

Detection of some technical and environmental parameters of forest road network based on ZEB1 LiDAR data

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Abstract

Forest road networks constitute critical infrastructure mandated to comply with established ecological and technical standards according to the principle of Silviculture which is the practice for controlling the composition, health, growth and sustainability of forest ecosystems.

Traditional, survey-based methods used in determining road network adherence to standards, safety, and maintenance needs, are time consuming and costly, with shortcomings accentuated in the presence of steep terrain and dense vegetation. The primary purpose of this study is to develop an innovative and precise method based on ZEB1 LiDAR data for technical assessment of forest roads and environmental impacts during construction or maintenance in terms of sustainability. Many studies focus on the detection of forest roads using airborne LiDAR data. These studies usually aim to extract and map forest roads. The innovative aspect of this study is that the mobile handheld laser scanner ZEB 1 is used for collecting LiDAR data. ZEB1 laser scanner has not yet been used for forest road mapping but mainly for collecting data in order to derive biometrical characteristics of the forests.

The main methodology aspects include: data preparation, classification of the point cloud between terrain and non-terrain points using the Multiscale Curvature Classification Algorithm, DTM generation from the study area, detection of forest roads on the DTM, environmental and technical assessment of forest roads according to standards that have been set according to each road class, and accuracy assessment of the technical parameter results which are based on ZEB1 data.

The technical road parameters that are evaluated include roadway width, traverse and lengthwise inclination, while the intensity parameters that cause problems to the ecosystem, are the road surface area with construction problems and ditches network. The accuracy assessment of the results based on ZEB1 data is performed by comparing them to results

based on Leica TS 15 data regarding the same road parameters using t-tests.

The proposed methodology based on ZEB1 data for both technical and environmental road assessment is found to be precise and reliable solution especially for short forest road networks. There is no significant statistical difference regarding the detected parameters between ZEB1 and Leica TS 15 results. The main advantages of the implemented methodology are the following: less time is needed to collect dense datasets from the study area, only one person is needed to do field measurements, and there is no need for GPS.

Keywords: Forest road networks, sustainability, ZEB1 LiDAR, technical road parameters, intensity parameters, Leica TS 15