

Exploring the Potential of Smartphone Photogrammetry for Field Measurement of Joint Roughness

Pengju An

Institute of Rock Mechanics, Ningbo University, Ningbo 315211, China

Abstract: Rock joints, natural fractures or discontinuities in rock masses, significantly influence their behavior and stability. However, devices for easily and accurately measuring joint roughness in field conditions are lacking. This research investigates the viability of smartphone photogrammetry for large-scale joint roughness characterization in the field. A large natural rock joint served as the specimen. Both two-dimensional (2D) and three-dimensional (3D) roughness parameters were utilized to characterize joint roughness. A high-accuracy 3D laser scanner and a traditional profile gauge were used for comparison with smartphone photogrammetry. The results indicate that smartphone photogrammetry's accuracy is comparable to that of the profile gauge with a needle diameter of 1.0 mm for 2D roughness measurements, yielding average measurement errors of 1.7%, 4.7%, 7.8%, and 6.1% for Z_1 , A_i , Z_2 , and PSD-D roughness parameters. Regarding 3D roughness, smartphone photogrammetry achieved high accuracy levels of 14.67%, 3.83%, 1.17%, and 3.1% for models with point intervals of 1.0 mm, 2.0 mm, 5.0 mm, and 10.0 mm, respectively. In summary, this study demonstrates that employing smartphone photogrammetry as a portable and cost-effective method for measuring rock joint roughness in field conditions could significantly benefit engineering geological investigations.

Keywords: smartphone photogrammetry; rock joint; roughness; Cloud-to-Cloud distance; measurement error