POINT CLOUD COARSE REGISTRATION USING IMAGES FROM TERRESTRIAL LASER SCANNER MOUNTED CAMERA

Youngmok Kwon[1], Cheolhwan Kim[1], Wonjun Choi[1], Hong-Gyoo Sohn*[1], Namhoon Kim[2]

[1]Graduate Student, School of Civil and Environmental Engineering, Yonsei University,
50, Yonsei-ro, Seodaemun-gu, Seoul, Republic of Korea
Email: polosport104@yonsei.ac.kr, pat5789@yonsei.ac.kr, wonjun9262@yonsei.ac.kr

*[1]Associate Professor, School of Civil and Environmental Engineering, Yonsei University,
50, Yonsei-ro, Seodaemun-gu, Seoul, Republic of Korea
Email: sohn1@yonsei.ac.kr

[2]Assistant Professor, Department of Civil Engineering and Environmental Sciences, Korea Military Academy,
574, Hwarang-ro, Nowon-gu, Seoul, Republic of Korea
Email: kim_namhoon@kma.ac.kr

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ABSTRACT: As the application of 3D spatial information expands across numerous fields, an increasing demand emerges for the efficient construction of such datasets. Due to its accuracy and efficiency, 3D laser scanners are widely used to generate 3D spatial data. Moreover, in recent years, 3D laser scanning technology has seen significant advancements, leading to broader applications.

The 3D modeling of indoor environments serves various purposes, including monitoring and change detection, with point clouds being a prevalent data source for these applications. Generally, obtaining data from multiple stations is necessary for the practical use of point cloud data due to occlusions. However, manual registration of these multi-station data is time-consuming and requires a comprehensive understanding of the data acquisition site. Therefore, it is desirable to support this tedious process.

In this study, we utilized images from a camera mounted to the terrestrial laser scanner (TLS) for the coarse registration of point cloud data acquired from different stations. First, the calibration of the mounted camera was done with the point cloud and the image acquired from the TLS to define the relationship between 3D point cloud coordinates and 2D image coordinates. According to the image width and focal length, the point cloud data of the source station is divided into sections using to extract the 3D points that project into the corresponding image data. Then, the 3D coordinates from the extracted point cloud and the 2D coordinates from the image data are related according to the IOPs (Interior Orientation Parameters) and EOPs (Exterior Orientation Parameters).

Conjugate points between the images acquired from the source and target stations were obtained by an image matching algorithm. The conjugate points were filtered with a threshold applied to the matching score. The extracted 2D feature points from the source station image were related with the 3D coordinates from the relationship defined beforehand. The 3D coordinates and the conjugate points of the target station image obtained were then utilized as control points for the image of the target station. The rotation and the translation information of the target station were calculated using these control points, providing the parameters for coarse registration of the point clouds.

The evaluation of the result was done by using RMSE (Root Mean Square Error) distance. Through qualitative and quantitative evaluations, it indicated that our registration results were suitable for the registration of point clouds leading to 3D modeling of the indoor environment. In the future, it is necessary to apply this method to other various laser scanning sensors that capture both point cloud data and image data for generalization.

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