Volume XXXIX-B5

Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XXXIX-B5, 199-203, 2012
www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XXXIX-B5/199/2012/
doi:10.5194/isprsarchives-XXXIX-B5-199-2012

CONTINUOUSLY DEFORMATION MONITORING OF SUBWAY TUNNEL BASED ON TERRESTRIAL POINT CLOUDS

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Keywords: Deformation Monitoring, Vertical Section, Quadric Fitting, Random Sample Consensus, Terrestrial Laser Scanner (TLS)

Abstract. The deformation monitoring of subway tunnel is of extraordinary necessity. Therefore, a method for deformation monitoring based on terrestrial point clouds is proposed in this paper. First, the traditional adjacent stations registration is replaced by sectioncontrolled registration, so that the common control points can be used by each station and thus the error accumulation avoided within a section. Afterwards, the central axis of the subway tunnel is determined through RANSAC (Random Sample Consensus) algorithm and curve fitting. Although with very high resolution, laser points are still discrete and thus the vertical section is computed via the quadric fitting of the vicinity of interest, instead of the fitting of the whole model of a subway tunnel, which is determined by the intersection line rotated about the central axis of tunnel within a vertical plane. The extraction of the vertical section is then optimized using RANSAC for the purpose of filtering out noises. Based on the extracted vertical sections, the volume of tunnel deformation is estimated by the comparison between vertical sections extracted at the same position from different epochs of point clouds. Furthermore, the continuously extracted vertical sections are deployed to evaluate the convergent tendency of the tunnel. The proposed algorithms are verified using real datasets in terms of accuracy and computation efficiency. The experimental result of fitting accuracy analysis shows the maximum deviation between interpolated point and real point is 1.5 mm, and the minimum one is 0.1 mm; the convergent tendency of the tunnel was detected by the comparison of adjacent fitting radius. The maximum error is 6 mm, while the minimum one is 1 mm. The computation cost of vertical section abstraction is within 3 seconds/section, which proves high efficiency..

Conference Paper (PDF, 1057 KB)

Citation: Kang, Z., Tuo, L., and Zlatanova, S.: CONTINUOUSLY DEFORMATION MONITORING OF SUBWAY TUNNEL BASED ON TERRESTRIAL POINT CLOUDS, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XXXIX-B5, 199-203, doi:10.5194/isprsarchives-XXXIX-B5-199-2012, 2012.