Designing a remote aerial system to image and analyze the health of grape crops at Cal Poly San Luis Obispo

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Introduction / Objectives

AFL's first contract was with the Cal Poly Agricultural Department to photograph their vineyards and analyze the health of the grape crops using a hyperspectral camera. A hyperspectral image collects and processes information from across the electromagnetic spectrum in order to obtain the spectrum for each pixel in the image. This goal of this portion of the project was to learn how to use the camera, confirm that the images can be viewed in the lab, and if possible given the status of the lab's UAVs determine how to mount the camera to a vehicle, and remotely control the camera from the lab site or ground control station (GCS) van.

Equipment / Methods

The Selectable Hyperspectral Airborne Remote sensing Kit (SHARK) (Fgure 5) is comprised of a hyperspectral visible and near-infrared (VNIR) scanning spectrometer, an inertial navigation system (INS), a system computer that runs on Windows 7 and additional hardware and software to support the collection, annotation, and storage of imagery from airborne platforms. Figure 1 outlines the key elements of the system. The entire system can then be accessed remotely through a remote desktop connection and from a GUI that loads through a web browser.

Progress / Results

For some time the Cal Poly Agricultural Dept. has been running its own research project consisting of growing grapes under different conditions, and assessing which methods are most beneficial to the crops. The last step to finishing this research lies in using the SHARK on the RMAX and taking images. The SHARK has now been fully tested and modified for flight and AFL has a trained team of operators confident and capable of running the SHARK. Since ALF does not yet have access to its UAVs the SHARK has not yet been outfitted for safe flight or modified to be mounted on the RMAX.

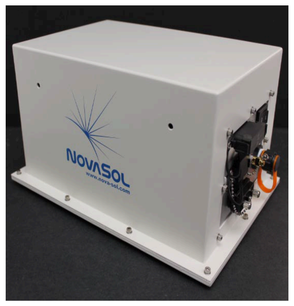

Figure 1: SHARK system

Figure 2: AeroVironment RQ-20 Puma is a small, battery powered, hand-launched UA. Wingspan: 9' 2" Length: 4' 7"

Figure 3: Yamaha R-MAX is a two-bladed, gasoline-powered, unmanned helicopter Rotor Diameter: 10' 3" Length: 11' 11"

Figure 4: Example of how the SHARK will be mounted on UAV similar to the the RMAX[1]

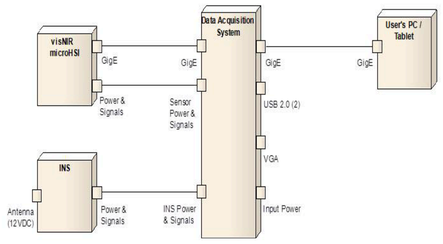

Figure 5: Key elements of the SHARK system.

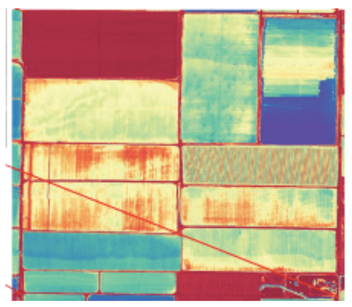

Figure 6: Example hyperspectral image of crop field

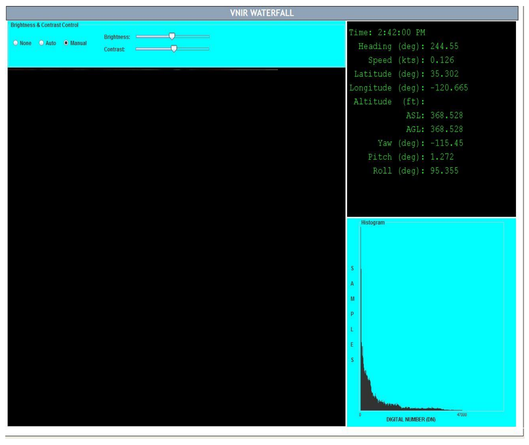

Figure 7: Realtime GUI viewer for the SHARK

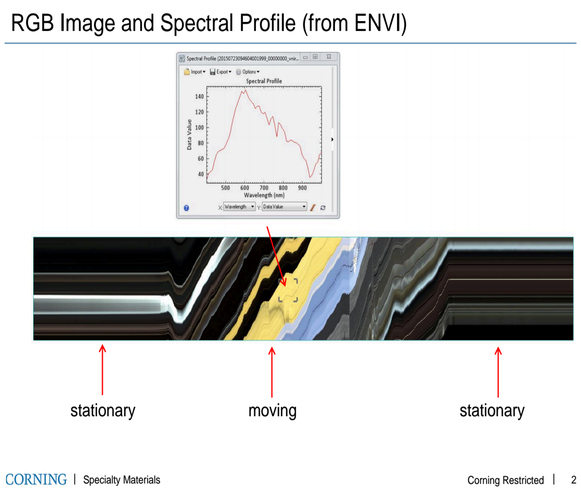

Figure 8: Lab test of SHARK hyperspectral camera

Autonomous Flight Lab

The Autonomous Flight Lab (AFL) at Cal Poly San Luis Obispo is a new lab site that is dedicated to using UAVs to benefit research for all backgrounds. Before AFL was able to fly missions the lab first needed to actually receive their vehicles the RMAX and Puma, create a lab space that would provide all of the necessary resources and equipment necessary to fly, and to be granted permission by the Federal Aviation Administration (FAA) via a Certificate of Authorization (COA) to fly. The lab is run by Cal Poly Aerospace professor Dr. Aaron Drake.

Conclusion / Future Work

Unfortunately during the summer of 2015 AFL was not able to yet get access to any of its UAVs due to delays; however, much progress was made towards getting the SHARK flight ready. Until AFL gets access to its UAVs the lab will move forward with the project by mounting the SHARK onto a helikite to take initial imaging data. Once AFL gets access to its UAVs the SHARK will be able to begin the mounting process onto the RMAX and the first initial imaging flights will occur. AFL now to receive its UAVs sometime during fall of 2015 which will allow the vineyard imaging project to move forwards towards completion.

Figure 9: Skyhook helium helikite

Acknowledgements / References:

- Keith Nakanishi, Sr. Systems Engineering Manager, Corning – Advanced Optics
- Ziph-Schatzberg, Leah, and Keith Nakanishi. "Spectral Imaging: Compact, High-performance Hyperspectral Imaging Systems." Laser Focus World, 06 Jan. 2015.

This project was supported by a grant to the STAR program from the Howard Hughes Medical Institute.