Development of LIDAR-based, Autonomous Agricultural Robot Navigation Guidance System

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Introduction

The world population is increasing at a rate of 80 million people annually [1]. A consistent fuel source will help sustain the population. Sorghum bicolor, a biofuel source, does not require much water to grow; however, increasing biomass yield is vital for this crop to be a solution. There is no systematic way to find optimal sorghum plants, since not many genetic traits have been found that directly correlate to biomass yield. The inability to identify these crop features is due to the difficulty to quickly collect large datasets. A robot was developed to autonomously collect data on sorghum.

Objective

Autonomously navigate through a sorghum field without damaging plants

Methods

- Testing in a simulated environment with Husky A200 with solely 2D laser scans
- Collecting field data in a young sorghum bicolor field
- Optimizing threshold values to work with sorghum point clouds

Conclusion

The navigation system is controlled by GPS and by a Pure-Pursuit [2]-based, line-following controller. The controller requires the base_link's perpendicular offset to a path and the robot's heading offset, which is found using this system.

Future Work

- Improving path detection by creating ideal RANSAC model
- Field testing how the multiplexer handles crop row navigation
- Incorporate mapping into navigation

Results

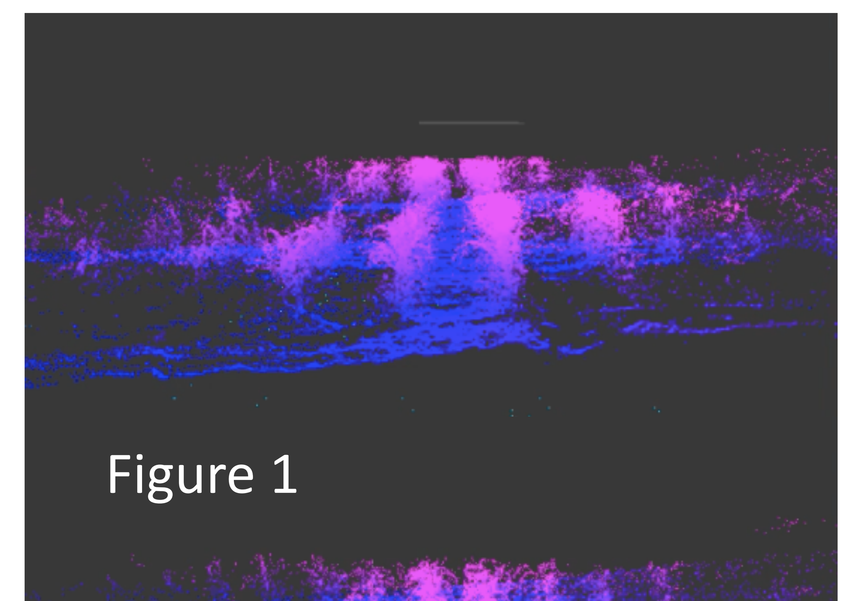


Figure 1

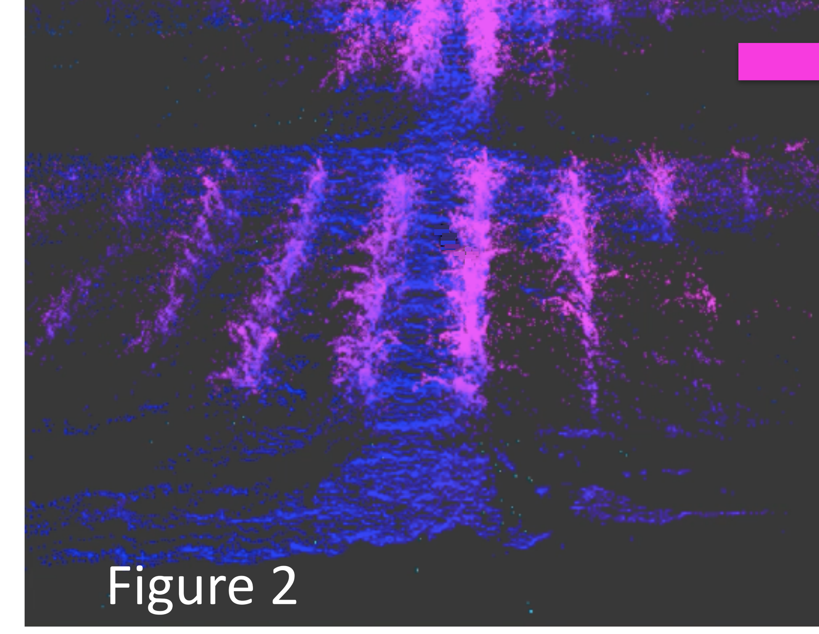
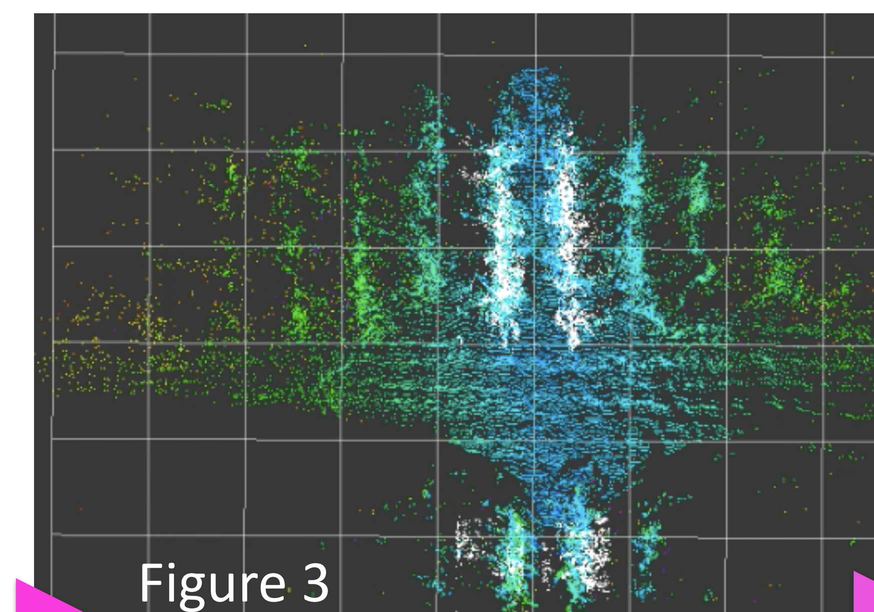


Figure 2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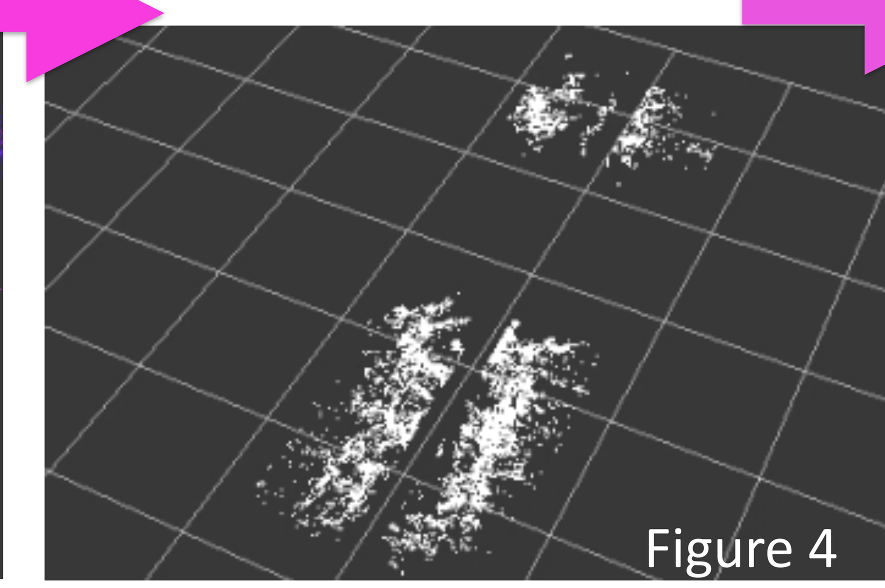
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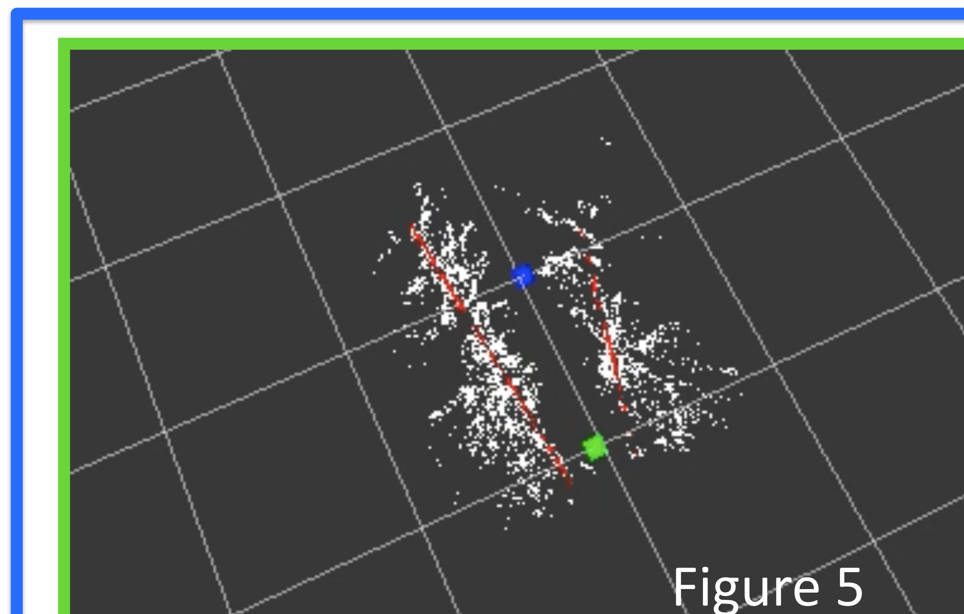
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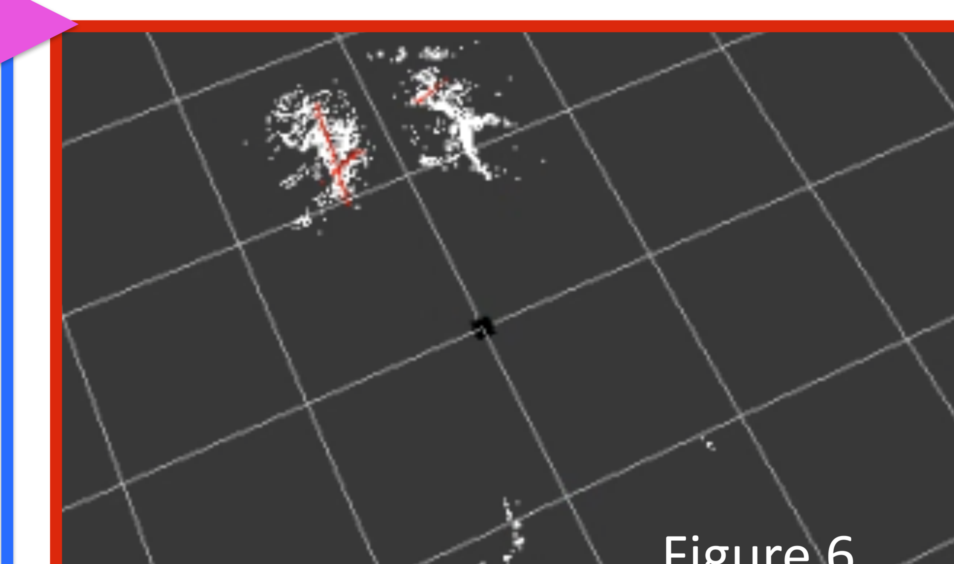
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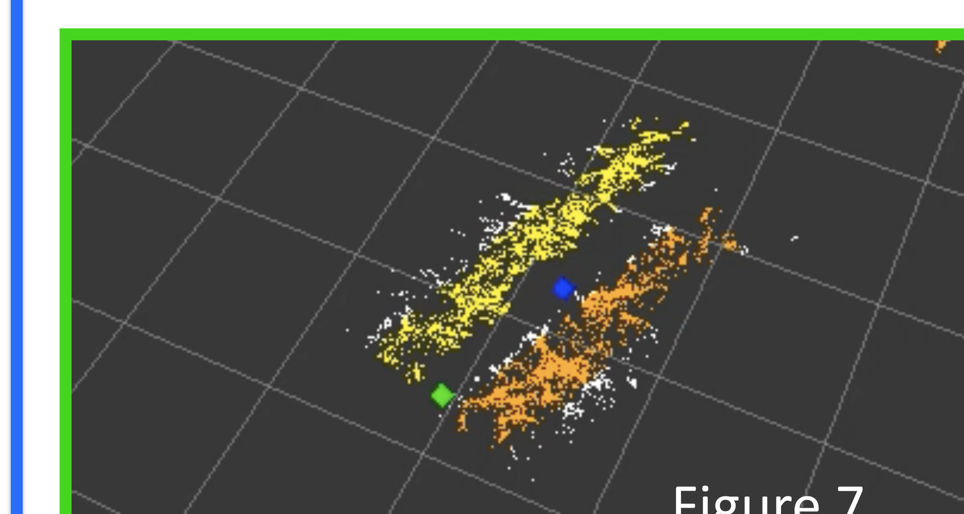
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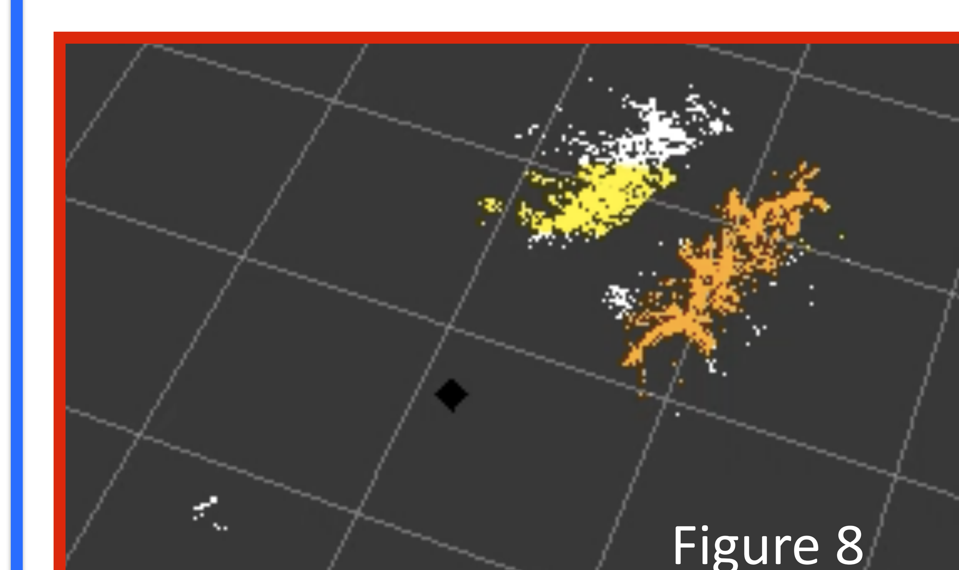
Figure 8

Blue Outline	The results after obtaining the point cloud of interest
Green Outline	Has found two rows of plants and is capable of finding a path
Red Outline	Did not find two reasonable rows and cannot find a path
Red line	Inliers in the row in an earlier version
Blue dot	The start of the path found, which is always on the x-axis relative to the base_link coordinate frame
Green dot	The end of the path found
Black dot	Location of the base_link frame, but only appears if no path is found
Orange	Inliers for row1, which is the most identifiable row
Yellow	Inliers for row2

Acknowledgements

Special thanks to Dr. George Kantor, Timothy Mueller-Sim, Merritt Jenkins, Margarett Oates, and Justin Abel for their support and guidance. Thanks to everyone in the Field Robotics Center, and the RISS coordinators for making this such a lovely learning experience.

References

[1] "Current World Population." World Population Clock: 7.4 Billion People (2016). N.p., n.d. Web. 03 Aug. 2016.
[2] Snider, Jarrod M. Automatic Steering Methods for Autonomous Automobile Path Tracking. Tech. N.p.: n.p., n.d. Print.