Small is the new BIG: Monitoring and future of the forest stands with UAS

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ABSTRACT

Seedling by seedling. Browsing the understory. Assessing successional potential. That is the levels of details on a forest landscape now can one capture, visualize, quantify and monitor using the miniaturized sensor technology on newly emerging UAS (Unmanned Aerial Systems) platform. In the last few years, using convergent imagery we have been extensively working on assessing if this platform could be efficiently used to improve existing processes (e.g., hazards prevention assessment, compliance report), provide flexible solutions at finer / local scales (e.g., regeneration, free-to-grow surveys) and to develop innovative applications (e.g., prototypes for dynamic pile assessments) for operational forestry. Advances in miniaturized technology further allowed integration of lightweight laser scanning capabilities through full-waveform digitization of multi-targets on a UAS. In addition to having a larger field-of-view, lidar on UASs combine advantages of terrestrial (high density, short range) and aerial (perspective, homogeneity in point distribution) scanning lidar for detailed description of the canopy and below the canopy layers.

Based on a study conducted in 2014, our findings in a white pine dominant forest stand in Petawawa (Ontario) showed that almost all individual trees were detectable, structure of individual trees and undergrowth was well pronounced and underlying terrain under dense undisturbed canopy was well captured with UAS based Yellowscan Mapper lidar even at 80 m range. Thereafter, the site was re-scanned twice over two years, in leaf-on and leaf-off conditions with a high-end Riegl Vux-1 lidar system. Besides physical characteristics, significant differences are seen in terms of the scanning method, pulse frequency, laser beam divergence, number of echoes per laser pulse and recording of the intensity that directly impact the way vegetation structure is captured. In this study, we compare these two lidar systems, in understanding (i) the impact of forest structure and (ii) late autumn foliage on penetration of the laser up to the floor to describe the canopy and below the canopy. In addition, we also looked into the potential of UAS based lidar systems in monitoring short-term growth of vegetation.