

Taikichiro Mori Memorial Research Grants

Graduate Student Researcher Development Grant Report

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Research Project: An Object-based Image Analysis and Change Detection Approach Using Very High Resolution Optical and LiDAR Sensors Data to Develop a Green Cadastre for Monitoring and Preserving of Urban Private Gardens

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Undoubtedly, the trees in urban areas are the green live sprit of the city, and the city life strongly ties to them, but in despite of the exclusive social, ecological and economical different functions of them in our lives, they are treated unkindly.

Trees living in urban environment face with critical constraints and stresses which severely threaten the life cycle of them in the urban landscape. Herwitz stated that the different urban constraints limited the average lifespan of the urban trees to only 32 years (13 years if planted in a downtown area) which is significantly shorter than the average of 150 years is expected for the trees growing in the rural areas.

The factors which critically threaten the life span of urban tress can be categorized in two main categories: the

factors which directly threaten the existence of the tree and the factors influence the tree health condition.

Urban trees cutting and removal occurs for many reasons. Beside the exceptional cases, which cutting or removal of a tree is an inevitable task, urban trees are mostly being cut and removed illegally during the urbanization process and construction projects in the private properties.

This major destructive process is more obvious in the developing countries which are usually suffering from the lack of the public awareness and legal supervision. Therefore, unfortunately by

the rapid trend of urban expansion and sometimes informal and unplanned process of the urban settlement, the urban trees are disappearing quickly from the urban ecology.

By raising environmental awareness and public concerns about the urban biodiversity, the governments have been approved the supportive legal frameworks in the national and local scales to protect and preserve the trees against the critical factors which affect the life span of them in the urban areas.

In this context, many local governments and authorities have been developed the routine monitoring and inventory to preserve the urban trees which are located in the public lands such as public parks, streets and high ways. Beside the formal legal policies and actions and tree inventory and management projects, the urban trees on the public properties are additionally supported by the public supervision, which significantly promotes the efficiency of trees' monitoring and perversion programs.

In contrast with the trees growing in the public green spaces in the urban environment, less attention has been paid to the trees on the private properties as there is a less accessibility for urban authorities to have a common periodic supervision and maintenance services in the private lands. The lack of legal periodic supervision and formal technical supportive care and tree maintenance programs beside the isolated and unexposed nature of the private properties (which significantly decreases the public supervision), has sharply increased the risk of destruction and damaging of the trees in the private lands.

So far, less attention has been done to the object based image analysis and change detection for fine scale tree

inventory and tree detection, crown delineation and change detection in the previous studies. Moreover, most of current fine scale, object based methods in this context were proposed for homogenous case studies such as forests. So, a few studies have been done in the complex and heterogeneous case studies such as urban areas. To cover the abovementioned research gaps in this area, an object-based methodology has been developed to process the very high resolution remotely sensed data for monitoring of the trees in urban private gardens.

This study aims to develop a geographical object based image analysis (GOBIA) methodology to detect and delineate individual tree crown objects and detect individual tree physical changes in the landscape by using of Very High Resolution (VHR) imagery for the means of establishing a green urban cadastre for monitoring and preserving the trees in the urban private gardens.

In this study, the classification strategy was executed with classification rules to exploit object features at multiple segmentation levels according to the contextual information such as spectral response, height, texture, geometry, size, roundness which were utilized to modify the assigned class and geometry of image objects (Figure 1). In this context the Optical and Urban Cadastral Data were fused to conduct a knowledge based context-aware classification.

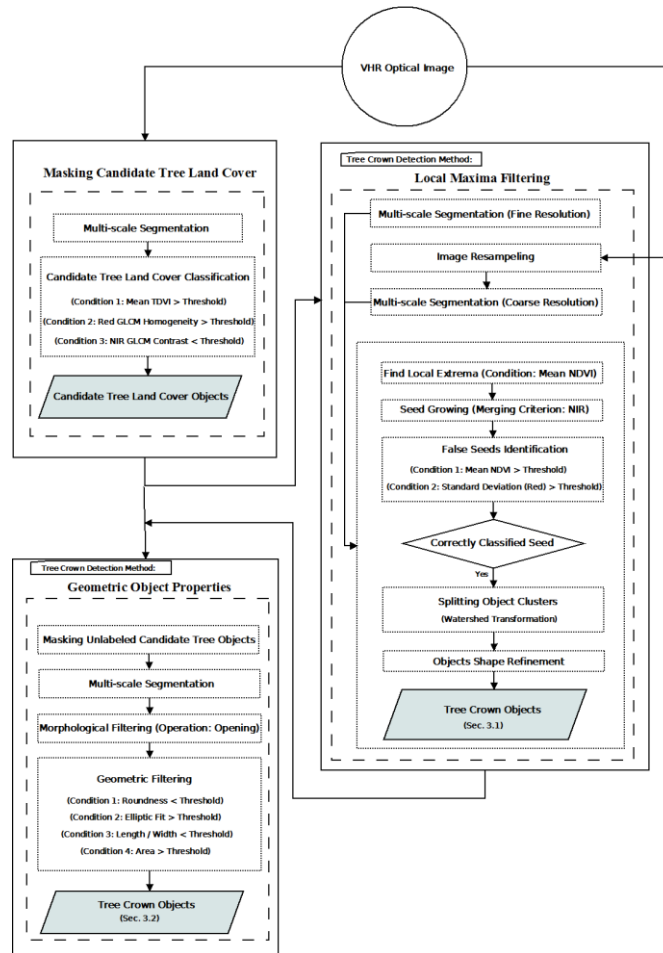


Figure 1: Workflow of Developed Methodology

The proposed OBIA framework was implemented on very high resolution imagery from Hashemieh District, Mashhad, Iran as a good example of fast growing district in Mashhad, Iran to detect and delimitate the individual trees located in urban private gardens and monitor the changes (mainly as the result of illegal cutting and removal of trees during the urbanization process and construction projects) to create a pilot fine resolution tree inventory system for official and legal applications in the context of urban private gardens. For selection of this case study and collecting the ground truth a field work was conducted in Mashhad city, Iran in 2015.

Finally, the results of this study was by the conventional accuracy indicators in remote sensing, which shows that our results are promising in the context of positional accuracy and completeness of detected tree crown objects (Figure 2).

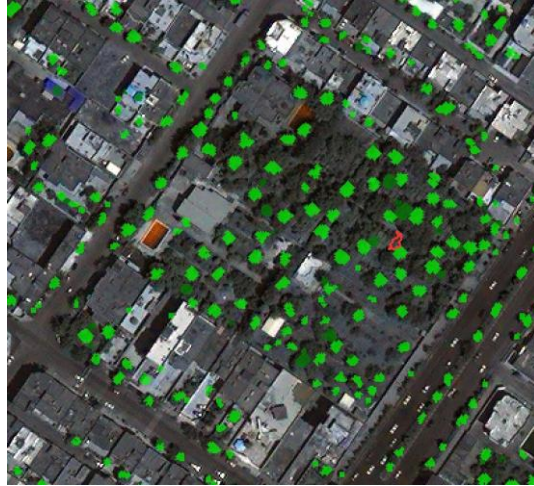


Figure 2: The Detected Tree Crowns with the Specific Crown Size

The first output of this study formulated as an extended abstract entitled “An object-based image analysis approach for developing a green cadastre for monitoring of private urban gardens: case study of Hashemieh district, Mashhad, Iran” and it was accepted for oral presentation at SPIE Remote Sensing Conference in France. Also another full paper is under preparation to submit for a scientific journal.

Finally, I would like to take this opportunity to express my sincere gratitude to Mori Fund Steering Committee for selecting me as one of Mori Grant recipients and provide this unique opportunity for me to conduct this research.