Light Interception Estimation : Ground Data Vs Aerial

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OBJECTIVES

- To estimate Light Interception(LI) as a function of Canopy architecture.
- Correlating Light Interception estimated from data collected by ground robot with aerial vehicle.

INTRODUCTION

- Amount of Light Intercepted is what decides a plant's productivity, hence it's important to measure LI.
- The algorithm proposed is robust to illumination variations hence making the system on the go.

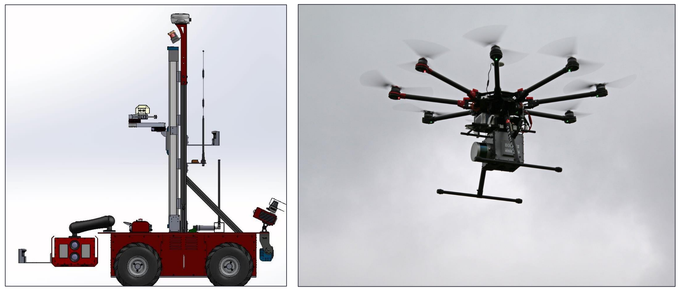

Fig.1: Ground robot and aerial vehicle which were used for data collection

- Upward facing camera with fisheye lens mounted on the robot to collect RGB images.
- Drones from Near Earth Autonomy for aerial data collection.

ACKNOWLEDGEMENT

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GROUND DATA

- Adaptive sky mapping for data from upward facing camera on the ground robot.

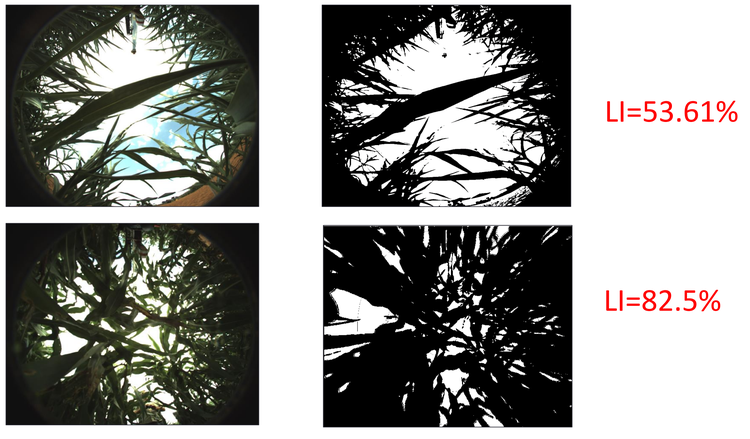

Fig.2: (a) Raw images obtained from ground robot (b)Processed images with calculated LI

AERIAL DATA

- Plots(bounded by white boxes in the image below) were extracted.
- Shadow removal had to be incorporated to achieve leaf vs non-leaf segmentation for every plot.

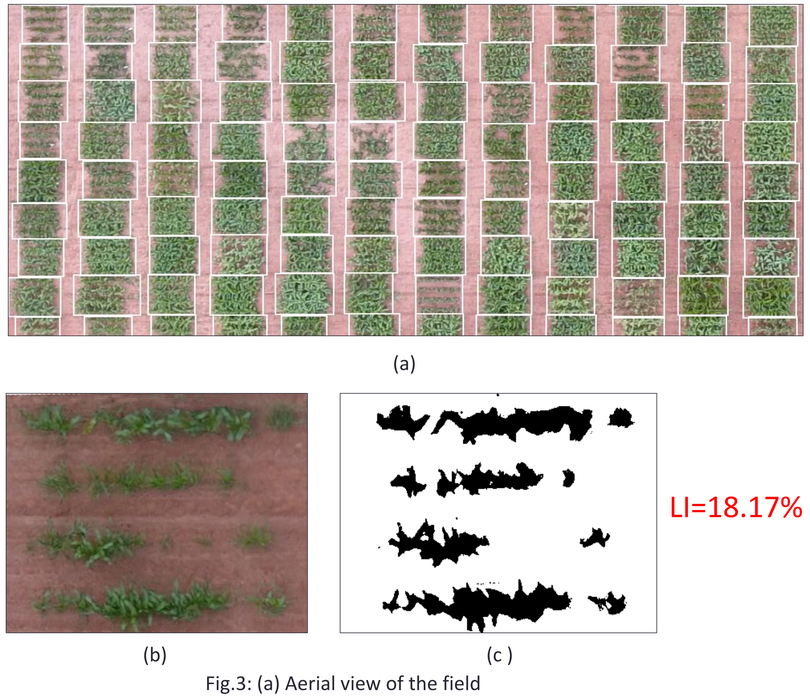

Fig.3: (a) Aerial view of the field
(b) Raw image of one plot (c) Segmented image

RESULTS

- 10 images at different illumination conditions were used for ground truth. Images were manually segmented into leaf and non leaf pixels.
- Since obtaining ground truth to validate Light Interception as it is nearly impossible to achieve manually, estimated LI was compared with manually collected harvest data. LI had positive correlation of 0.47 with Leaf Weight at harvest(Fig.4.).

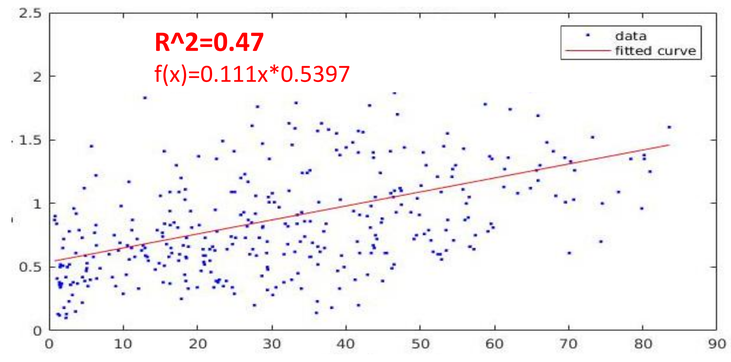

Fig.4: Correlation of Light Interception(x-axis) with Total Leaf weight at harvest (y-axis)

- LI had the highest correlation with the Yield data as compared to any other phenotype.
- The processed data can then be used to quantify genotype by phenotype and by environment interaction.

FUTURE WORK

- Estimating Light Interception from LIDAR point cloud and comparing it with the ones from RGB cameras
- Capturing more plant traits
- Extending the technique to other crop varieties