Is fixed-wing unmanned aerial vehicle with real-time kinematic great deal for forestry?

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The fixed-wing type of unmanned aerial vehicle (UAV) is great tool for precision forestry. It provides data on demand with high detail and resolution. The fixed-wing UAV is able to cover large areas faster and at once when compared to rotary-wing UAV. The crucial part of data acquisition is to establish ground control points within the area and measure their exact position. The placing is time consuming and in some remote areas very difficult. Furthermore, in some cases it is not possible to see the points on images within whole area due to full tree crown cover. The fixed-wing UAV equipped with real-time kinematic GNSS solution could solve this problem. In this case each image taken is geotagged with high accuracy.

We have decided to investigate the positional accuracy of fixed-wing UAV equipped with RTK in practice. We compared the positional accuracy derived only when RTK was used with positional accuracy derived when 4 and 9 ground control points were used. Furthermore, we tested impact on positional accuracy of additional important factor for forestry: the state of leaves (leaf-off and leaf-on season).

The study site has approximately 300 ha. The dominant tree species is Fagus sylvatica. Within the study site are multiple open areas caused by windthrow event (cca 26 ha). The slope is very diverse. The elevation ranges from 490 to 700 meters AMSL. Within the study site we have established 43 check points which we measured by Topcon Hiper SR GNSS receiver using RTK method with 15 seconds observation time. Imagery of the study site was conducted by eBee plus RTK/PPK UAV. One flight in late spring and one flight in late autumn. Both times two perpendicular flights were conducted with sufficient overlap. Agisoft Photoscan Professional was used to align images, generate dense point cloud and for marking all 43 points, and generate 5 cm GSD orthophotomaps.

The results showed that most accurate results were achieved when only the position of images (RTK) was used in leaf-on season RMSE = 3.08 cm. The worst results were achieved when 4 GCP points were used for georeferencing in leaf-off season RMSE = 3.81 cm. It can be seen that the difference between best and a worst result is only 0.73 cm. Furthermore, in all three cases (4 GCP, 9 GCP, RTK) the worse results were achieved for datasets from leaf-off season. But in all cases the difference was under 0.5 cm and not statistically significant.

Is fixed wing UAV with RTK great deal for forestry? Results indicate that it is not necessary to use GCP to achieve high positional accuracy when fixed-wing UAV equipped with RTK is used. It decrease the time needed for the imagery greatly and it is providing the opportunity to survey fully forested areas.