

Point Cloud Registration Based on Feature Lines Derived from Depth Difference

Tetsuji Konno Kouichi Konno Tadahiro Fujimoto Norishige Chiba

Faculty of Engineering, Iwate University

ABSTRACT

Registration of multiple point cloud data

- Based on a "*feature-line-matching*" approach, and consists of following two steps.

STEP1. Feature line Extraction.

STEP2. Registration

Advantage

- Our algorithm works well for scanned data such as data of linear buildings.



Figure 1. The south gate on outline of ruins of Shiwa castle.

OVERVIEW OF OUR METHOD

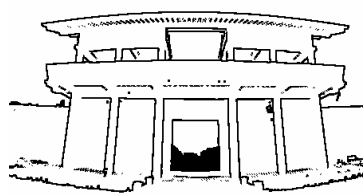


Figure 2. Depth Edge image.
(View from the front)

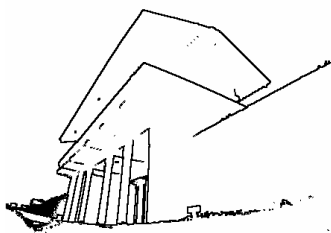


Figure 3. Depth Edge image.
(View from the right-hand side)

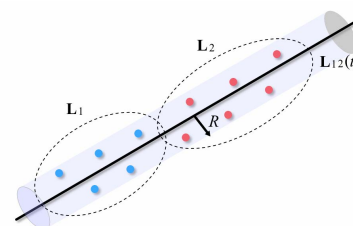


Figure 4. Merging line segments.

Feature Line Extraction

- (1) Extracts edges and makes the "*Depth Edge*" image from a point cloud data (Fig 2, 3).
 - Depth Edge is set of feature lines, that correspond to a portion with the large difference of the neighboring pixels depth value.
- (2) Edges are converted into line segments in 3D space.
 - The number of straightly lined pixels on a feature line is the number of vertices that construct the line segment in 3D space.
- (3) Merging and optimization.
 - Algorithm checks each pair of line for merging condition.
 - If all vertices of this two line exist within the area with R radius from an infinite line, they are merged into a one line (Fig 4).

Registration Algorithm

- (1) Makes the geometrical transformation.
 - It calculates the matrix of rotation, and the matrix of translation.
 - Select some lines from the extracted line segments.
 - Calculate the error evaluation function for each corresponding pair.
- (2) Evaluate the geometrical transformation.
 - The distance between each pair of line segments is evaluated for all of combinations of two line segments.
 - The geometrical transformation is evaluated based on following two criteria..
 - The total number of matching pairs among all combinations.
 - The sum of selected pairs evaluation values.

EXPERIMENT RESULTS

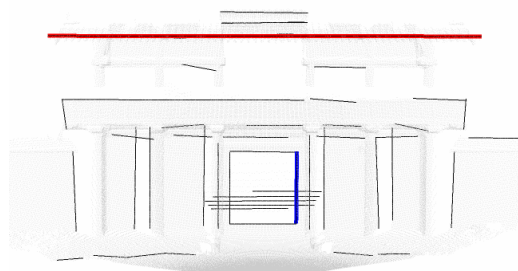


Figure 5. Result of feature line extraction.
(View from the front)

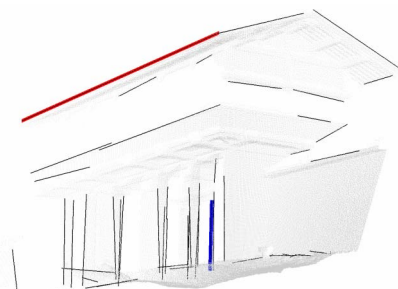


Figure 6. Result of feature line extraction.
(View from the right-hand side)

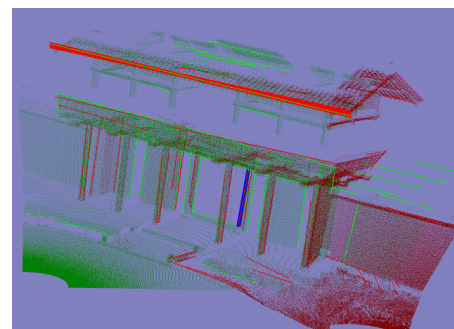


Figure 7. Result of registration.