Applications of Long-Wave Thermal Infrared Imagers on Unmanned Aerial Systems for First Responders

Nick Harris and Lorenzo Coykendall

Introduction

The Embry-Riddle Prescott UAS Team will design, build, and test three Unmanned Aerial Systems (UAS) for competing in the Student UAS Competition June 18-22 at Patuxent River, MD, hosted by the Association for Unmanned Vehicle Systems International (AUVSI).

The team will design and build these unmanned aircraft to carry a five-pound payload, sustain flight for at least forty minutes, and be hand-launchable and rugged; they will be constructed from composite materials and will be fully autonomous through the use of open-source autopilots.

The aircraft’s payload consists of a camera, microcontroller, and digital communications system. The camera will be stabilized to point downward at all times and will be tasked with taking high-resolution photographs of the target area. The microcontroller and digital communications system have two tasks: send photographs from the aircraft’s camera to the ground station, and relay textual data from other ground stations.

The team will utilize a target detection and recognition software program. The program will analyze photographs retrieved from the aircraft and determine the probable existence and characteristics of a target in the image (shape, color, alphanumeric, position).

The team will utilize a failsafe recovery method for the aircraft. This recovery method will consist of either a commanded spiral or a parachute. In either case, the recovery system will be triggered by a complete loss of power to the aircraft.

Methods

The team will first build simple UAS based on remote-control aircraft. This provides an easily replaceable platform to test sub-systems and a platform with which to practice flight test operations and crew coordination. These remote control planes could also be back-up aircraft for the competition.

The competition aircraft will be built from composite materials, such as carbon fiber, fiberglass, and Kevlar. The team will use a tested aircraft construction technique, which involves cutting the components out of foam with a hotwire, embedding carbon fiber tube spars, and coating the wing with fiber-reinforced plastic. The fuselage will be constructed using a new method modeled after UAS industry techniques. The fuselage is then constructed using Kevlar material sandwiching foam honeycomb.

For digital communications, the team will use off-the-shelf components as much as possible. The team will use Ubiquiti radio modems for their low cost, high power, and technical support. The team will program a microcontroller on the aircraft to facilitate the communications between the camera and the modem. The microcontroller will also control the communications with a remote ground station, called the Simulated Remote Intelligence Center (SRIC). This is an important bonus for the competition in which the aircraft must connect to a router in the field and retrieve a passphase.

To achieve truly failsafe recovery, the team will experiment with two recovery methods: spiral and parachute recoveries. The spiral will be commanded by using the aircraft’s flight surfaces to command the spiral. The second experiment will use a parachute with a spring-activated release solenoid and is triggered by loss of power.

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