Algorithms for Weed Detection in UAS Imagery

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Abstract:

Recent years have seen a significant growth in the use of unmanned aerial systems (UAS) for remote sensing applications, particularly in agriculture and environmental monitoring. Unlike traditional remote sensing platforms such as manned aircraft and satellites, UAS offer the opportunity to collect large amounts of data at high spatial and temporal resolutions. However, this capability is both blessing and a curse – while the increased data volumes enable us to address novel questions and perform analyses at previously unachievable scales, it also poses challenges for data management and processing. In this talk, we address the problem of turning large volumes of aerial imagery into semantically meaningful information.

Over the past five years, the Australian Centre for Field Robotics has addressed this problem in the context of weed detection. We have applied techniques from machine learning and computer vision to segment images and classify the segments into semantically meaningful groups – for example, native vegetation, weed and soil. Specifically, we use a multi-scale convolution neural network classifier (Hung et. al. 2014) that can be "trained" to detect different species of interest using examples labelled by human experts. This adaptive algorithm has allowed us to detect numerous different weed species, ranging from small weeds such as serrated tussock, to shrubs such mimosa and African boxthorn, to woody weeds such as parkinsonia and mesquite, as well as aquatic weeds such as water hyacinth and alligator weed. Detection accuracies of up to 95% have been reported.

The use of photogrammetric techniques have also allowed the weed detections to be turned into useful data products such as spatial distribution maps. An example of such a map is shown in Figure 1, which shows the distribution of serrated tussock on a property owned by the University of Sydney near Marulan, NSW. The use of automated techniques for weed detection and geo-registration have allowed us to generate weed distributions at a property scale (multiple square kilometres).

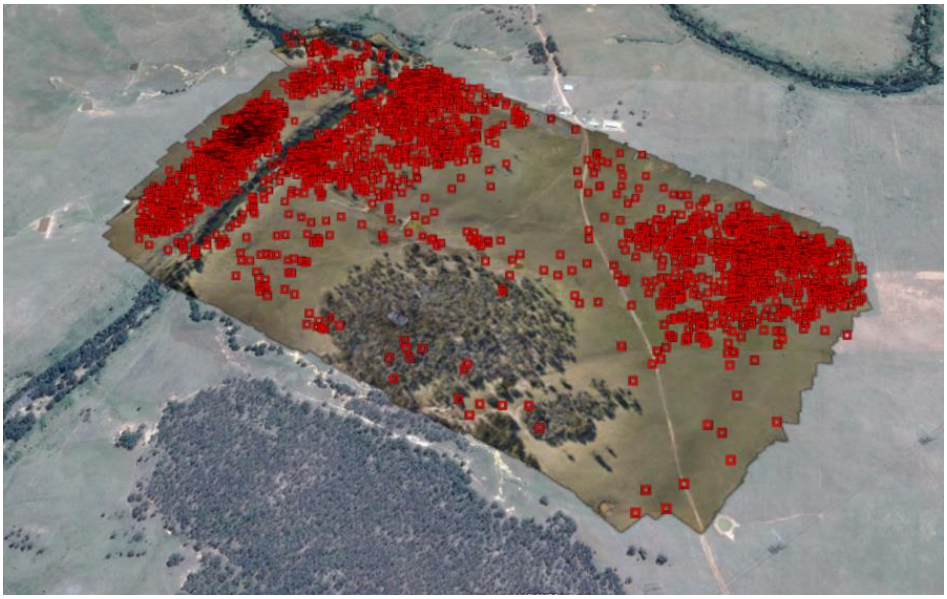

Figure 1: Spatial distribution of serrated tussock on a property owned by the University of Sydney near Marulan, NSW. The survey area is 2km$^{2.}$

References:

Hung, C, Xu, Z, Sukkarieh, S (2014), Feature Learning Based Approach for Weed Classification Using High Resolution Aerial Images from a Digital Camera Mounted on a UAV, Remote Sensing, 6 (12), pp. 12037-12054.