UNIVERSITY OF MINNESOTA
Driven to Discover℠

Automated Detection of Nitrogen Deficiency in Corn

Detect Nitrogen Depletion from Corn Leaves

A new data collection and algorithm system automatically detects nitrogen stress on the leaves of corn plants. Small-scale unmanned aerial vehicles (UAVs) collect high resolution images in the visual (RGB) spectrum by hovering over stressed areas at a low altitude. Computer vision RGB image analysis algorithms eliminate the need of a control/reference plant by analyzing the color and shape of the stressed leaves to determine potential nitrogen depletion. The algorithm identifies potential segments of the images that exhibit nitrogen deficiency, even when unhealthy leaves are heavily occluded by other (healthy or stressed) leaves. The algorithm determines the density of leaves affected by nitrogen stress and the severity of stress, leading to an accurate fertilizer recommendation to correct the deficiency. This low-cost solution can help farmers efficiently increase crop production in several ways: The method provides state of the field information on a regular basis and offers early detection of exact deficiencies present, and it determines whether or not a crop needs nitrogen fertilizer and estimates the amount of fertilizer needed and where to apply it. Furthermore, it prevents unnecessary fertilizer from entering the environment and polluting water sources.

Note: This technology for detecting nitrogen deficiencies in corn has been exclusively licensed. If you have questions, please contact the University of Minnesota's Office for Technology Commercialization.

Determine Nitrogen Deficiency Severity

Current field surveillance for estimating nitrogen stress is done either manually, which is time and labor intensive, or with the assistance of satellite imaging, which provides infrequent and costly information. Precision agriculture technologies using reflectance spectroscopy for assessing plant or soil nutrient contents (specifically nitrogen) rely strictly on RGB color and are unable to distinguish nitrogen deficiencies from other deficiencies. The computer vision technology used in this new system is able to distinguish nitrogen deficiencies from other deficiencies and crop stresses. In addition, the algorithm can determine the type, extent and severity of nitrogen deficiencies based on the number and density of leaves affected by relying on color, texture and the derivative of changes across an image.

BENEFITS AND FEATURES:

- Computer vision using high resolution RGB images
- Detects nitrogen stressed leaves of plants
- eference or control (non-stressed) leaves not needed
- Small-scale UAV analysis of corn fields, done remotely and without intense labor
- More accurate
- Provides a spectral diagnosis based on density and number of leaves.
- Determines whether or not crops need nitrogen fertilizer and estimates the amount needed and where to apply it
- Prevents unnecessary fertilizer from entering the environment and polluting water sources

Technology ID

20160058

Category

Engineering & Physical Sciences/Instrumentation, Sensors & Controls
Engineering & Physical Sciences/Robotics
Software & IT/Algorithms
Agriculture & Veterinary/Food Science & Nutrition

Learn more

APPLICATIONS:

- Corn crops
- Soybean crops
- Precision agriculture
- Precision farming
- Fertilizing

Phase of Development - Prototype

Researchers

Nikolaos Papanikolopoulos, PhD

Professor, Computer Science & Engineering

External Link (www.cts.umn.edu)

David Mulla, PhD

Professor, Soil, Water, and Climate

External Link (www.swac.umn.edu)

Dimitrios Zermas, PhD candidate

Computer Science and Engineering

Daniel Kaiser, PhD

Associate Professor, Soil, Water, and Climate

External Link (www.swac.umn.edu)

Vassilios Morellas, PhD

Research Staff, Director, Computer Science and Engineering

External Link (www.cts.umn.edu)

Michael Bazakos

Researcher, Computer Science and Engineering

Publications

Automation solutions for the evaluation of plant health in corn fields

Intelligent Robots and Systems (IROS) - 2015 IEEE/RSJ International Conference, 28 Sept.-2 Oct. 2015