Sorghum Stalk Detection for an Agricultural System

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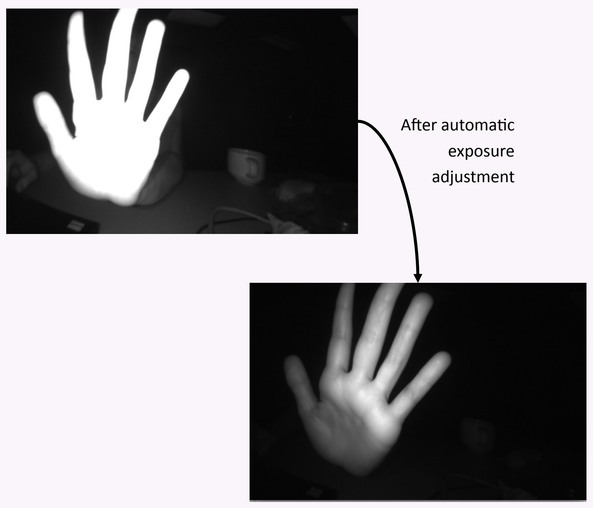
Development of new biofuel crops requires automated data collection

Sorghum, a cereal crop, is a promising biofuel candidate. The advancement of new genetic strains of sorghum requires massive plant data collection, a time-intensive and costly manual task. This motivates the development of an automated phenotyping system, able to gather data points on individual plants and plots. While research exists in vision-based crop phenotyping, much of the current work relies on greenhouse conditions or aerial field views[1].

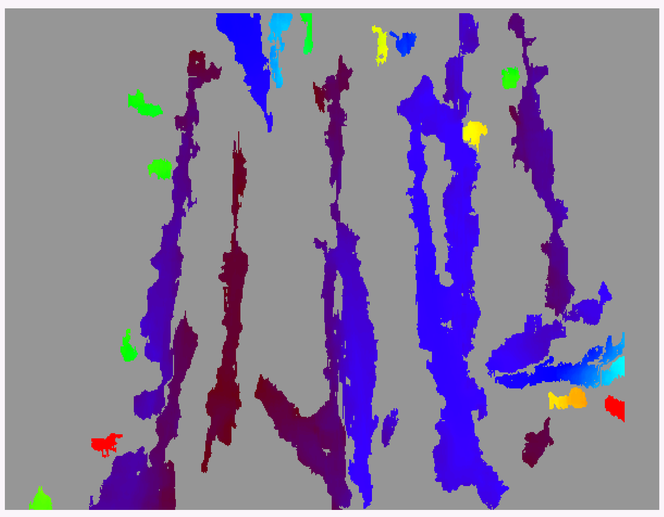
The Robotanist is our custom ground robot designed for in-row field navigation and equipped with a manipulator and eye-in-hand stereo camera. This research works toward the detection of sorghum stalks in field conditions, with the eventual goal of obtaining information such as stalk diameter and strength.

The Robotanist, a ground robotic system designed for navigation in sorghum fields .



1. Heuristic exposure control is called to camera API, preventing washed-out or dark images

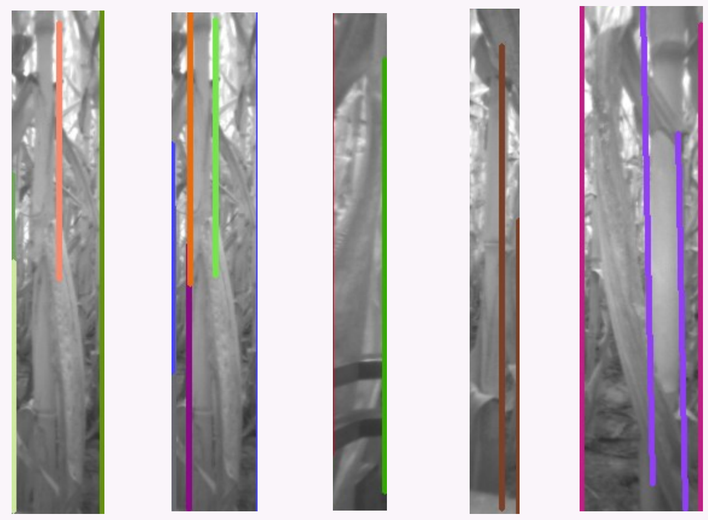
2. Raw intensity data from left & right cameras



3. Disparity map is computed using semi-global block matching

4. Tall, vertical areas are extracted using Opening by Reconstruction

5. Regions of interest are extracted using contour identification



6. Vertical lines are extracted using a Probabilistic Hough Transform. Parallel lines are paired & drawn as same color.

Methods:

We implemented a geometry-based stalk detection algorithm in ROS and OpenCV, tested on field data using a DUO MLX low-resolution, infrared stereo camera. Rectified images were run through a processing pipeline similar to the one shown above.

Results:

We present a successful but limited approximation of stalk location in messy field data. Geometry-based processing in two domains, depth and intensity, allows for a quick stalk-finding at ~10Hz. However, there are many limitations in this geometry-based detection, especially in the case of vertical leaves.

Future Work:

As the Robotanist project gains access to a mass of real field sorghum field data, a particularly interesting new avenue of investigation will be using larger data sets to serve as the training data for new stalk detection algorithms which incorporate modern Machine Learning techniques.

Acknowledgments:

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Work Referenced:

1. Li, Lei et al., “A Review of Imaging Techniques for Plant Phenotyping”, *Sensors* 14, no. 11, 20078-20111, 2014.

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