Brief description of procedures used for building and tree detection at

Vaihingen Test Site

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1   Preprocessing

As input data for the object extraction served only the given DMC-I imagery (3 channels) with the orientation and calibration data, the provided orthoimages and LiDAR data were not used.

1.1   Generation of Digital Surface Model (DSM) and TrueOrthoMosaic (TOM)

First the raw images were imported into the INPHO software and the given AT were checked and optimized for the use of the Semi-Global Matching (SGM) process (Hirschmüller, 2008).

In the next step the SGM matching was performed. Where no matching was possible (matching count mask eq 0) a no-data mask was produced and the height value was interpolated. The resulting DSM was output as raster data with a x- and y resolution of 10 cm, the height scale was set to 5 cm. Using this DSM a TOM was calculated.

The quality of the photogrammetric DSM and the DOM depends on the overlap of the imagery. In the center region where the test areas for building and tree extraction are located the overlap of 60% along track and to neighboring flightlines is given, therefore the quality of the DSM is as expected. In some border regions of the whole Vaihingen test area (including the regions for road extraction) the overlap is not given, which may result in a reduced quality of the DSM.

1.2   Generation of DTM and nDSM

A fully automated modification of the method described in (Mayer, 2004) was used to subdivide the DSM into ground- and elevated pixel. Matching algorithms like SGM may produce erroneous matchings and artefacts in a DSM e.g. caused by homogenous surfaces or surfaces with repetitive textures. As the DTM-generation method uses filter windows sensitive to such noise, a preprocessing was done on the DSM in which small negative outliers were removed from the DSM using a one-sided median filter that fills gaps in the surface. Once the subdivision of the DSM into surface and elevates object-pixels was done, a DTM was generated by cutting and interpolating all elevated pixels using the surrounding ground pixels with an inverse distance weighting function. Subtracting the DTM from the DSM resulted in a normalized DSM (nDSM) containing only heights above ground.

1.3   Further input layers

In addition to the processed TOM and nDSM data, also layer derivatives like slope and edge layers were used for the detection of buildings and single tree crown objects.

2   Object Detection

The classification is performed using the commercial software packages Trimble eCognition and ArcGIS. The complete workflow for the extraction of building and single tree crown objects is depicted in the Figure 1. A brief description of the single detection steps can be found in the chapters below.
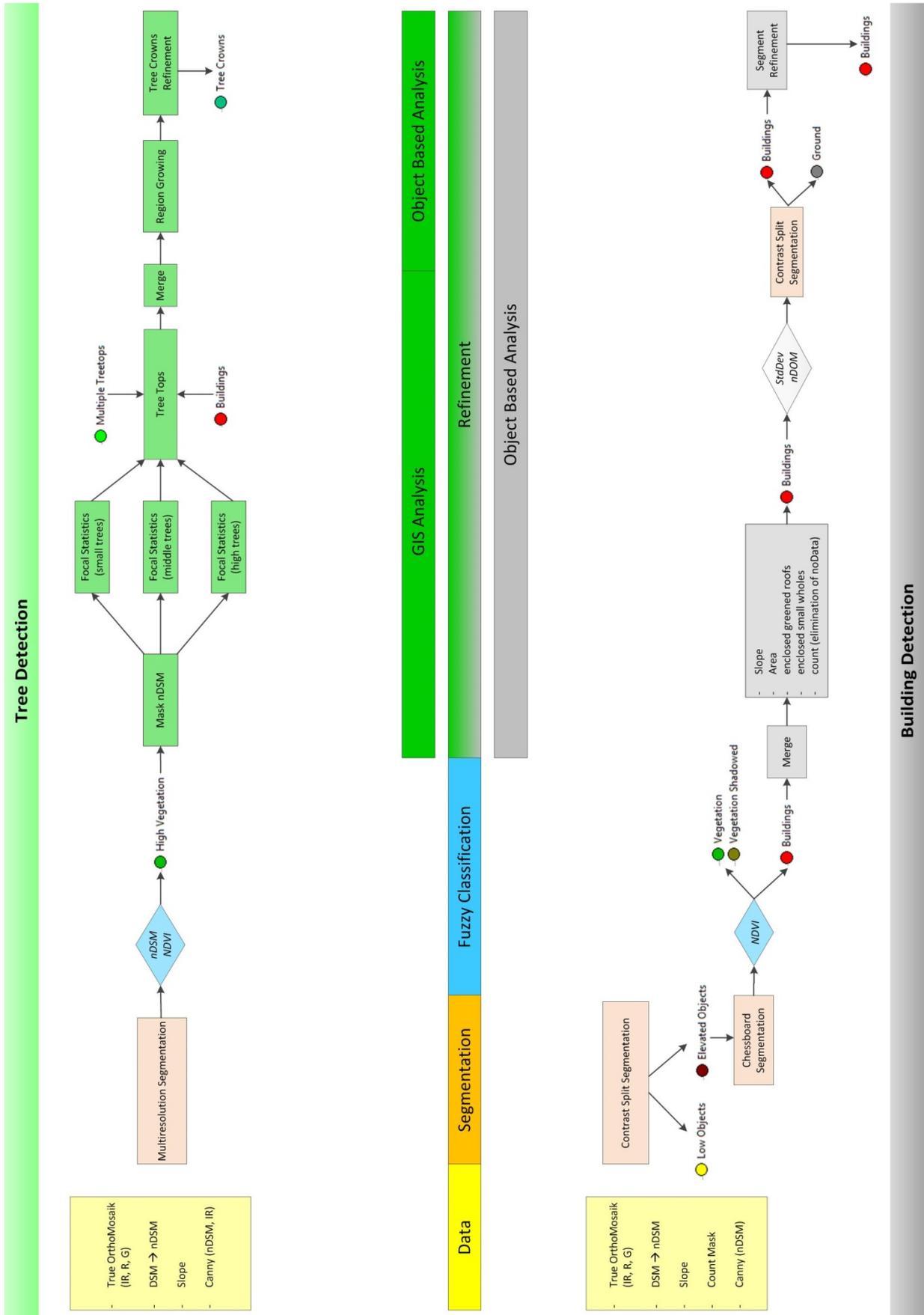
Figure 1 Workflow for the building and single tree detection based on the Vaihingen dataset

2.1 Building detection

For the detection of building objects the commercial software Trimble eCognition was used. To avoid problems with the shadowed surfaces, the iterating segmentation and classification steps were mostly executed on the nDSM. The contrast split segmentation based solely on the nDSM layer was chosen to separate low and elevated objects. At last the NDVI was used for the separation of vegetation and detection of greened roofs. Subsequently the chessboard segmentation was used to execute a pixel accurate object refinement. The building objects and their borders were refined considering the thresholds for slope, area and the count mask. Also morphology filters were applied.

2.2 Tree detection

The data base was a TOM and nDSM and solely trees with a minimum height of 2 meters were detected. The main aim of the single tree detection is the identification of one single object per tree and the extraction of the natural crown extent. The tree detection started with a segmentation in Trimble eCognition. For the detection of single trees a focal statistics analysis in ArcGIS was used for the extraction of tree tops and a region growing segmentation was used for the identification of tree crowns (Bayer et. al. 2013).

3 References

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