to a classification of the model in several subsets corresponding to the main directional families. The data on these planar discontinuities, traditionally acquired manually in certain points necessarily accessible of the rock face, result now from dense 3D models covering the whole of the work. Therefore, statistical sampling is stronger, while the time of the on-site survey is reduced. By these means, the diagnosis should be made reliable and the recommendations optimized with the unfavourable sectors. Then, risk analysis can be targeted on the potential disorders zones and not on the whole of the studied sector.

**Keywords :** Discontinuities, fractures, railway exploitation, terrestrial laser-scanner, dense image matching, rock mass characterization, directional families, data processing