Development and Implementation of Real-Time Information Delivery Systems for Emergency Management

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ABSTRACT

The disaster management community has an on-going need for real-time data and information, especially during catastrophic events. Currently, twin engine or jet aircraft with limited altitude and duration capabilities collect much of the data. Flight safety is also an issue. Clearly, much of the needed data could be delivered via over-the-horizon transfer through a uninhabited aerial vehicles (UAV) platform to mission managers at various locations on the ground. In fact, because of the ability to stay aloft for long periods of time, and to fly above dangerous situations, UAV's are ideally suited for disaster missions.

There are numerous situations that can be considered disastrous for the human population. Some, such as fire or flood, can continue over a period of days. Disaster management officials rely on data from the site to respond in an optimum way with warnings, evacuations, rescue, relief, and to the extent possible, damage control. Although different types of disasters call for different types of response, most situations can be improved by having visual images and other remotely sensed data available.

"Disaster Management" is actually made up of a number of activities, including:
- Disaster Prevention and Mitigation
- Emergency Response Planning
- Disaster Management (real-time deployment of resources, during an event)
- Disaster / Risk Modeling

All of these activities could benefit from real-time information, but a major focus for UAV-based technology is in real-time deployment of resources (i.e., emergency response teams), based on changing conditions at the location of the event.

With all these potential benefits, it is desirable to demonstrate to user agencies the ability to perform disaster management missions as described. The following demonstration project is the first in a program designed to prove the feasibility of supporting disaster missions with UAV technology and suitable communications packages on-board. A several-year program is envisioned, in which a broad range of disaster-related activities are demonstrated to the appropriate user communities.

The objective of the demonstration missions is to successfully integrate the following capabilities into a system and operate in a disaster management scenario:

- UAV platform providing safe, flexible, long endurance operations
- Suitable remote-sensing payload
- Over-the-horizon data downlink to data hub
- Real-time or near-real-time disaster data analysis
- Real time disaster information distribution to users in the field
- Real-time tasking of system to optimize information value
- Real or simulated disaster situation with user agencies participating
- Asset tracking
- Communications

NASA-Ames Research Center, the U.S. Forest Service, the State of California, and General Atomics – Aeronautical Systems, Inc. (GA) are participating in an effort to demonstrate the utility of employing UAV and commercial-off-the-shelf (COTS) data acquisition and tele-communications technology for real-time disaster monitoring and management. Utilizing a thermal scanner, the Airborne Infrared Disaster Assessment System (AIRDAS), developed at NASA-Ames Research Center, in concert with a large payload capacity UAV (GA's Altus™ platform) and a data relay (via satellite communications) system, this consortium is demonstrating rapid deployment and on-site data collection of a wildfire event. By employing a remotely operated AIRDAS thermal imaging system, a system engineer on the ground is able to control the data acquisition process onboard the UAV. Digital calibrated spectral data, collected in four wavelengths (including the red, near-infrared, and thermal infrared) are uplinked from the aircraft to a geo-stationary communications satellite and relayed to a ground receiving station located anywhere on the globe. The imagery data sets are geo-referenced utilizing aircraft and sensor projection model data delivered as an ancillary package file with the associated imagery. The total process time from data acquisition aboard the UAV, through satellite uplink / downlink, processing into a geo-referenced image data file, to web distribution, to a fire manager in a remote camp is less than an hour. The data received at the ground station are geo-referenced in near real time and distributed to a web site for use by the fire manager at the incident command center.
A three-band color quicklook file is also down-linked from the aircraft and is available for viewing on any web site within a few minutes of acquisition. This data set is not geo-rectified but can be used for a quick reference of data quality and an overview of the disaster scenario. Any access point on the globe can monitor all the disaster imagery data sets with WWW connectivity.

The employment of the Altus UAV provides the unique capability of unmanned flight (thereby reducing the potential for loss of human live during hazardous missions), and the ability to "linger and stare" over a disaster event for extended periods of time (beyond the capabilities of human-pilot endurance). This unique perspective enables monitoring of disasters both day and night in order to derive change in environmental conditions and extent. This demonstration will lead to an improved acceptance of UAV technological capabilities, rapid data formatting and dissemination capabilities via satellite

communications and Internet connectivity, and increase understanding of the ability to manage and mitigate disasters in a more rapid manner.