SMART Farm

OLDS COLLEGE 1913

Smart Ag Research

Proof of Concept 2021: Hail Damage Classification in Barley using Drone Imagery

Objective

This research was a proof of concept exploring whether various formats of imagery captured by drone-mounted cameras and LiDAR equipment could be used to classify simulated hail damaged areas within a barley crop.

Introduction

Agriculture Financial Services Corporation (AFSC) is Alberta's leading service provider of hail insurance to farmers. AFSC currently uses radar imagery to identify and notify farmers when a large hail event takes place; adjusters then complete in-field damage assessments. Using drone imagery to classify hail damage could result in increased efficiencies for hail assessments.

Study Details

- The study took place August 2021 in Field 19, a barley field of the Olds College Smart Farm, with above-average yield and topography gently sloping to the south/southwest.
- Two blocks were cut out during silage operations; total footprint of 9.2 acres.
- Drone and survey equipment used for pre and post damage flights:
    - eBee SQ Drone for Multispectral/NDVI image layers; DJI M600 Pro Hexacopter for RGB/Thermal/DSM image layers; Yellowscan LiDAR surveyor for LiDAR elevations; Propeller AeroPoints 2 for location correction.
- Various patterns and levels of damage were applied to the barley crop using a hail simulator (spinning pipe with small chains attached powered by an orbital motor); levels of damage were controlled by tractor speed, rotational speed of simulator, and height of loader mount.
- Two AFSC crop adjusters scouted numerous damaged areas within the field to estimate the crop damage as applied by the hail simulator; crop damage ranged between 35 - 100%.
- Imagery was collected using drones immediately after the hail simulation and 5 days later.
- Types of image processing and GIS software packages used: POSPac UAV & CloudStation, ESRI ArcGIS Pro 2.8, Autodesk AutoCAD Civil 3D and Pix4D Mapper.
- Supervised and unsupervised classification methods, and various overlay methods, were used in an attempt to automatically (or semi-automatically) determine damaged areas in the field.

Results

It is plausible to use specific types of imagery and classification methods to decipher damaged crop areas from undamaged crop areas.

- Operation of Hail Simulator functioned as anticipated; applied variable levels of damage to the barley crop; tire tracks of the tractor reduced total eligible assessment areas.
- Simulated hail damage in orthoimages wasn't identical to natural hail damage (e.g. damaged top of crop from simulator versus lodged or blown over crop).
- Collecting elevation data on the standing crop vs post-damage crop shows promise for defining areas of damaged crop.
- Digital Surface Models produced by Photogrammetry and LiDAR are very similar to one another (less than 10 cm difference in elevation range).
- Slope calculations and thermal images show potential for defining damaged areas; combining both datasets improves the identification of damaged areas.
- Supervised classification methods using pixel reflectance values show promise in identifying severe types of crop damage when large spectral differences from surrounding (undamaged) vegetation is present.

Future Research

Initial results of this proof of concept are encouraging. More study is recommended such as using simulation techniques that simulate hail damage more accurately, collecting crop imagery from actual hail storms, adjusting time of trials, and studying additional crop types.

Thank you to **Farming Smarter** for use of the hail simulation equipment.