Detection of Individual Trees in Urban Areas Using the Point Cloud Produced by Dense Image Matching Algorithms

Naci Yastikli and Zehra Cetin (Turkey)

Key words: Engineering survey; Low cost technology; Photogrammetry; Remote sensing; Aerial Photographs; Image Matching; Point Cloud; Classification; Clustering; Point Based; Tree Detection; Urban Tree

SUMMARY

Urban environment is the principal habitat for the human population. Trees in urban areas play an important role in modern urban spatial data management, local micro-climatic conditions, the ecosystem and air quality. The distribution and number of trees impact the health and life quality of urban residents considerably. Timely and accurate acquisition of individual tree information is very crucial for the decision makers to supply better living conditions for the residents. Today, LiDAR point cloud with high point density and accuracy is widely available in particular for urban areas for different studies such as 3D city modelling, chance detection, object extraction as well as the delineation of individual trees. Although LiDAR systems have various advantages in recent years, they are still expensive for data acquisition especially in small areas. The cost-effective alternative of the LiDAR systems is the 3D dense point clouds generation with aerial photogrammetry using image matching algorithms such as semi-global matching approaches.

This study concentrates on the detection of individual trees in urban environments, which is very difficult task because of structural complexity of urban environment includes various objects such as buildings, roads, trees, temporary objects, power lines and cables. The high density point cloud data obtained with semi global matching using aerial photographs is used to acquire detailed and accurate information about urban trees for further studies instead of LiDAR point cloud. Firstly, a point-based classification has been used to classify the dense point cloud data automatically which based on hierarchical rules. The detailed analysis in different pilot areas has been performed for the determination of most suitable parameters used in hierarchical rules. The ground, low vegetation, medium vegetation, high vegetation, building, low point and air point classes are obtained with proposed point-based classification approach. After the classification step, a point-based segmentation with advanced clustering techniques carried out using the points in high vegetation class to detect individual urban trees. The dense point cloud data were generated with dense image

matching algorithms in the pilot areas and test side, which is situated in Zekeriyakoy, Istanbul within the scope of High Resolution Digital Surface Model (DSM) and Real Orthophoto Production Project by the Directorate General of Geographic Information Systems of the Republic of Turkey Ministry of Environment and Urbanization. The obtained detection rate of individual trees in the study area verified that individual trees in urban environment can be obtained successfully using the dense point cloud data produced by dense image matching algorithms using aerial photographs.