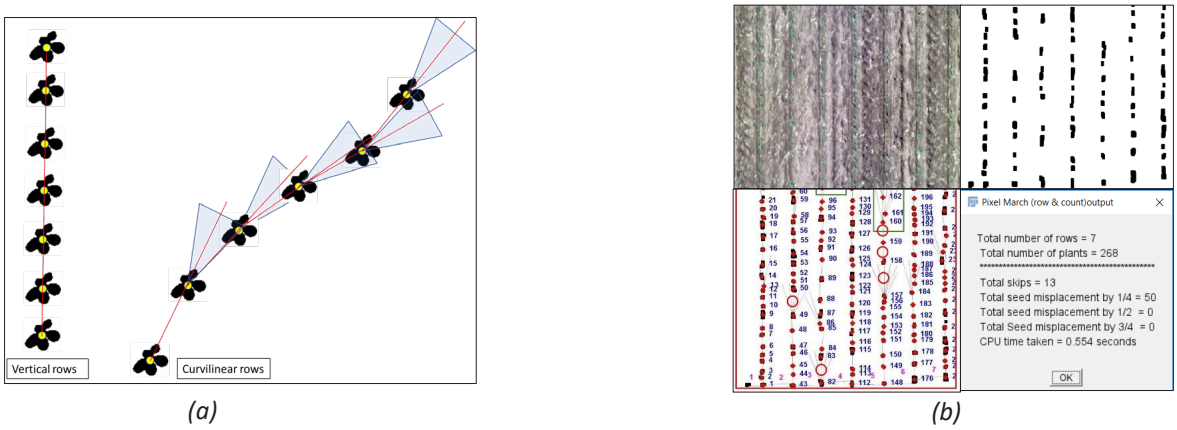
Overview of application of UAS in agriculture and an example plant stand count application

S. Dharani and Dr. C. Igathinathane, Agricultural and Biosystems Engineering, NDSU. Dr. Joao Paulo Flores, Carrington Research Extension Center, NDSU.

Aerial image recognition with an unmanned aerial system (UAS) provides new research opportunities in precision agriculture. There is a vital need for spatial data on plant distributions for management decisions, which benefits farmers and producers to investigate grain yield response to plant density and to explore genotype x environment x management (G x E x M) interactions. The real-world applications of UAS are expanding rapidly in different fields. Overall, the total available market (TAM) for drones in agriculture is $32.4 billion (Joshi, 2017). Goldman Sachs predicted that the agriculture sector is going to be the second largest user of drones in the next five years. The Bank of America Merrill Lynch projects that agriculture is going to make use of 80 % of the future U.S. drone market between 2015 and 2025 with the potential to generate $82 billion (Joshi, 2017).



(a) *(b)*

Fig. 1. (a) Schematic representation of “search hands” and “pixel-march” methodologies, and (b) Output of cropped section of UAS stitched image

Farmers/producers are embracing this new strategy of using drones as a part of a solution with the support of governmental, non-governmental organizations, and technology experts to increase the food production and move towards sustainable agriculture. Drones are useful in precision agriculture in a variety of ways. Drones are used for soil and field analysis replacing manual scouting, which is time-consuming and laborious. Crop spraying can be performed using the drone, making it advantageous to deliver the right amount of chemicals in the right place without getting exposed to such chemicals. Irrigation management and health assessment can be monitored using drones by calculating vegetation indices.

Plant stand count is a UAS agricultue application that was considered in this study. Nonuniformity of plant population can negatively impact crop yield. General grain yield and plant component yield were significantly affected by both row spacing and plant spacing. Among plant spacing, a skip contributes more to yield loss, whereas doubles are slightly positive and misplaced plants have no effect on the yield. Thus, there is a crucial requirement for the farmer/producer to gain the information about the population density and plant stand uniformity in the field. Obtaining accurate plant count in field conditions is time-consuming and laborious, and might also result in undesirable disturbance to plant ecosystems. To address this, a machine vision Java-based program (plugin) was developed using UAS images to measure the spatial variability of early-stage corn plant population density and inter-plant spacing.

A “pixel-march” algorithm was developed to count individual plants and to identify plant rows (Fig. 1). A “search hands” criterion was introduced in the algorithm to make the program more robust and accurate in detecting and counting plants even if the rows were curved (Fig. 1a). The output also included the quantification of “skips” and “seed misplacement” by calculating the center of gravity of plants based on plant distances (Fig. 1b). Plant count performance of the plugin was found to be accurate within a UAS stitched image (> 99%), and further development is in progress. This work provides a scope for further research by including crop modeling to assist production technology.

Reference: Joshi, D. (2017, August 15). Common commercial applications of drones in agriculture, business, and the military. Retrieved from http://www.businessinsider.com

Igathi Cannayen 701.667.3011, igathinathane.cannayen@ndsu.edu