# Measurement and monitoring of geological repository boreholes using terrestrial laser scanner and photogrammetry

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Several experiment boreholes were bored in the rock characterization facility ONKALO in order to analyze and experiment various technical aspects of the nuclear waste disposal. Among them is required an accurate measurement method to verify the strict design requirements and monitoring of the deformation of each borehole. In a 7.8 m deep borehole with a diameter of 1.75 m this has been proven challenging. The design requirements for the diameter are -2.5 – +25 mm and for example for the straightness of the bottom 1:1750 mm. The present study aims at finding the most suitable technique for measuring and verifying the strict design requirements and also to develop a method for monitoring the deformation of these boreholes with high confidence and accuracy in a millimeter scale. Two different close-range measurement techniques are compared here: LiDAR and photogrammetry. Both techniques are applied using multitemporal acquisitions.

Parts of the 3D datasets are affected by an artificial distortion, with a maximum shift up to 6 mm, which is clearly above the required accuracy. The origin of this artifact is related with the data acquisition strategy. Largest distortions with LiDAR are e.g. the incidence angle, position of the scanner and rock surface moisture and color (Carrea *et al.,* 2014). For photogrammetry the greatest challenges are the setup and overlap of the images, moisture of the rock surface and georeferencing.

Up to now, the photogrammetric acquisitions have provided more accurate results than the laser scanning, but there is a range of improvement in acquisition procedures for both techniques and new acquisitions are in progress.

## References:

Carrea, D., Jaboyedoff, M. & Derron, M-H., 2014. Feasibility study of point cloud data from test deposition holes for deformation analysis. Posiva working report 2014-01.