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Applications of RGB-D sensors (Google Tango) in forestry

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A wide demand on 3d data useful for environmental documentation has inducted the need of evaluation of various techniques applicable. In forestry, the 3d data are used mainly for determination of forest inventory parameters (e.g. heights and diameters of trees…). Many studies have been conducted recently, aimed especially on LIDAR and photogrammetry application. Both of these techniques have proven to be applicable. However, a relatively high price of laser scanners and high processing demands of modern SfM and MVS photogrammetry perhaps prevents a wider adoption of these technologies. Therefore, low-cost alternatives have to be evaluated. An application of so-called RGB-D sensors was studied recently. These sensors supplement the RGB data with depth data acquired using various techniques (e.g. IR sensors, stereoscopy etc.). Currently, the Google Tango technology probably represents the highest degree of RGB-D sensors integration. Based on three crucial parts – depth sensing, motion tracking, and area learning – this technology can provide point clouds in real time. However, when compared to LIDAR and photogrammetry, effective measurement range of the RGB-D sensors is significantly shorter in the current state of art. Proposals of the measurement methodology are therefore crucial parts of first experiments.
Two experiments aimed on DBH (diameter at breast height) measurement accuracy were conducted. In both, the values acquired using the Tango technology were compared with the caliper measurements. Two mobile applications were used to acquire DBHs of 19 trees in the first experiment. The “Measure” app allows real-time measurements in field. Using this application, we acquired the DBHs with an RMSE of 1,9 cm with significant negative bias. The second application, “RTAB-Map”, was used to acquire a point cloud of the plot including trees. DBHs were subsequently determined on the point cloud using the CloudCompare software with an RMSE of 1,0 cm with negative bias. In the second experiment (Tomaštík et al., 2017), also the trees’ positions were considered. The RTAB-Map app was used to capture point clouds of three 500 m2 test plots (differing in age, number of trees, mean DBH etc.). Root mean square DBH error were 1,83 cm and 1,91 cm respectively. These two values are related to two sensing patterns – Spiral and Sun –, which had a major impact on accuracy of the trees’ positions. For the Spiral pattern, the positional RMSE was over one meter, while for the Sun pattern it reached 0.20 m. This confirms the necessity of optimal motion tracking and so-called “loop-closures” when Tango is used to capture wider areas.
Besides the mentioned experiments, the Tango technology is currently evaluated for e.g. documentation of landslides, visual-inertial positioning in forests etc.

Tomaštík J., Saloň Š., Tunák D., Chudý F., Kardoš M., Tango in forests – An initial experience of the use of the new Google technology in connection with forest inventory tasks. Computers and Electronics in Agriculture, Volume 141, 2017, Pages 109-117