UNMANNED AERIAL SYSTEM (UAS) BASED COTTON GROWTH MONITORING SYSTEM

Anjin Chang
Jinha Jung
Texas A&M University – Corpus Christi
Corpus Christi, TX
Juan A. Landivar
Murilo M. Maeda
Josh McGinty
Texas A&M AgriLife Research
Corpus Christi, TX
Ruizhi Chen
Texas A&M University – Corpus Christi
Corpus Christi, TX
Juan Enciso
Texas A&M AgriLife Research
Weslaco, TX
Tianxing Chu
Texas A&M University – Corpus Christi
Corpus Christi, TX
Chenghai Yang
USDA-ARS
College Station, TX

Abstract

Advances in Unmanned Aircraft System (UAS) and sensor development offer great potential and provide very high quality data for developing scalable high-throughput phenotyping systems to monitor and manage crops throughout whole lifecycle. The objective of this study is to develop a novel monitoring system to track cotton growth and growth rate over growing seasons using data acquired from UAS and then develop an automated procedure to generate variable PIX application rate map for precision field management.

This study was conducted in an experimental cotton plot that consists of 27 varieties with different genotypes and treatments in Texas A&M AgriLife - Corpus Christi (Fig. 1). Cottons were planted in two different planting dates; early planting plots were planted on April 10, 2015 and late planting plots were planted on May 9, 2015xxx. 8 ground control points were installed to generate precisely georeferenced data product over the growing season, and the ground control points were GPS surveyed by Leica system. DJI Phantom 2 Vision Plus platform was used to acquire raw images with significant forward and side overlaps between June 3 and August 27 in 2015. Ortho-mosaic image and 3D point cloud were generated by applying SfM (Structure from Motion) algorithm to the raw images, and the 3D point cloud data were used to generate Digital Surface Model (DSM). Canopy Height Model (CHM) was generated by subtracting Digital Elevation Model (DEM) from the DSM to remove topographic effects. Regular grids with 1m by 1m spatial dimension were created along the center lines of each variety, and maximum height values were extracted from the CHM. The average height of the maximum value was calculated to representative height of each cotton variety. The growth curve of each cotton variety was then fitted using a sigmoid function and the growth rate curve was calculated by differentiating the growth curve (Fig. 2). Finally, features that represent growth characteristics of each cotton variety were extracted from the growth and growth rate curve. In addition to extracting the growth characteristics of each cotton variety, we also demonstrated that the CHM can be used to generate variable PIX application rate map to regulate growth of cotton depending on different target cotton height over whole area of cotton plot (Fig. 3).

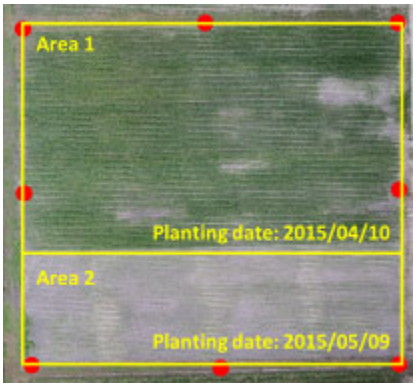

Figure 1. Cotton plot located in Texas A&M AgriLife – Corpus Christ. Red circles indicate ground control points.

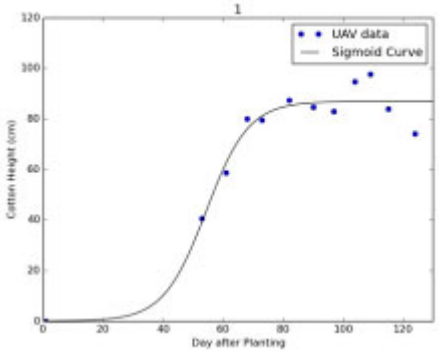

Figure 2. Cotton growth curve from UAV data

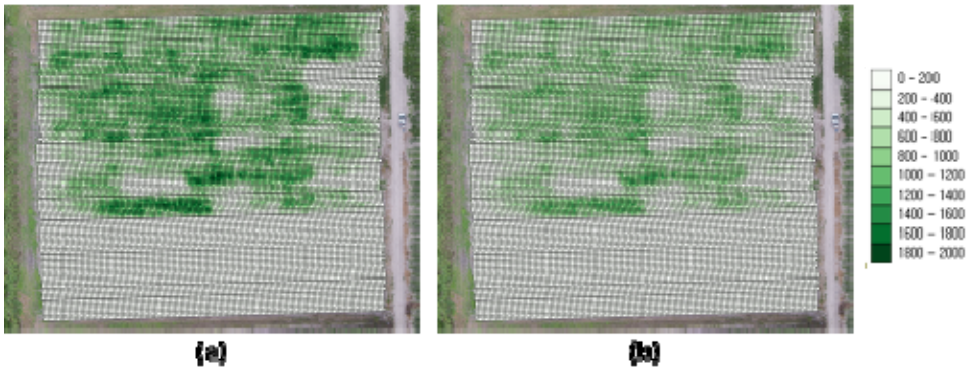

Figure 3. PIX application rate map with different desired cotton height: (a) 70cm and (b) 100cm.