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Small fixed wing UAV for natural disaster survey: Its needs and challenges

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Recently multicopters are used for disaster survey, environment and agriculture survey, civil and construction engineering survey and new reports and will become more popular in coming few years. They could, however, always have a chance to crash by an improper mission plan or judgment of situation, GPS signal loss, battery or equipment failure and other causes. According to our experiences, it is difficult to reduce the chance less than once a hundred flights at least for new users. If the number of uses increases, many of the equipment will crash, some of them hit humans, vehicles and houses, and some of them cause severe injury and damages. The chance of such accident may be small at rural areas, but should not be neglected in urban areas. One of the purposes of our usage of UAV is for disaster risk assessment, monitoring and response, and the target areas are inhabited. It is therefore at the first priority to reduce the chance of accident.

Possible safety counter measures are, more strict regulations of the usage, improvement of flight controller and safety gears by manufacturers, proper operation of the equipment by the users. Another way we propose in this paper is use of fixed wing drones instead of multicopters. Fixed wing drones here are electric-motor planes made of Styrofoam with one to two meters wingspan. We purchased and are testing several types of foam planes with APM flight controller including 3DR Aero. We also used eBee of sensFly in outside Japan. Fixed wing planes can also crash as similar to multicopters by equipment failure and human erros. They, however, are made of soft material, heavy parts such as battery and camera can be within the fuselage, motors and props are facing rear side, thus they will not cause heavy damages to someone or objects when they hit. This simple safety mechanism is the biggest advantage of fixed wing drones. Fixed wing planes can also fly faster and float in the air by wing with less energy, they can fly longer time and go longer distances with the same size of batteries as compared with multicopters. This is the biggest merit in case the danger caused by crash is not significant such as flights in mountain areas.

Fixed wing drones, on the other hand, also have demerits. The biggest difficulty is landing. Take off is not difficult by hand launching and no wide space is not necessary. Switching to autopilot immediately after the take-off makes the following flight with no difficulty. A pin-point landing by a slow speed is not easy either by manual or by autopilot and a wide area is needed. Manual cruise is also more difficult than multicopters which can hover without any stick control. This is a fate of fixed wing planes which always have to move forward not to stall and crash. The auto-landing function of fixed wing drones is, however, improving. The limitation of the choice of landing point is reduces by using large net to catch the aircraft. Manual controllability is also improved by the flight controllers, such as straight and constant altitude cruise or circling around a point in the sky even without touching the controller. The difficulties of fixed wing planes are going to be reduced. The advantages of the safety and the ability of 10km over flight outweigh the weaknesses. The safety is of paramount importance in flights above urban areas. As long as a multicopter which never crashes or never injures people on the ground even when it crashes is not available, we must use a foam plane.

Keywords: natural disaster, UAV, fixed wing, safety