Applications of Handheld Off-The-Shelf Multispectral Spectrometers for Improving Water and Soil Quality Assessments for Satellite Earth Observation

Ahadu Assegued, Aerospace Engineering (Astronautics)
Mentor: Saurav Kumar, Assistant Professor, SSEBE

Background

Research question: How do spectral reflectance trends from low-cost multispectral spectrometers differ from hyperspectral imaging and satellite multispectral data?

The study investigates how STELLA, an affordable multispectral sensor, can complement hyperspectral imaging and satellite-based earth observation as a way of making remote sensing technologies more accessible worldwide.

Methods

Collected spectral reflectance of lab-grown algae and compared measurements from hyperspectral imaging and STELLA.

Acquired spectral reflectance of spinach in an agricultural field using hyperspectral imaging, STELLA, and satellite data.

Processed and modeled both experiments in MATLAB to generate comparative reflectance plots across sensors.

Figure 1: Data acquisition systems used in this study. From left to right: PlanetScope Dove satellite constellation, HySpex Mjolnir hyperspectral imager, and STELLA 1.1 multispectral sensor.

Results

Figure 2: Aerial View of Spinach Field at the Maricopa Agricultural Center

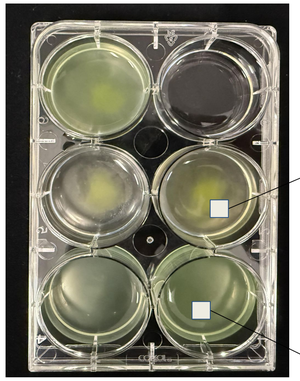
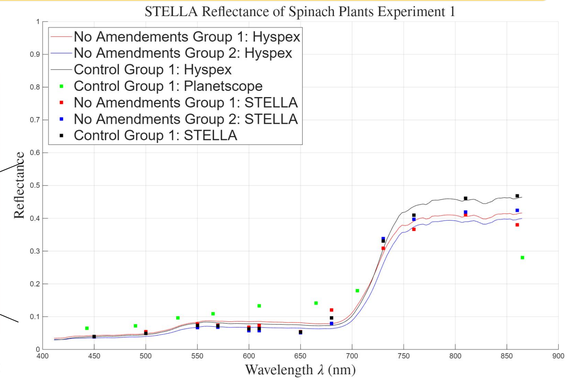
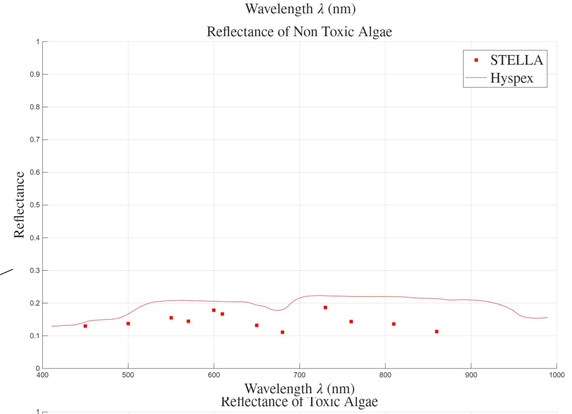
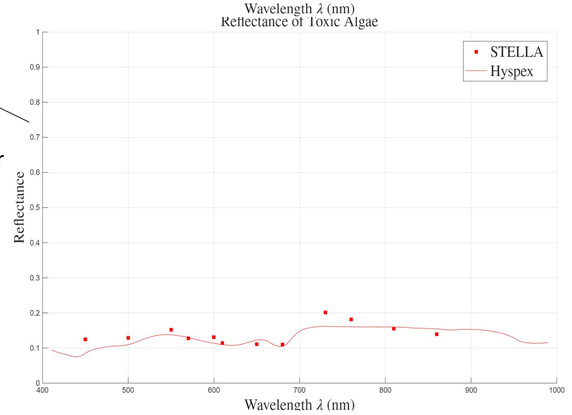


Figure 3: DIfferent species of Algae used for experiment







Conclusion

Noise is observed across all STELLA measurements, however, overall spectral trends remain consistent when compared to HySpex data. This increased noise is likely due to the lower radiometric quality and band design of the sensor. Additionally, satellite data lacks sufficient spatial resolution to accurately capture the spectral reflectance of individual spinach leaves.

Future Work

Systematic accuracy assessments of real-world analytical products, such as vegetation indices or algal bloom identification will be conducted. Although STELLA measurements are less precise, large scale data collection across varying locations could counter inaccuracies.

Further experimentation also allows for the quantification of error through statistical analysis. Establishing these tasks is critical to determining the feasibility of low-cost sensors as a complement to high-fidelity systems.

Research the use of data-driven models to provide corrections for STELLA to compensate for limitations in sensor design and satellite spatial resolution, while improving accuracy.

FURI

Ira A. Fulton Schools of Engineering
Arizona State University