Route planning and communication of drone fleet for microscale weather observation ×

*Yuichi Yaguchi[1], Shuzo Nakano[3], Akira Sasaki[6], Masayuki Itaha[4], Tatsuya Iyobe[5], Kazuhiko Yamagishi[2]

1. The University of Aizu, 2. e-Robotics Fukushima Co., Ltd., 3. East-Japan Accounting Center Co., Ltd., 4. Japan Environment Research Co., Ltd., 5. Iyobe Shoji Ltd., 6. GClue Inc.

This research considers the operation and communication of the drone in the case of actually carrying out microscale fixed point observation using the drone fleet. In the case of using multiple drones at the same time, some applications were proposed in the field of entertainment and already commercialized such as the Intel 500. In these entertainment drone fleet has 1% to 5% of the drone will not crash, take off or may be unintentionally briefly beneath. In order to avoid unforeseen circumstances caused by these, in addition to miniaturization, such as 500 g or less in these drone, countermeasures such as attaching a frame are carried out. However, when the plane flying at a height of 1000 m to 2000 m where clouds can be formed, it is not necessary to use a large drone with a wind resistance of about 20 m / s, and in the assumed coastal area measurement, the sea will be directly below. In these situations, we need to design a system that guarantees the drones' completeness, but can return safely if there is a deficiency.

When sending 27 drones to a fixed point of 3 x 3 x 3, even if there are problems to crash and drop in the middle of the process, the flight path management should be excluding the two-dimensional intersection. We consider these kind of path planning which the drones are safe to flight all process from the taking off to landing. The requirement of the takeoff sequence, the drones should be enough to tight to set small area, but it should not affect propeller wind such as from 3 to 4 m lattice form. Also, we should divide the flight group because to make safety. A drone group should away from the Knight-jump and take off for each group. From there we moved to a pool that opened horizontally in a row and we aimed at the destination from there so that we avoided two dimensional intersections at long drone flight.

In addition, for the long range telemetry system of drones, we constructed a 920 MHz power saving small radio using the LoRa modulation scheme, define the data payload, aggregate each data once per second While allowing commands such as feedback from the ground station to be entered. This telemetry system can obtain the information such as the latitude, longitude, and altitude of the current position of the drone from the GPS of the drone body, the data payload includes data on wind direction, wind power, temperature, pressure and humidity acquired from the weather observation device, and any additional sensor with reservation data section corresponding to 20 bits is provided.

In this fiscal year's verification, at the Fukushima Robot Test Field, we verified whether 3 x 3 x 3 row flight is possible at intervals of 40 m, 70 m, 100 m at 30 m intervals, up to an altitude of 100 m. As a result, while occasionally there was a drone descending due to the turbulence of the airflow, we were able to hover at a fixed point while maintaining a sufficiently safe airspace. With respect to communication, if the distance is about 150 m straight, the collision due to the carrier sense in only 1 channel in a one second period when spreading at a spreading factor of 7 and frequency band of 500 kHz and performing communication for 28 units is 10% or less is there. When it is replaced with a distance of about 3 km in a straight line, communication with radio wave intensity of 20 mW is possible for each single unit, but since the communication speed problem arises, it is necessary to try with the radio wave intensity of 250 mW in the next fiscal year.

Keywords: Drone fleet, Wireless Communication, Observation System