



IV Congresso Nazionale di Selvicoltura

IV National Congress of Silviculture

Torino, 5-9 Novembre 2018

IV CONGRESSO NAZIONALE DI SELVICOLTURA

**IL BOSCO: BENE INDISPENSABILE
PER UN PRESENTE VIVIBILE E UN
FUTURO POSSIBILE**

TORINO 5-9 NOVEMBRE 2018

ABSTRACT BOOK



Survey and structural characterization of single trees using photogrammetry from UAV and Sentinel 2 multispectral data

Samuele De Petris, Roberta Berretti, Luigi Perotti, Enrico Borgogno-Mondino

Keywords: survey; UAV; photogrammetry; single tree; forest measurements; CHM; remote sensing.

The introduction of UAV (Unmanned Aerial Vehicle or drones) have enriched the survey of vegetated surfaces. Especially in the forestry context, the drones, equipped with appropriate sensors, can provide information about the surfaces investigated with a high geometric resolution. The photogrammetric survey of the surfaces shows unpublished scenarios largely related to the possibility of measuring morphometric and structural parameters of forest stand or individual trees. Moreover, the actual availability of low-cost multispectral sensors and the simultaneous free accessibility to medium-high geometric resolution satellite images (e.g. Copernicus Sentinel 2 A / B) allows to hypothesize scenarios of integrated use which the spectral information, according to the higher resolution of the UAV photogrammetric survey, determining a complete knowledge of observed tree subjects characteristics. This work shows a methodological proposal based on the integration of photogrammetric survey and process of images from UAV with Sentinel 2 multispectral optical satellite data aimed single tree characterization in Arboricultural and Silviculture point of view. The authors identified an area (about 30 hectares) in the Regional Natural Park "La Mandria" (Torino). With the collaboration of the Park's technical staff, a rigorous overflight planning was made fixing precisions required to expected application. The survey was done by DJI Phantom4 equipped with integrated 12.4 Megapixel RGB camera with a forward overlap of 80% and a 70% side overlap between the frames, determining an images average geometric resolution (GSD ground sampling distance) about 5 cm. The orientation of the photogrammetric block and the restitution of the point cloud were made using the AGISOFT Photoscan v 1.2.4 software. The point cloud has been exported in .LAS format, typical of the ALS (Aerial laser scanner) point clouds, to be implemented with the LAsTools libraries. After a filtering and classification (ground – Not ground) process DSM (Digital Surface Model) was generated with a 10 cm GSD. The CHM (Canopy Height Model) was computed using matrix difference with the DTM (Digital Terrain Model) ICE with 5 m GSD, freely available from Piedmont Region geoportal. This Canopy height model was used like reference layer to derive forest inventory data, whose accuracy respect to the real field data was assessed on single tree measurements using "field map" detection system. Starting from CHM we derived some forest parameters useful to characterizing single tree with object-based analysis method (typical of image segmentation processes). The extracted parameters are based on the preventive isolation of the crown (interpret as object from the segmentator). The authors use for the segmentation phase watershed algorithms. Afterwards, for every identified objects detected by segmentation algorithm, CHM zonal statistics like average and standard deviation were calculated. To isolated single tree crowns was used a threshold related to average height value in each polygon. For the selected polygons we proceeded:

- (i) to identify the value and position of the maximum height local;
- (ii) maximum and minimum diameters;
- (iii) minimum Height;
- (iv) volume;
- (v) area of polygon.

These values are direct measurements that we propose as alternative to the more traditional methods of indirect measurements of the Crown parameters that are known to suffer unknown uncertainties. Indeed, with photogrammetric technique is also possible estimate both this uncertainty and subsequent uncertainty derived by indirect predictions of which they are proxy (eg Diameter and biomass). In addition, the aerial acquisition made an unitary and contemporary of the measurements, making survey more efficient especially in extensive forest surfaces reducing relative costs. These evaluations were integrated with multispectral Sentinel 2 data, allowing the exploration of species characteristics, vigor and water content at plot scale through the analysis of both spectral signatures and synthetic spectral indices (NDVI, EVI, NDWI, etc.). The proposed method finds applications both in the silvicultural field, for the survey of forest inventory data, both in the arboricultural field especially in the ornamental context; indeed the detected parameters can be used as input data for tree risk assessment / management models, especially in extensive contexts.

con il patrocinio di



con il contributo di

