



**Universitatea  
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# **HABILITATION THESIS SUMMARY**

**Title: USE OF GEOMATIC TECHNIQUES IN  
SUSTAINABLE FOREST MANAGEMENT**

**Domain: FORESTRY**

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The habilitation thesis summarizes the main personal achievements in the field of forest geomatics. As is well known, the last period has witnessed a great progress in this field. While in the past the first GIS projects were based on old plans (from the 1960s and 1970s) which were georeferenced and then digitized/vectorized, today a very wide range of materials and means can be used for such determinations such as GNSS equipment, drones, Lidar technique etc.

The main aim of this habilitation thesis was to highlight the potential that geographic information systems hold and can be used with preference in the field of forest management. The first chapter proposed a method for GIS analysis of cuttings on forest watersheds, taking into account the current realities when there may be several owners in the same watershed and some harvesting staggering rules may be (unintentionally) violated.

Chapter 2 presents the results of the analyses carried out on a large sample of points whose coordinates were determined using GNSS equipment. Equipment was used that has proven to give good to very good results in terms of accuracy (*Trimble Pro XH* and *Pro XT*), but also a method that is suitable in all respects (accuracy, ease of use, speed - *Stop&go* method). The points were grouped by the following criteria: location (forest, forest edge, forest road, upper tree line forests and alpine pasture), forest formation (spruce, beech and mixed tree stands), orography (valley, slope, ridge), aspect (S-N, E-V), forest density (canopy) (<0.7, 0.7-0.8, 0.9-1.0) and age (21-40years, 41-60 years, 61-80 years, 81-100 years, >100 years). The data was processed using the Statistica 8.0 software. The obtained precisions were analysed for each category in part, but also in combinations of 2, 3 and 4 factors. Very good result were registered, as expected, in alpine pastures, for which the median has a value of 0.1 m. Very good precision values were also recorded on forest roads (0.4 m). By analysing multiple factors at once the following aspects were found out: species does not influence horizontal precision if the measurements are made during the leaf-on season; orography has a significant influence on the horizontal precision, very good values being registered on ridges, good values on slopes and weak one in valleys; forest density does not significantly influence the precision of determining coordinates; age has an influence on the studied parameter only in combination with other factors. The most favourable conditions are spruce tree stands located on ridges or slopes, older than 60 years and with an aspect favourable to the satellites` orbits (E-V), regardless of forest density.

In the third chapter, a statistical analysis of the accuracy of determining the planimetric coordinates determined with GPS equipment in the forest was carried out, using a

different location to see if the previous conclusions are verified. A forest area of over 9500 ha was surveyed, located in the area of the Barsa River, close to the Zarnesti town. More than 14000 point coordinates were determined. The measurements were carried out with two GPS receivers: Trimble Pro XH and Pro XT, using the *Stop&Go* method with post-processing. Data regarding the field collected coordinates were grouped according to: composition, age and consistency of tree stands, terrain shape, aspect. This stratified data was processed using the Statistica software. Coordinate precision was analysed by taking into consideration each criteria individually, as well as in combinations of 2 factors (which resulted in 25 combinations), 3 factors (145 combinations), 4 factors (142 combinations) and 5 factors (103 combinations). Looking at the arithmetic means, the best situation is for spruce stand with an age of 101-120 years and the worst situation is for the spruce stands located on northern slopes. Regarding orography, the fact that the lowest precision is found in valleys was highlighted. Stand age also has a significant influence in the analysis of the precision factor, with the young and dense tree stands having the lowest precision. Regarding aspect, research shows that the most favourable situation is for the NE-SV aspect, while the least favourable is for the NS aspect.

Chapter 4 highlights the beneficial aspects of the use of geographical information systems in the thorny issue of forest retrocession. This area covers a few hundred hectares, and parcels plans need to be developed for it, which are then sent in to OCPI Brasov for approval (this being the only manner by which these parcels can be recorded in cadastral records). The opportunities which GIS offers in terms of incorporating field data into forestry projects, for carrying out comparisons or validation of forestry parcel plans and for flagging issues have been highlighted. A number of critical issues were identified and an attempt was made at solving them using VBA code sequences in the ArcGIS software package.

Chapter 5 presents some of the issues that look at a modern possibility for managing torrential watersheds as a viable and much more efficient alternative to the traditional way of working. The paper presents the opportunities that the AutoCAD program offers to the user to determine the elements underlying the calculation of the maximum liquid flood flow. In particular, the substantial advantages of determining basin area and runoff concentration time in this way are highlighted. Thus, the catchment area was determined by using the Calculate Watershed... function, which, in addition to automatically determining and displaying the area value, also performs a removal of bordering areas that do not actually feed the catchment in question. As for the time of

concentration of the runoff, it was determined in two variants: the first - based on the classical approach, but using the facilities offered by AutoCAD in the various determinations; the second - representing a specific approach of AutoCAD software through the Hydrology module. The work also used the HEC-RAS program which, by means of the calculated value for the maximum liquid flood flow (broken down or calculated on homogeneous sub-basins), manages to highlight the water level in each studied section and, based on it and the adopted design slope, to opt for a particular variant of the design of the torrential watershed.