HTT30-01 Room:101A Time:May 25 16:30-16:45

Performance evaluation of UAV to use for disaster prevention

SAITOU, Osamu[1*]

[1]Center for Disaster Prevention and Security, IBARAKI University

Especially in the past several years, other disasters caused by extreme weather because of our changing climate, such as heavy typhoons, rain cataracts, flurries, and tornadoes, also cause widespread destruction. When these disasters or earthquakes occur, rapid situational assessment is crucially important, but it is difficult because transportation systems including roads and railways often shut down under those circumstances. Therefore, a monitoring system that provides information immediately when a disaster occurs is required. When a disaster occurs, monitoring from an airplane or satellite is effective but such systems are not easy to use. This study examines the performance of disaster monitoring systems using ready-made uncrewed aerial vehicles (UAV).

Keywords: UAV, sensor network, disaster prevention

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HTT30-02 Room:101A Time:May 25 16:45-17:00

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

INOUE, Hiroshi[1*] ; FUKUI, Hiromichi[2] ; SUGITA, Satoru[2]

[1]National Research Institute for Earth Science and Disaster Prevention, [2]IDEAS, Chubu University

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

HTT30-03 Room:101A Time:May 25 17:00-17:15

Position measurement of ground control points and its accuracy with UAV photogrammetry

TOBITA, Mikio[1*] ; NAKANO, Takayuki[1] ; KAMIYA, Izumi[1] ; OTOI, Kousei[1] ; IWAHASHI, Junko[1] ; NAKAJIMA, Hidetoshi[1]

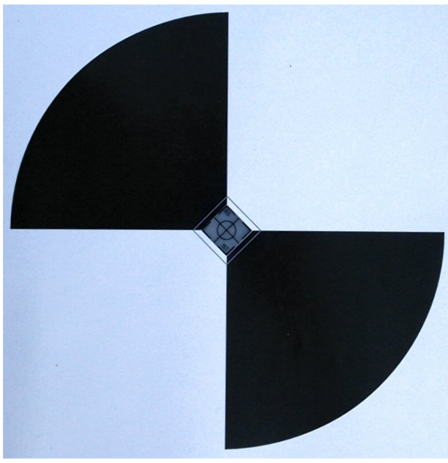
[1]GSI of Japan

It is sometimes possible to measure surface position in the spatial density of a few cm by SfM (Structure from Motion) - MVS (Multi-view Stereo) techniques using photographs taken by UAV (Unmanned Aerial Vehicle) at low altitude. The higher the accuracy is, the more diverse the field will be in the fields of geoscience, geospace, and disaster prevention.

The accuracy of the estimated positions highly depends on the camera, camera model, quality of photos, flight altitude, overlap, position accuracy of the drone, analysis software, and conditions of the analysis.

We installed ground markers in the site of Geospatial Information Authority, Tsukuba and took nadir and oblique images with a multicopter. Comparisons of estimated positions varying some of the parameters will be reported.

Keywords: UAV, Ground Control Point, SfM, MVS, Drone



Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HTT30-04 Room:101A Time:May 25 17:15-17:30

Monitoring the sediment movement in deep-seated landslides in Nara Prefecture utilizing UAV

SAKAGAMI, Masayuki[1*] ; KANAI, Hiromichi[1] ; SHIMIZU, Mikiteru[1] ; HORI, Daiichiro[1]

[1]Kokusai Kogyo Co., Ltd.

By the great floods in Kii Peninsula in September, 2011 large-scale of slope failure occurred frequently in the wide area of the southern part of Nara Prefecture, and gave serious damage to many houses as well as human lives. In the area of deep-seated landslides in 2011, the heavy rain subsequent to the typhoons caused a secondary sediment movement. It is, therefore, very important to perform continuous monitoring in this area. In this presentation, we examined the possibility of monitoring sediment transport using UAV. Among 60 locations of large-scale collapse by the great floods in Kii Peninsula, 11 places were selected and survey using UAV was conducted in order to investigate sediment transportation around the landslide.

The field survey was carried out on the 11th and 12th of November, 2014. Flight speed was set between 20 and 45km/h. The longest flight with automatic navigation was about 14km (one way 7km). The flight of UAV with rotary wings in steep terrain may be the first trial in the world. We have investigated both of the photographs taken by the UAV and the ones by airplanes or helicopters in the previous research, and detected the change of terrain and vegetation. We also calculated with deference analysis the amount of the sediment movement on the slope where measurement data of laser survey were obtained immediately after the landslide. As the result we could detect the change of the followings,

-Topographic change of terrain such as erosion of cliff, flow channel of small rivers, development of gully.

-Change of vegetation such as outflow of fallen trees and elimination of woods.

-Amount of sediment erosion at the lower part of the landslide within one or two year.

Keywords: UAV, Monitoring, Measurement, Deep landslinde, Sediment disaster

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HTT30-05 Room:101A Time:May 25 17:30-17:45

Rice growth condition estimation using small UAV

TANAKA, Kei[1*] ; KONDOH, Akihiko[2]

[1]Japan Map Center, [2]Center for Environmental Remote Sensing, Chiba University

The advances of GPS, gyro and acceleration sensor has made possible low-cost and miniaturization. Thereby, multi-copter mounted with these sensors have appeared. That it requires a high level of technology and knowledge in the handling of RC traditional helicopter, beginner to steer is difficult.However, it has become possible to get easily geospatial information of high-resolution for beginners.

In this study, we examined method of rice growth monitoring by using small UAV.

Keywords: small UAV, NDVI, orthophoto, DSM, rice growth monitoring

HTT30-06 Room:101A Time:May 25 17:45-18:00

Rice growth monitoring by radio control electric-powered Multicopter

HAMA, Akira[1*] ; HAYAZAKI, Yuka[3] ; TANAKA, Kei[2] ; KONDOH, Akihiko[3]

[1]Chiba Univ. Graduate school of Sience, [2]Japan Map Center, [3]Chiva Univ. CEReS

1. Introduction

Currently,radio control electric-powered Multicopter became miniaturization and cost reduction also the attitude control technology improves. And it became to do the proximity remote sensing at a low cost by mounting a camera or sensor as UAV (Unmanned Aerial Vehicle).

Crop production management is one of the important issues of remote sensing,the number of case studies have been accumulated.In particular,in the paddy rice is Japan's key crops,such as yield and harvest optimum time forecasting and eating quality decision is challenged, observation and prediction that target a vast field that utilizes the aircraft and satellite remote sensing has been carried out.

In this study,by using the UAV for growth monitoring of rice,it was attempted a detailed growth situation monitoring based on the image of high time-spatial resolution.In addition,we used SfM (Structure from Motion) technic to the analysis of a plurality of images taken,which can create ortho mosaic image,DSM,were utilized for growth monitoring of rice. Observation by the UAV,less limitations by clouds,such as a satellite,in addition UAV is possible to observe at any time. So if the observation costs are inexpensive and the data is the high accuracy,the advantage of using UAV is increase especially the wet area like Japan.

2. Methods

In rice Proving Ground in Chiba Prefectural Agriculture and Forestry Research Center, we observed in June 2014 from May to September.In this field is subdivided two of paddy in 48 compartments, seeding, transplanting time in each compartment,varieties and changing the amount of fertilizer,can be grown in different conditions.

To observation,electric-powered Multicopter and digital camera were subjected to aerial using.

Creation of ortho photographs and paddy fields of DSM(Digital Surface Model)was created using the SfM software PhotoScan.DSM in order to change due to the growth of rice,is subtracted the initial ground surface altitude (ground surface before planting) from DSM of each shot time,determine the average plant length of rice in each compartment.

3. Results,Discussion

1) NDVI

NDVI of rice for each partition in common,rises from transplanting time,it was lowered toward maturity around heading to the peak.

Transplant period 4 phase(4/10,4/23,5/14,6/3),appear peak earlier about what time that was transplanted early,began then descent. Due to differences in the varieties, the difference of the growth process also observed,NDVI of the same period of the previous heading slow-growth Koshihikari became lowest. In addition, even those of the same day of transplantation-breed,a higher fertilization amount became high NDVI.

Differences in growth conditions in field by growth conditions were observed in detail. (Using the NDVI)

2) DSM (the Plant length)

Results of the comparison the plant length measured from the DSM and actual measured plant length previous heading,we could observe in the error number cm level. Plant length is one of the important indicator rice to growth conditions and we could observe it from the Aerial photos.

The cause of the error, as well as DSM accuracy problems,strictly to seeking high state fallen state and wind hanging the DSM is measured "plant height". On the other hand, Actual measured values is measured by stretched straight(plant length).

3) Growth estimation using NDVI (plant length, LAI)

Based on the correlation between the measured data and NDVI of rice, I was led to the regression model for plant length ? LAI estimation in before heading using the NDVI. Each of RMSE of these models, 0.047m (plant height) 0.478m2 / m2(LAI), estimation accuracy is high, the possibility that can be applied to the growth state measurement of critical time to adjust, such as top-dressing amount has been suggested.

Keywords: UAV, SfM, NDVI, DSM, Plant length

HTT30-06 Room:101A Time:May 25 17:45-18:00