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On 27th & 28th February, 2015

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Department of Mechanical Engineering, Magna College of Engineering, Chennai-600055, India.

Design and Fabrication of Unmanned Aerial Vehicle

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ABSTRACT: This paper summarizes current work on theoretical and experimental cooperative tracking of moving targets by a team of UAVs. The Institution Group is leading a diverse group of researchers to develop building block foundations for cooperative tracking. The building block algorithms have been maturing through the partners, and the team led by Institutions is now pulling the technologies together for demonstration and commercialization. The work reported here focuses on cooperative tracking using multiple UAVs, with the ability for one operator to control many UAVs which are tasked to 1) provide autonomous tracking of moving and evading targets, and 2) report to a centralized database, position history, and velocity vector of the target being tracked. Flock guidance algorithms have been developed and simulated to enable a flock of UAVs to track an evading vehicle. Algorithms have been demonstrated in simulation that dynamically allocate tasks and compute near-optimal paths in real-time; minimize the probability that vehicles are destroyed due to collision or damage from threat; and accommodate moving targets, time-on-targets, and sequencing, as well as the effects of weather and terrain. Additionally Relocation estimation algorithms and software have been developed which exchange information among vehicles, process the information robustly and in real time, and have demonstrated that the joint accuracy is improved. Work has also focused on accurate probabilistic analysis of the estimates, especially considering variations across multiple vehicle sets of Scan Eagle UAVs.

I. INTRODUCTION

Recent military operations and search and Rescue operations have demonstrated the presence, Need, and usefulness of uninhabited aerial vehicles (UAVs). For many of these missions, UAVs with on-board camera systems are very important element for operations, with their ability to both track and identify objects on the ground. With a single UAV and camera as a building block, current research is now focused on developing teams of these vehicles for cooperative missions. These "teams of vehicles" open up very important research questions such as: What information is shared between the vehicles? How do the vehicles cooperatively plan trajectories and tasks for each mission type? How can the impact of communications constraints, such as outages and dropped packets be minimized? The Insitu Group, Cornell University, and the University of Washington have teamed up to conduct research in order to answer many of these questions. The Insitu Group develops a variety of production UAVs, including the Scan Eagle/Sea Scan system. The Scan Eagle is currently the smallest UAV with an inertial-stabilized turret, enabling the persistent tracking of coordinates/landmarks with limited input from users. Using the Scan Eagle as a basis, the goal of the proposed work is to rapidly evaluate, and demonstrate in flight, algorithms for cooperative tracking of moving targets using multiple UAVs, The work reported here focuses on cooperative tracking using multiple UAVs, with the ability for one operator to control many UAVs which are tasked to 1) provide autonomous tracking of moving and evading targets, and 2) report to a centralized database (without operator attention): the position, position history, velocity vector. Reporting expected position of the assigned target enables Intelligence, Surveillance, and Reconnaissance (ISR) missions to be more cost effective and efficient. ISR resources have generally been regarded as the number one resource scarcity during recent operations in Iraq and Afghanistan. ISR resources will continue to be limited by personnel constraints unless the vehicles autonomy and cooperation can be increased. This work is intended to lead to a demonstration of the ability for multiple UAVs to self-organize and cooperate for the tracking of a moving target (SUV, vessel, tank, etc). The UAVs will demonstrate autonomous behaviours to modify strategy based upon the number of UAVs available for cooperation, and will help each other regain image lock in the event that the image is temporarily lost by one or more UAV.

II. UAV VS. MANNED AIRCRAFT

- Remotely piloted vehicles will ever fully replace manned aircraft
- They can perform an increasingly sophisticated array of missions due to their small size and decreased radar, acoustical, and infrared signatures.
- To wholly replace man would be expensive and technically risky.
- UAS should be only considered for certain types of missions for which it can be a cost effective (dirty, dull and dangerous)
- The absence of an aircrew means that a great deal of space and weight can be saved.
- With a continuing trend of miniaturization in electronics and other components, the RPV can be made much smaller and cheaper
- Size largely determined by the size of the payload,
- Could be a sophisticated electronics package or weapons system

III. UAV CLASSIFICATIONS

Target and decoy - providing ground and aerial gunnery a target that simulates an enemy aircraft or missile.
Reconnaissance - providing battlefield intelligence.
Combat - providing attack capability for high-risk missions.
Logistics - UAVs specifically designed for cargo and logistics operation.
Research and development - used to further develop UAV technologies to be integrated into field deployed UAV aircraft.
Civil and Commercial UAVs - UAVs specifically designed for civil and commercial applications

Raven
Mission
The RQ-11 Raven Small Unmanned Aircraft System is a small man-portable UAS that performs reconnaissance, surveillance, and target acquisition missions for Air Force Special Operations Command Battlefield Airmen and Air Force security forces.

Features
The Raven back-packable UAS features two air vehicles or AVs, a ground control unit, remote video terminal, transit cases and support equipment. Two specially trained Airmen operate the Raven AV. The AV can be controlled manually or can autonomously navigate a preplanned route.

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The Raven includes a color electro-optical camera and an infrared camera for night operations. The air vehicle is hand-launched, weighs less than 5 pounds, has a range of 10-15 kilometers and an endurance of up to 80 minutes.

Background

The Raven system has proven itself in combat supporting U.S. operations in Iraq and Afghanistan, and other areas of conflict. The Raven is now used by all of the military services. Air Force security forces are currently purchasing the Raven UAS to replace its aging Desert Hawk UAS

General Characteristics

Primary Function: Situational awareness and direct target information
Contractor: Aerovironment, Inc.
Power Plant: Electric Motor, rechargeable lithium ion batteries
Wingspan: 4.5 feet (1.37 meters)
Weight: 4.2 lbs (1.9 kilograms)
Weight (ground control unit): 17 lbs (7.7 kilograms)
Speed: 30-60 mph (26-52 knots)
Range: 8-12 km (4.9-7.45 miles)
Endurance: 60-90 minutes
Operating Altitude: 150-500 feet air ground level (45-152 meters)
System Cost: approximately $173,000 (2004 dollars)
Payload: High resolution, day/night camera and thermal imager
Date deployed: 2004
Inventory: Classified

Shadow

- The Shadow 200 is a small, lightweight, tactical UAV system. The system is comprised of air vehicles, modular mission payloads, ground control stations, launch and recovery equipment.
- The air vehicle is intended to provide coverage of a brigade area of interest for up to four hours, at 50 kilometers from the launch and recovery site.
- The maximum range is 125 kilometers (limited by data link capability), and operations are generally conducted from 8,000 to 10,000 feet above ground level during the day and 6,000 to 8,000 feet above ground level at night.
- The air vehicle uses a pneumatic launcher and is recovered by a tactical automatic landing system without pilot intervention on the runway. The air vehicle is stopped using an arresting hook and cable system.
- Performance:
- Speed 194.5km/h (105kt)
- Flight Ceiling 4,572m (15,000ft)
- Endurance 5 to 7 hours
- Mission Radius 200km
- Climb Rate 300m to 450m a minute
- Take-Off Distance (Launcher) 10m
- Maximum Dash Speed 219km/h (118kt)
- Cruise Speed 167km/h (90kt)
- Loiter Speed 111km/h (60kt)

Datalinks

- X band, C band, UHF
- Standard Datalink Range 50km
- Optional Datalink Range 200km

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Mq-1 predator

• Mission

The Q-1 Predator is a medium-altitude, long-endurance, unmanned aircraft system

• The MQ-1's primary mission is interdiction and conducting armed reconnaissance against critical, perishable targets

The basic crew for the Predator is one pilot and two sensor operators. They fly the aircraft from inside the ground control station via a line-of-sight data link or a satellite data link for beyond line-of-sight flight

• The aircraft is equipped with a color nose camera (generally used by the pilot for flight control), a day variable-aperture TV camera, a variable-aperture infrared camera (for low light/night), and other sensors as the mission requires. The cameras produce full-motion video.

• The MQ-1 Predator carries the Multi-spectral Targeting System which integrates electro-optical, infrared, laser designator and laser illuminator into a single sensor package. The aircraft can employ two laser-guided AGM-114 Hellfire anti-tank missiles

General Characteristics

Wingspan: 48.7 feet (14.8 meters)

Length: 27 feet (8.22 meters)

Height: 6.9 feet (2.1 meters)

Weight: 1,130 pounds (512 kilograms) empty

Maximum takeoff weight: 2,250 pounds (1,020 kilograms)

Fuel Capacity: 665 pounds (100 gallons)

Payload: 450 pounds (204 kilograms)

Speed: Cruise speed around 84 mph (70 knots), up to 135 mph

Range: up to 400 nautical miles (454 miles)

Ceiling: up to 25,000 feet (7,620 meters)

Armament: two laser-guided AGM-114 Hellfire missiles

Global hawk

Mission

• The RQ-4 Global Hawk is a high-altitude, long-endurance unmanned aircraft system with an integrated sensor suite that provides intelligence, surveillance and reconnaissance, or ISR, capability worldwide

• Global Hawk's mission is to provide a broad spectrum of ISR collection capability to support joint combatant forces in worldwide peacetime, contingency and wartime operations

• The Global Hawk complements manned and space reconnaissance systems by providing near-real-time coverage using imagery intelligence (IMINT) sensors.

Features

• The Global Hawk system consists of the RQ-4 aircraft, mission control element, or MCE, launch and recovery element, or LRE, sensors, communication links, support element and trained personnel

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- The IMINT sensors include synthetic aperture radar, electro-optical and medium-wave infrared sensors.
- The system offers a wide variety of employment options
- The long range and endurance of this system allow tremendous flexibility in meeting mission requirements.

General Characteristics
Primary function: High-altitude, long-endurance intelligence, surveillance and reconnaissance
Contractor: Northrop Grumman (Prime), Raytheon, L3 Comm
Power Plant: Rolls Royce-North American AE 3007H turbofan
Thrust: 7,600 pounds
Wingspan: (RQ-4A) 116 feet (35.3 meters); (RQ-4B) 130.9 feet (39.8 meters)
Length: (RQ-4A) 44 feet (13.4 meters); RQ-4B, 47.6 feet (14.5 meters)
Height: RQ-4A 15.2 (4.6 meters); RQ-4B, 15.3 feet (4.7 meters)
Speed: RQ-4A, 340 knots (391 mph); RQ-4B, 310 knots (357 mph)
Range: RQ-4A, 9,500 nautical miles; RQ-4B, 8,700 nautical miles
Ceiling: 60,000 feet (18,288 meters)
Uav applications

- Military/Security
  - Defense
- Civil
  - Defense
  - Natural Disasters
  - Humanitarian Relief
- Science
  - Environment
  - Weather & Storm Tracking
- Commercial
  - Wireless Communications
  - Precision Agriculture

Cargo Transport

UAV applications

- Military/Security

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- Defense
- Civil
  - Defense
  - Natural Disasters
  - Humanitarian Relief
- Science
  - Environment
  - Weather & Storm Tracking
- Commercial
  - Wireless Communications
  - Precision Agriculture
  - Cargo Transport

Advantages

- Can do jobs that are dirty, difficult, and dangerous
- Combat/Reconnaissance
- Less risk to humans
- More efficiency
- Can acquire otherwise unattainable information.

Disadvantages

- Limited air time.
- Shorter lifespan than manned combat aircraft.

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