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Rong Huang

Change detection of construction sites using radiometric and geometric information from point clouds

Automatic monitoring of construction processing has drawn attention in the field of Architecture, Engineering, Construction and Facilities Management industry increasingly. However, traditional construction surveying methods for construction monitoring are labor-intensive, error-prone, time-consuming and lack of continuity. With the development of remote sensing techniques, providing data sources with improved spatial and radiometric resolution, new possibilities arise for us to achieve precise and accurate monitoring consecutively.
This research aims to develop robust methods and techniques to acquire changes of structural components of the building and the temporal environments in the site during the construction process, 3D point clouds generated from photogrammetric surveys (e.g., terrestrial SLR images or UAV images) and laser scanning of the construction site will be utilized and analyzed.

This research mainly intends to provide answers to the following questions:

- ❑ In case of different acquisition methods of data sources, how to achieve continuous and efficient monitoring of a construction site?
- ❑ How to eliminate the influence of irrelevant changes in the context of a construction site?
- ❑ In which way the changes shall be efficiently represented

To solve these aforementioned questions, the research are subdivided into following essential aspects:

- ❑ Detection and filtering of irrelevant artifacts. The geometric, radiometric, or contextual information will be applied to detect extraneous artifacts (i.e., moving objects) and remove them from acquired point clouds.
- ❑ Consecutive co-registration of filtered point clouds. The consecutive co-registration can be conducted in different strategies, i.e., 2D-3D strategy, which utilizes corresponding 2D features, and directing geo-referencing strategy.
- ❑ Reconstruction of 4D model of building objects and necessary surroundings. The graph-based techniques will be used for segmentation and classification of point clouds. During this process, deep learning techniques can also be applied. Then， building objects will be recognized and modeled based on the geometric, radiometric and semantic information. These models are fed into the 4D model of building objects with the addition of the dimension of time.
- ❑ Change detection and detailed change representation. Detailed differences between measures of different acquisition time can be detected through the comparison of reconstructed models or extracted objects. The output of detected changes will be represented in different levels, e.g., existence change or temporal variation of building objects.

The main contribution of the research will be the formulation of an object-based change detection framework using point clouds for construction monitoring, which includes co-registration between point clouds from different acquisition dates, building object recognition and reconstruction and change detection. Simultaneously, the as-planned BIM will serve as the reference data for evaluation. Furthermore, a set of novel or improved methods or techniques will be proposed and tested, which includes the investigation of the utilization of graph-based optimization approaches capable of exploiting topological information.