AGGIEAIR - A LOW-COST AUTONOMOUS MULTISPECTRAL REMOTE SENSING PLATFORM: NEW DEVELOPMENTS AND APPLICATIONS

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1. INTRODUCTION

Data acquired by aircraft, satellites and other sources of remote sensing has become very important for many applications such as irrigation control, crop management, flood prevention and ecological monitoring. Even though the platforms currently used for remote sensing have proved to be robust, they can also be expensive, have low spatial and temporal resolution, and take a long time to process the data [1]. At Utah State University (USU), there is an ongoing project to develop a low-cost, high resolution, autonomous, multispectral remote sensing platform which can be deployed almost anywhere. This platform (AggieAir) is a flying wing radio controlled (RC) aircraft (see fig. 1a) with an onboard autopilot. The autopilot controls the aircraft according to a preprogrammed flight plan. It can also carry different payloads depending on the application. Some payload options include cameras which cover the visual, the near infrared (NIR) and the thermal bands of the spectrum.

The features of AggieAir give an opportunity for many applications which previously have not used remotes sensing data because of the price, availability or resolution. To serve these applications, a service center at USU has been created to fly AggieAir on a regular basis. This paper will talk about the development of AggieAir and some of the projects the platform is being used for. More information on AggieAir and other platforms can be found in [1, 2, 3] and the references therein.

2. PLATFORM DEVELOPMENT

Since last year [1], many improvements have been made to AggieAir. One improvement is switching autopilots to an open source autopilot called Paparazzi. Paparazzi is a very powerful autopilot with many features which give the user full control over the aircraft. The most important feature of Paparazzi is the open source code. With full control over the source code, the system can be changed to fit any application. For example, the autopilot can be programmed to interface with the aircraft payload. With this interface, the autopilot can control the payload, or the payload could help navigate the aircraft. Taking advantage of the open source code, we have interfaced an inertial measurement unit (IMU) to Paparazzi for better navigation and orthorectification. We have also developed some navigation routines for Paparazzi to improve the autonomy of the system. Some of these routines include: an auto-takeoff routine with a bungee launch system, a flower navigation routine to help calibrate the aircraft sensors [3], and a sector survey navigation routine which helps the aircraft survey the area of any convex polygon.

A new high resolution imaging system (GFoto) has also been developed for AggieAir (see Fig. 1b). GFoto is a Canon Powershot SX100 camera which is controlled by an onboard Gumstix computer via a USB interface. The Gumstix tells the camera when to take a picture and records the aircraft data for orthorectification. Due to the software interface through the Gumstix, the GFoto system has the potential for real-time onboard image processing, broadcasting data to the ground station and using the images for navigation. With the high resolution Canon camera, GFoto can achieve centimeter resolution and has a 3 second sample time.

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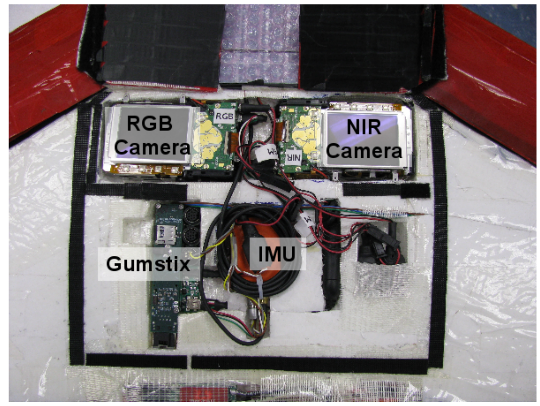
(a) Flying wing aircraft



(b) Payload

Fig. 1. Platform Images

3. MISSION APPLICATIONS

AggieAir is currently involved in a large scale agricultural project which will use the remote sensing data from AggieAir to measure the soil moisture of the area to help save water. The project includes 30 square miles of different types of crops where 50 wireless soil moisture ground probes are placed. The ground probes sample and send the data every hour wirelessly to a base station. The base station displays the data on the internet. The ground probes will be used as ground truth to calibrate and check the validity of the images. LandSat will also be used as a conventional RS platform to compare with the images from AggieAir.

AggieAir is also being used to survey a river basin to map different parts of the river and to track the population of Tamarix in the river basin. Tamarix is foreign to North America, endangers the native plant species, monopolizes the water supply and increases the chances for floods and fires [4]. A beetle has been introduced into the area in order to get rid of the Tamarix, so AggieAir will help track the progress of Tamarix by frequently mapping the area.

Other projects AggieAir is involved in include: monitoring the volume of a small irrigation pond to control the salinity of the water, fish tracking and mapping highways and roads for inventory. More details on these projects will be included in the final paper.

4. FUTURE DEVELOPMENTS

Future developments will be focused on making AggieAir more cost effective and autonomous. An in-house IMU (AggieNav) is currently being developed at USU to decrease the cost of AggieAir while maintaining quality inertial data. In addition, more features like onboard image processing, image navigation and wireless communication will be added to GFoto.

5. REFERENCES

[1] Austin M. Jensen, Marc Baumann, and YangQuan Chen, "Low-cost multispectral aerial imaging using autonomous runway-free small flying wing vehicles," in *Proc. of the IEEE International Conference on Geoscience and Remote Sensing Symposium (IGARSS).*, July 2008.

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[4] Virgin River Program, "http://www.virginriverprogram.org/," January 2009.