TerraSentia: Turnkey Autonomous Multi-Sensor UGV Platform for High Throughput Crop Phenotyping

Girish Chowdhary[1], Chinmay Soman[1], Thomas Aref[1], and Michael McGuire[1]

[1]Affiliation not available

October 30, 2023

Abstract

Autonomous robot platforms are increasingly being explored as a solution to critical problems in agriculture and in particular high-throughput field-phenotyping for crop-improvement. However, deploying autonomous vehicles in agricultural settings requires developing a complicated technology stack, including a robust hardware platform, reliable autonomy, multi-sensor recording, advanced analytics algorithms, and a data visualization and management pipeline. Without a robust platform in place, agricultural researchers and companies often have no choice but to develop their own robot from scratch. To address this problem EarthSense has developed the TerraSentia platform, capable of end-to-end autonomous data collection and high-precision high-throughput phenotyping in multiple crops. Our TerraSentia platform is capable of autonomous navigation using a planar LiDAR (sweeping horizontally), cameras, GPS, and IMU. It is equipped with four high-definition RGB cameras and a second planar LiDAR (sweeping vertically) for measuring phenotypes. A second UGV model, the TerraSentia+, supports more powerful drivetrain, on-board compute systems, and the ability to modularly configure the sensor stack. Furthermore, EarthSense has developed algorithms for estimating multiple key phenotypes with state-of-the-art precision, including corn plant height, corn ear height, corn stem width, corn nitrogen deficiency, Leaf Area Index (LAI), and soybean pod count. These algorithms are available to users out-of-the-box. Our system has provided estimates for many of these traits on thousands of experimental units over the last 2 years, with a steadily-improving rate of 2700 meters between interventions.

***Girish Chowdhary*[1,2]*, Chinmay Soman*[1]*, Thomas Aref*[1]*, Michael McGuire*[1]

[1]*EarthSense Inc., Champaign, Illinois, USA*

[2]*University of Illinois at Urbana Champaign USA, Agricultural and Biological Engineering and Computer Science, Champaign, Illinois, USA*

Keywords: Robotics, Autonomy, Phenotyping, Agriculture, Precision Agriculture, Machine Learning, Computer Vision