Fusion of Airborne LiDAR Data and Satellite SAR Data for Building Classification

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Abstract. A frequent map revision is required in GIS applications, such as disaster prevention and urban planning. In general, airborne photogrammetry and LIDAR measurements are applied to geometrical data acquisition for automated map generation and revision. However, attribute data acquisition and classification depend on manual editing works including ground surveys. In an airborne photogrammetry, a geometrical modeling and object classification can be automated using color images. Stereo matching is an essential technique to reconstruct 3D model from images. Recently, structure from motion (SfM) is proposed to generate 3D mesh model from random images. Although, object classification methods are automated using height data estimated with the stereo matching and SfM, it is difficult to recognize construction materials, such as woods and concrete. The construction materials are significant attribute data in building modeling and mapping. Therefore, ground survey and manual editing works are required in attribute data classification. In the LIDAR measurements, modeling and object classification are also automated by a segmentation of point cloud data. The intensity data also assist the object classification. Moreover, data fusion approaches are proposed using aerial images and LIDAR data. These approaches focus on modeling accuracy improvement and processing time improvement. However, these approaches classify geometrical attributes. On the other hand, although geometrical data extraction is difficult, SAR data have a possibility to automate the attribute data acquisition and classification. The SAR data represent microwave reflections on various surfaces of ground and buildings. There are many researches related to monitoring activities of disaster, vegetation, and urban. Moreover, we have an opportunity to acquire higher resolution data in urban areas with new sensors, such as ALOS2 PALSAR2. Therefore, in this study, we focus on an integration of airborne LIDAR data and satellite SAR data for building extraction and classification. In this study, we use airborne LIDAR and satellite SAR data to classify buildings. Firstly, we generate a digital surface model (DSM)

from point cloud acquired with airborne LIDAR. Secondary, the DSM is registered with a normalized radar cross section (NRCS) image calculated from SAR data. In a registration between SAR and LiDAR data, corresponded points are required to be extracted from each datum. Although SAR data and LiDAR data have different indices, we can recognize road intersections, rivers, and bridges as feature points in manual. Thirdly, buildings are extracted from the DSM. Finally, the buildings are classified into several clusters using NRCS in the DSM. In our object extraction process, buildings were extracted from DSM in our object extraction process. Although visual checks were required to determine the best threshold values to extract buildings, several small noises including automobiles were left as unknown objects in the DSM. In classification with NRCS, spatial resolution was too low to recognize small residential buildings and complex roofs of large buildings. In the classification with NRCS and number of roof planes, large buildings which have complex roofs were extracted. In our experiment, we prepared point cloud data acquired with an airborne LiDAR and satellite SAR data acquired with ALOS PALSAR in Tokyo. Next, we extracted buildings from DSM. Although our result included noises such as bridges and automobiles, we classified buildings into clusters with average NRCS values. In our future works, although we focused on building roofs, we can focus on an opportunity to acquire more details of buildings with airborne LiDAR. We would improve our classification with estimations of wall surface and smaller object of buildings. We will apply the supervised approach to improve our classification accuracy.

Keywords. Urban Sensing, Building Classification, Airborne LiDAR, Satellite SAR