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Drones

Using Drones in Forestlands and Nurseries

Priya Saini, *Graduate Research Assistant*, **Tennessee State University**
Jason P. de Koff, *Professor*, **Tennessee State University**
Contact: 615-963-4929, jdekoff@tnstate.edu, Twitter: @TSUBioenergy

Within the last decade, farmers began using small uncrewed aircraft systems (sUASs), also known as drones, to monitor their fields and to aid in precision agriculture programs. In many cases, farmers also have forested areas which may be managed using the monitoring and mapping capabilities provided by drones. Further, Tennessee has a large nursery production industry with about 600 producers, focused on the woody ornamentals, which can also benefit from this technology.

The use of sUASs for forest data collection has improved over the years due to their advantages over aircraft and satellites, such as lower material and operation costs, high intensity data collection, choice of sensors, and options for autonomous flight paths to add flexibility in operations. However, drones also have limitations such as short flight times, regulations (i.e. maintaining visual line of sight with the aircraft, flight altitude limitations), payload limits, data processing requirements, and longer periods for initial setup.

Ground assessment and monitoring of forestland is challenging and provides limited results. However, the integration of drones can support data acquisition, monitoring, and management. Examples of current drone-based applications include tree classification, inventory, and pest mapping.

Tree classification

Information to facilitate tree species identification can be useful for the accurate estimation of a forested area's economic value. Drones can provide high quality data to the individual tree level. Researchers have been using multispectral sensors attached to drones to capture individual wavelengths of light (i.e. red, green, blue, etc.), for tree species classification (Gini et al., 2014; Michez et al., 2016). Recent developments of of low-weight hyperspectral imaging sensors have enabled the collection of higher resolution measurements from drones.

A study by Nevalainen et al. (2017), investigated the performance of drone sensor imaging in both individual tree detection and tree species classification in forestlands (Fig. 1). Data were collected for eleven test sites and 4,151 trees that included various tree species and developmental stages. The results were compared to data collected on the ground, and revealed that the drone data was 95% accurate.

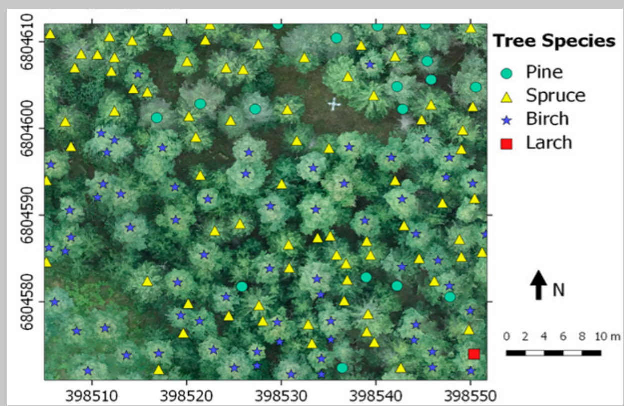

Fig. 1. Tree classification using sensor imagery and imagery analysis (Nevalainen et al., 2017).

Inventory

On-site inventory of a forest stand is laborious, however, using high resolution imagery from drones provides new opportunities. Researchers working on the Matang Mangrove Forest Reserve (MMFR) in Malaysia collected spectral data for species, girth, height and crown diameters for adult trees (Otero et al., 2018) (Fig. 2). It required only 12 minutes (with an additional 1 hr for preparation) to cover 2.5 acres of forestland with a drone. For on-site field sampling, this would normally take three people two days

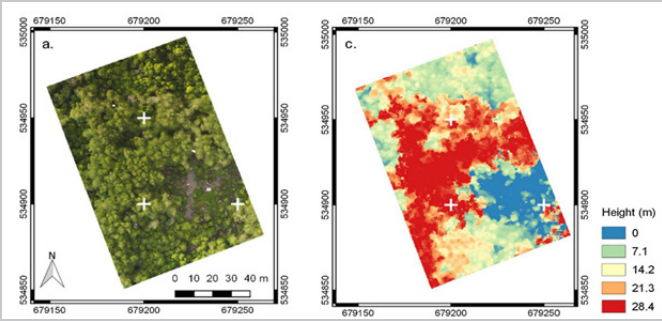

Fig. 2. Tree height map based on drone imagery and analysis (Otero et al., 2018).

to sample only 5% of the same area. Using the drone also facilitated access to areas difficult to reach by foot.

Inventories are also important for nursery producers to get an accurate number of products for sale. Creating a map using a drone can make this task faster and less labor intensive and can be conducted with a consumer-grade camera (Fig. 3).


Fig. 3. Example map produced for a Tennessee nursery producer using a DJI Phantom 4 PRO V2 drone.

Pest mapping

Forest ecosystems are regularly exposed to a series of disturbances caused by native and non-native insect pests and at different scales (Näsi et al., 2015). The traditional methods for pest detection in forests are usually laborious and time-consuming. Researchers investigated the potential of a drone using a 3D hyperspectral camera to determine bark beetle damage in a mature Norway spruce forest in Europe (Näsi et al., 2015). The trees were classified into healthy, infested and dead categories. As compared with field measurements, the drone was about 76% accurate at identifying between the three categories.

With continued research focused on using drones in forestry and nursery production, accuracy and options will increased and help to further enhance the potential for their use.

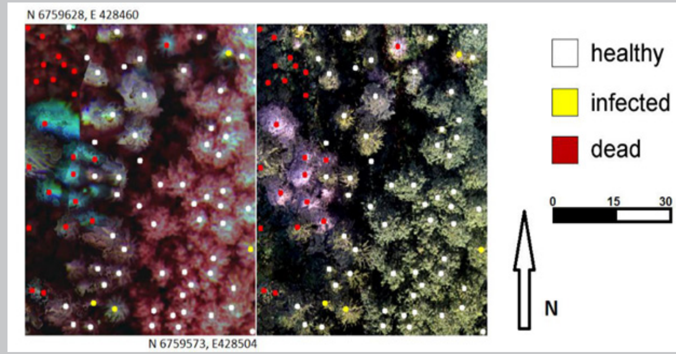

Fig. 4. Drone images used in mappig bark beetle damage at tree level (Nasi et al., 2015).

For more information

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