CONTRIBUTING ORGANIZATIONS

Japan Aerospace Exploration Agency

UNMANNED & INNOVATIVE AIRCRAFT TEAM ACTIVITIES

Motivated by the increasing awareness about disaster preparedness in Japan due to recent earthquakes, Great Sichuan Earthquake in China in 2008 as well as Niigata-ken Chuetsu Earthquake in Japan back in 2004, Unmanned and Innovative Aircraft Team (UIAT) has been conducting Research and Development on «Unmanned Aerial Vehicle Systems for Disasters Monitoring». The team is also active in making UAS safety guidelines (notice that JAXA is not a law making organization, but a research institute) for flights above populated areas in conjunction with Japanese UAS industry, exchanging information with aviation authorities, FAA, as well Japan Civil Aviation Bureau (JCAB). Other research areas of the team include future-oriented research on innovative aircraft technologies.

Concept of UAS for Disaster Monitoring

The team is conducting R&D on the disasters monitoring system that comprises of two UAV subsystems, small fixed-wing and LTA (Lighter-Than-Air or airship), with each subsystem complementarily performing disaster monitoring missions. The small fixed-wing subsystem is for fast launch, less heavily equipped and shorter endurance missions to deliver information prior to helicopters (disaster prevention or fire fighting), and the LTA is for heavily equipped and longer endurance missions to deliver high quality information. When an earthquake or a fire happens, small unmanned airplanes are launched and accident information on a stricken area is collected as soon as possible. Then a small airship is launched and observes the detailed state of the stricken area using the information obtained by the small unmanned airplanes. (Fig1)

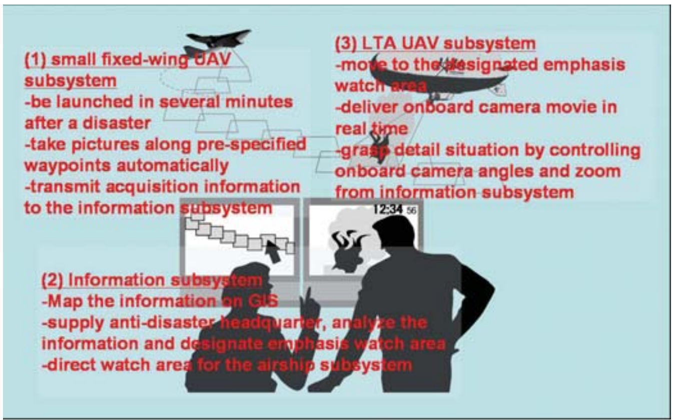


Fig.1 - UAS Concept for disaster monitoring

Flying test beds of both fixed-wing and LTA were manufactured and flight tests have been conducted to verify key technologies. After establishing elemental technologies, a prototype system will be developed for operational flight tests with local governments, which are expected to start around the end of fiscal year 2011.

Small Fix-Wing UAS Subsystem to Rapidly Confirm Accident Situations

The fixed-wing flying test bed has a wing span of approx. 2 m with a gross weight of 4 kilogram. A propeller driven by an electric motor is mounted on the rear of the fuselage between a wing and tail planes with control surfaces. Onboard batteries supply the electricity for one hour flight. The vehicle can be launched from a catapult in several minutes after a disaster, and can fly along preplanned waypoints automatically. After taking pictures of the stricken area by an onboard camera, it returns to the base station. Pictures taken are transmitted to the information subsystem.

Fig.2 - Small fixed-wing UAS testbed

UAS will supply information more quickly and cheaply in comparison to a manned disaster protection helicopter or a fire extinguishing helicopter.

Since the safety on the ground is critical to flights above populated areas, the propeller is moved and mounted on the rear of the fuselage to avoid a direct hit of the rotating propeller when colliding with a human. The nose of the fuselage can be covered with a soft material to mitigate the impact on the human body. Reduction of the speed before a collision by a parachute or other devices can also mitigate the impact. The team is conducting research on the assessment of the damage to the human scull using an FEM analysis method to make safety guidelines in terms of the mass and collision speed of a UAV (Fig2 & 3).

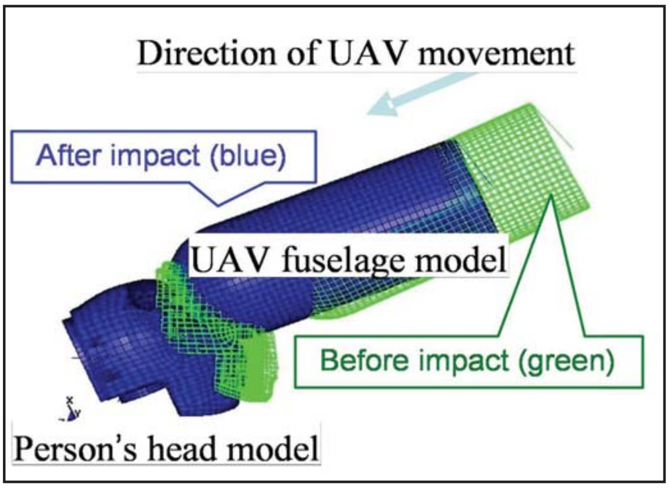


Fig.3 - FEM damage analysis of UAS impact on person's head

L-T-A UAS for Long Endurance Fixed-Point Observation

The L-T-A flying test bed is a 14 m long non-rigid airship and has a ballonet for pressure control inside the hull, tail planes with control surfaces, and a main gondola with two ducted propellers mounted on both sides, each driven by a two-stroke cycle gasoline engine, capable of tilting up and down via lateral axes to help altitude control. Flight control and guidance system is basically similar to that of the SPF-2 low altitude stationary flight test vehicle for the stratospheric platform airship project in Japan and the test bed can fly autonomously. (Fig.4)

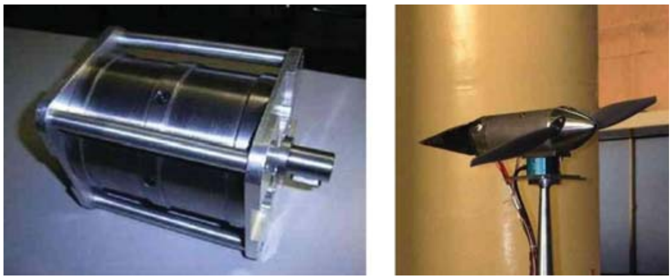
Since it is critical for operational system to be easy to operate, the prototype L-T-A is expected to be smaller than the flying test bed for easier ground handling. Automatic inflation capability will be incorporated for quick and easy deployment. L-T-A is more favorable for safe operation above populated areas because rapid crash is less likely thanks to its buoyancy. With its unique features, safe, long endurance and low noise, the use of LTA system is expected to expand to other missions such as environment observation and coastline monitoring.

Fig.4 - L-T-A UAS testbed

Technology For Future Innovative Aircraft

The basic research on future aircraft is conducted in UIAT focusing on environmental suitability and advanced convenience with safety. The «Fossil fuel free technology» corresponds to the environmental suitability, and electrical propulsion system including high power electric motor and battery system is being studied. We are going to fly «electric Ultra Light Plane» in 2 or 3 years.

Fig.5 - High power electric propulsion system



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