CV02 Exploring leaf angle dynamics using point clouds from a stereo vision robot.

Background

Understanding diurnal dynamics of plant structural characteristics is crucial for understanding plant health and ecosystem functioning. Leaf inclination angle is a key structural parameter that affects light interception, photosynthesis, and overall plant growth. With the advent of remote sensing technologies, there is an opportunity to link ground-level observations with aerial data for comprehensive insights into plant behavior. As the leaf angle changes throughout the day and with different weather conditions, it is crucial to explore leaf angle dynamics at short intervals, something that is difficult to do manually. Using robotic systems and stereo vision can help to automate the collection of 3D point clouds at short intervals (e.g., 15 min) across multiple days or weeks.

Goal

- Using the farm bot system (https://farm.bot/) and a stereo vision setup to develop a protocol for observing diurnal dynamics of sugar beet leaf inclination angle.

Tasks

- Review literature on 3D scanning, leaf inclination angle, and vision in plant science and agriculture.
- Developing a script (pref. Python) to control sampling intervals and 3D point cloud storage.
- Implement data visualization output for explorative data analysis.

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CV03 An automated workflow for in-flight radiometric calibration of UAV imagery.

Background

Multispectral UAV snapshot cameras capture incoming light and transform it into digital values, storing this data at the pixel level. Converting digital numbers (DNs) to reflectance in optical remote sensing is crucial for ensuring accurate and meaningful analysis of Earth's surface properties. Reflectance values provide normalized measurements of surface reflectivity, allowing for consistent comparison of data across different times, locations, and sensors. While camera manufacturers provide basic calibration panels, these are not sufficient to reflect in-flight lighting conditions and account for non-linear relationships between DNs and reflectance. Greyscale calibration tarps that can be automatically detected in multispectral imagery could improve the retrieval of optical signals in landscape remote sensing.

Goal

- Developing an object detection – radiometric calibration workflow for UAV multispectral imagery.

Tasks

- Understand the implications of multispectral imagery on image contrast and brightness.
- Develop a transferable concept to upgrade an already existing grey-scale calibration tarp to be automatically detected. Extract greyscale values for radiometric calibration.
- Optional: Develop a radiometric calibration procedure that converts multispectral imagery.

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