Potential Use of Mobile Laser Scanning Using LiDAR Integrated in a Mobile Device For Forest Road Mapping

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Introduction

Currently there is a significant wear on the surface of forest roads in Czech Republic. The most commonly used method of data acquisition and road condition monitoring is tacheometric surveying with the use of total station, but the actual process of data acquisition is relatively time-consuming. Therefore, this work aimed to test the possibilities of mobile laser scanning using LiDAR integrated in a smartphone device, as the smartphone devices and their optical sensors are becoming more advanced.

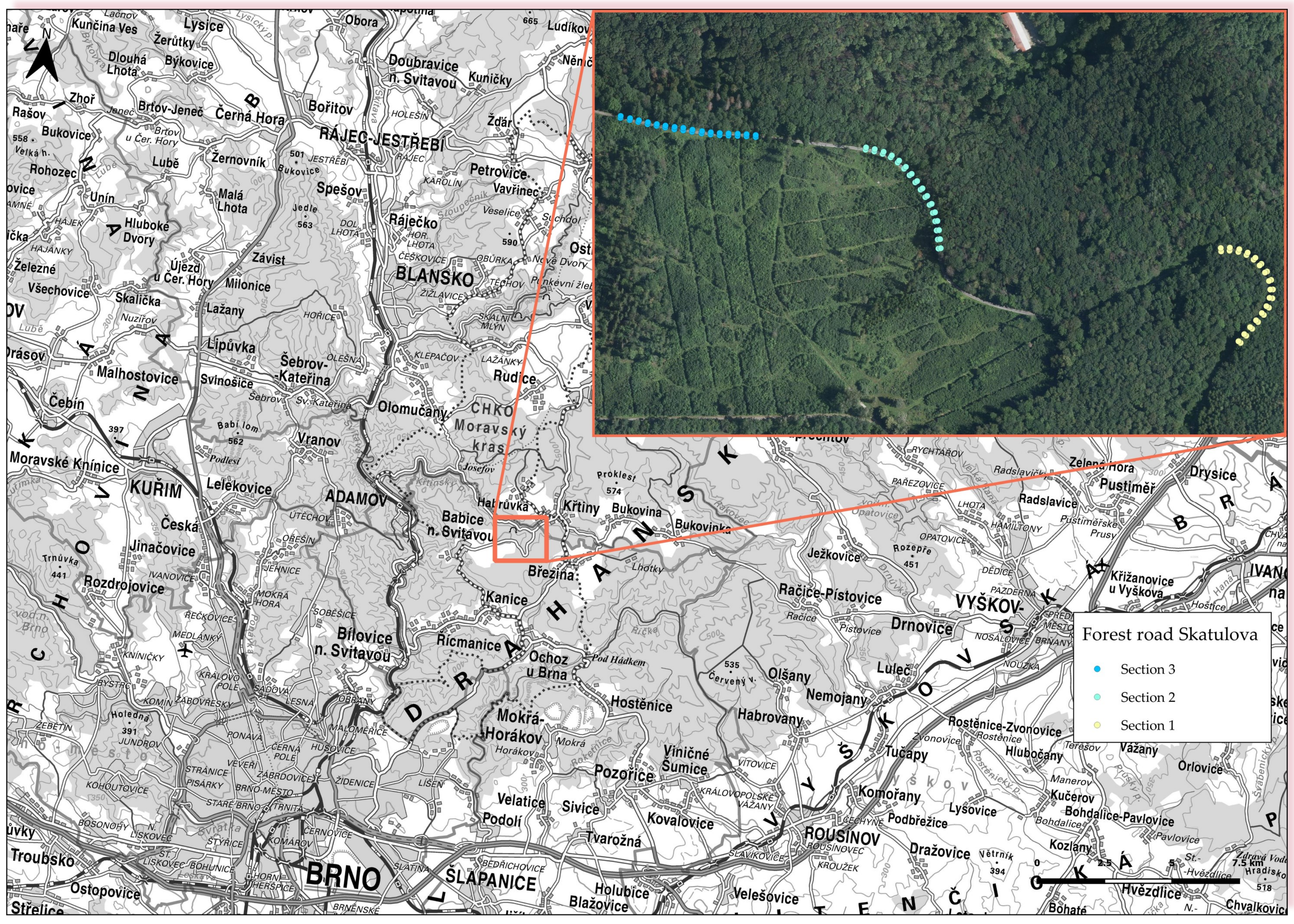

Figure 1. The study area - forest road „Skatulova“ located in the Training Forest Enterprise „Masaryk Forest“ Křtiny

Figure 2. Total station Trimble M3 used for measuring spatial coordinates X,Y,Z of reference crosses

Methodology

The comparison of different scanning methods was carried out on a forest road „Skatulova“ located in the Training Forest Enterprise Masaryk Forest Křtiny (Figure 1). Three damaged sections were selected for the purpose of testing the accuracy of scanning methods. Reference crosses were spray-painted at each side of the road and were measured using total station (Figure 2). Afterwards, different laser scanning methods were used:

- Faro Focus 3D (Figure 3a)
- Geoslam ZEB Horizon (Figure 3b)
- iPhone 13 Pro with built-in LiDAR (Figure 3c)

(iPhone Polycam app and 3D Scanner app)

Figure 3. Laser scanning instruments: a) Faro Focus 3D, b) Geoslam ZEB Horizon, c) iPhone 13 Pro

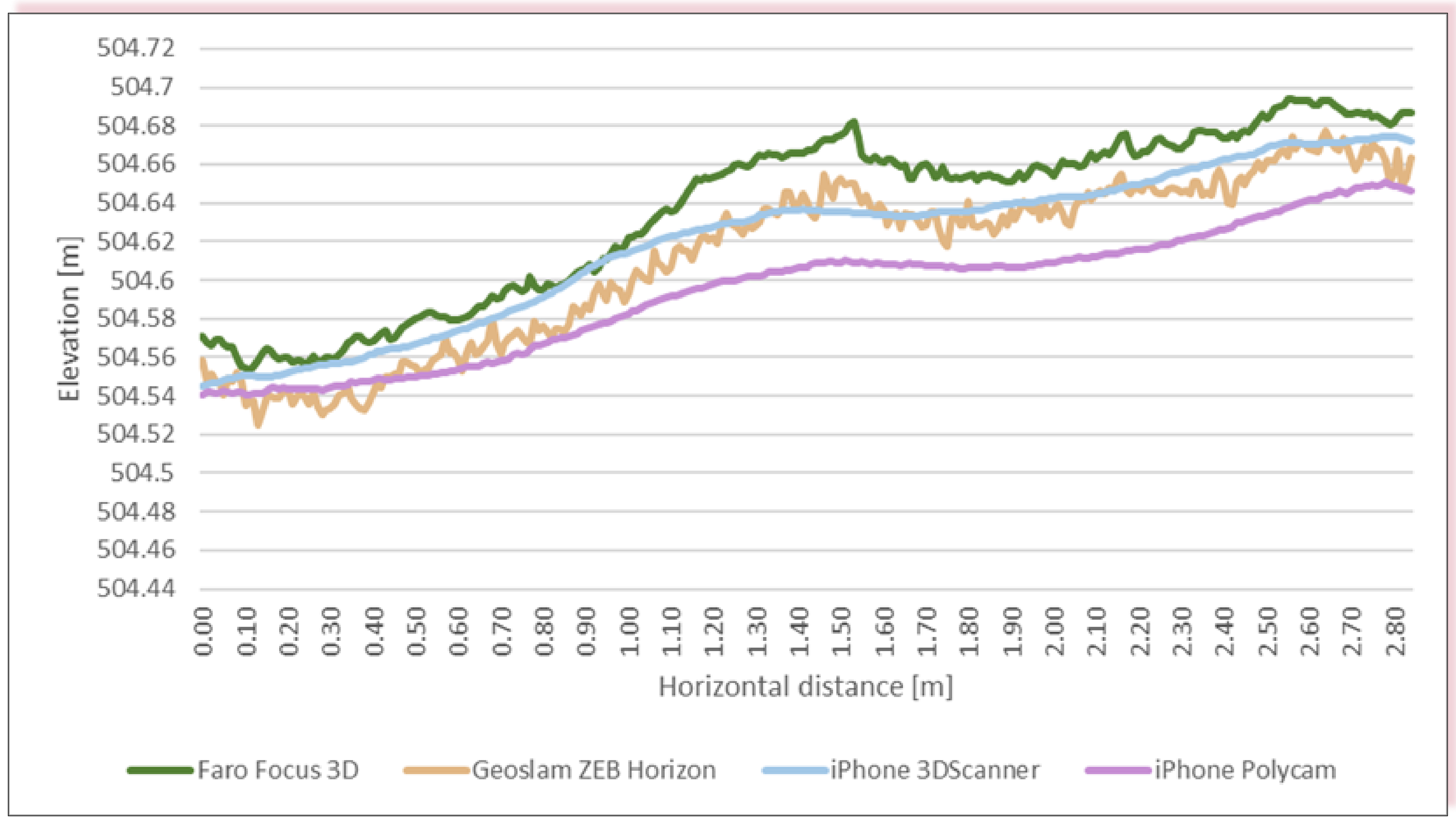

Figure 4. Comparison of transverse profiles

Results

Positional and height accuracy was validated based on the deviations from the tacheometric surveying. Comparison of transverse profiles (Figure 4) was carried out, as well as comparison of digital surface models (Figure 5) with reference model from Faro Focus 3D, as it was the most accurate measurement to tacheometric surveying. The results were very similar, GeoSLAM ZEB Horizon achieving RMSE of 0.03m, Polycam app 0.04m and 3D Scanner app 0.02m.

Conclusions

The research has concluded that technology, such as LiDAR integrated in smartphone device (iPhone 13 Pro) can be considered very promising, when comes to fast data collection and easy mapping and inspection of forest roads without depending on the GNSS signal, but still only locally (cross section of forest road up to 4m) and further research on all the methods must be made.

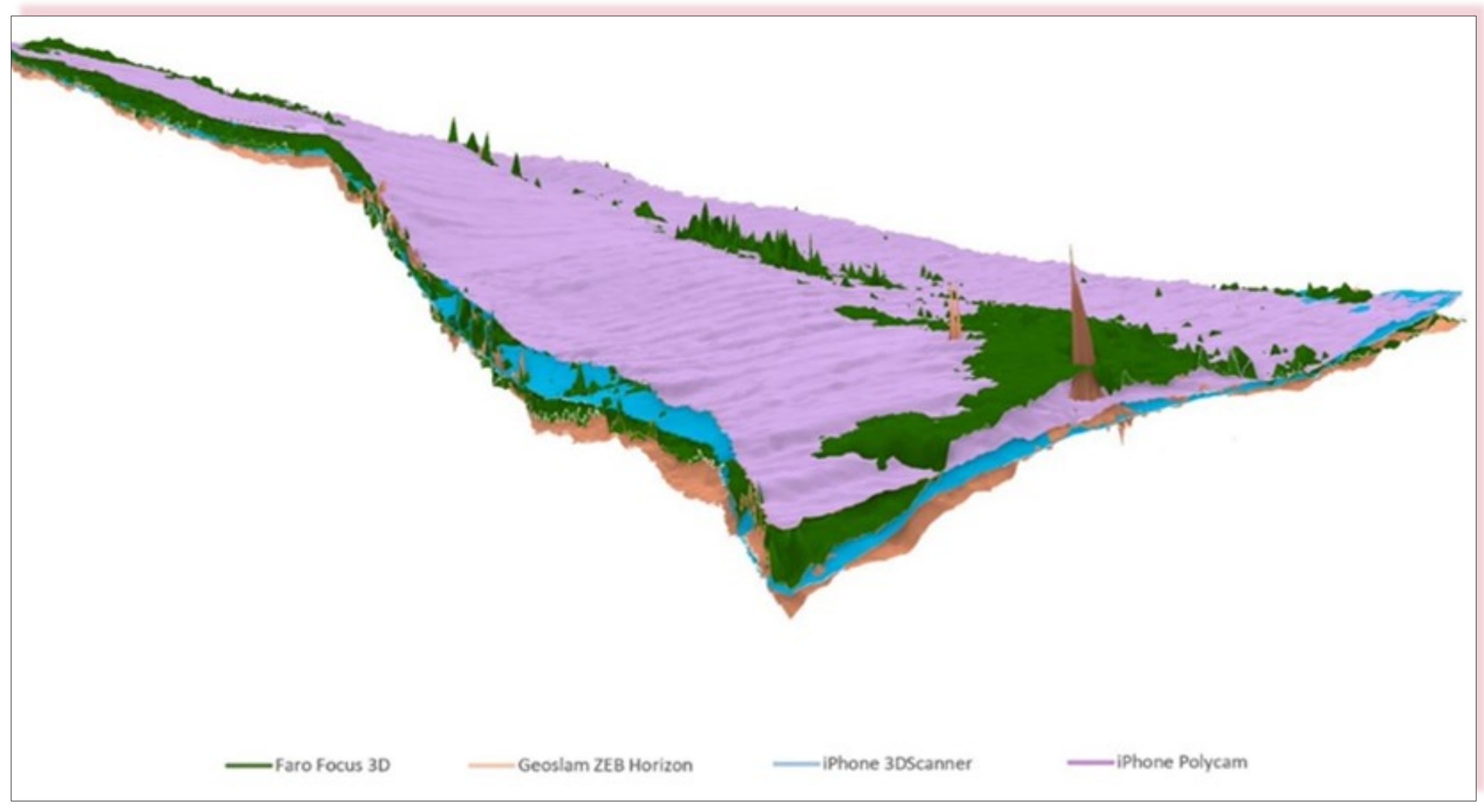

Figure 5. Digital surface model of each scanning method

An article has been published within this project in an Open Access journal Forests, in the Forest Operations and Engineering section, with a title: ***“Forest Road Wearing Course Damage Assessment Possibilities with Different Types of Laser Scanning Methods including New iPhone LiDAR Scanning Apps“***

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