UAVs as Platforms for Agricultural Research

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Abstract:
Remote sensing is an integral part of agricultural research, providing non-destructive data such as canopy cover, biomass, chlorophyll concentration, temperature and fluorescence. These measurements in turn are being used to characterise crop traits and plant response to the environment, such as growth rates, canopy nitrogen, water stress, response to heat stress and disease pressure. Satellite imagery often cannot provide the spatial resolution or turnaround time required for the scale of the research targets. For example, the AGFACE experiment (Mollah *et al.* 2009) typically relies on sub-plots smaller than 1.5 m in one dimension (Fig. 1). Similarly, canopy measurements in most apple and pear require spatial resolution smaller than 0.5 m to differentiate the tree canopy from the orchard floor. Multi-rotor UAV platforms not only provide the opportunity to acquire imagery of sufficient resolution for research, but the ability to hover over a target and provide repeated measurements. We see a tremendous potential for time savings using UAV platforms. For example, canopy temperatures can change rapidly and needs to be measured in an experiment within a short period of time. Measurements of canopy temperatures using a handheld infrared thermometer (IRT) often requires several hours to cover a research project. Thermal imagery for all of the same plots can be acquired within minutes using a UAV platform. We are currently flying multi-rotor UAV platforms with two cameras to capture canopy reflectance and canopy temperature. Canopy reflectance is acquired using a six band multispectral camera (Micro MCA-6, Tetracam Inc., Chatsworth CA, USA) with an incident light sensor to correct for changes in irradiance. Thermal infrared imagery is acquired using a FLIR Tau2 (FLIR Systems, Wilsonville OR, USA) configured with on-board imagery capture (Teax Technology UG, Bad Berleburg, Germany). We are currently configuring a mount and on-board processing to allow improved real-time image viewing and remote triggering for both cameras simultaneously. We plan to build automated ground targets to allow for continuous capture of reference temperature and reflectance measurements during the UAV flights, in order to eliminate the requirement for personnel to make these additional measurements.

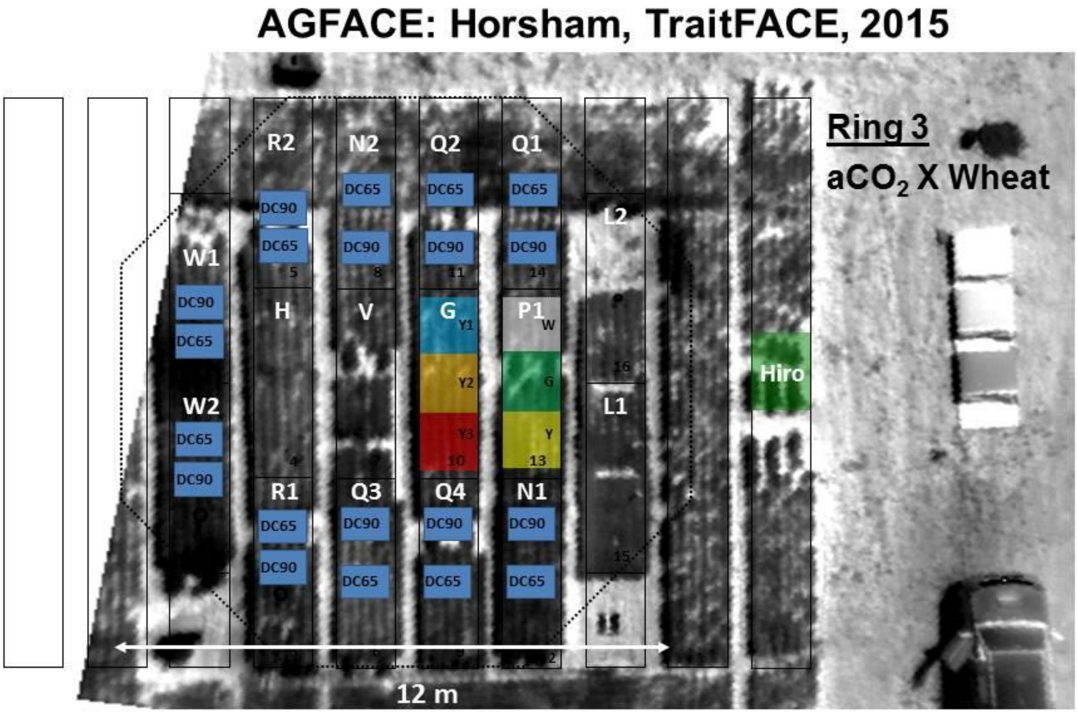

Figure 1. Thermal infrared imagery flown at 30m AGL over the AGFACE facility, 1 Oct 2015. The experimental treatment design is shown as an overlay to demonstrate complexity of the targets and the spatial resolution required.

References:

MOLLAH, M., NORTON, R. & HUZZEY, J. 2009. Australian grains free-air carbon dioxide enrichment (AGFACE) facility: design and performance. Crop and Pasture Science, 60, 697-707.