Geophysical Surveys by a Small Unmanned Aerial Vehicle, Ant-Plane

M. Funaki
National Institute of Polar Research, 10-3 Midori-cho Tachikawa, Tokyo 190-8518

We have developed the technology of small drones (unmanned aerial vehicles (UAV)) and onboard instruments focussed on the geophysical research under the Ant-Plane project. UAVs are expected in respect of not only safety flight in the risky area, but also economical efficiency with flights. They are more advantageous than the manned aircraft from the viewpoint of environmental pollution. The UAV of Ant-Plane4 consists of 2.6 m span and 2.0 m length with 2-cycles and 2-cylinder 85cc gasoline engine, GPS navigation system by microcomputer and radio telemeter system. The total weight is 25kg including 12.4 litter fuels and the coursing speed is 130 km/h. We succeeded long distant flight to 1108 km and high altitude flight to 5700 m by Ant-Plene4-1.

Aeromagnetic survey was performed in the area 10x10 km in West Australian by Ant-Plane4-1. The magnetic data were obtained from 41 courses (250m in interval) of EW direction. The altitude of the flight was 500m from the ground. The magnetometer system consists of a 3-component magneto-resistant magnetometer (MR) sensor (Honeywell HMR2300), GPS and data logger. The sensitivity of the magnetometer is 7 nT and we use a total magnetic field intensity for magnetic analysis due to unknown direction of heading of the plane. After 4 hours 14 minutes from the takeoff, the 500km flight was accomplished and the magnetic data were stored in the data logger. The straight flight course was almost consistent with the way point course, but the course was drastically disturbed when the plane was turning. The noise level of magnetic field was increased to 30nT, when the plane was flight in the tail wind. However, it is much higher when the plane flied in the head wind. The anomaly pattern obtained Ant-Plane 4 was consistent with the anomaly pattern published by Geoscience Australia. Consequently we conclude that the magnetic survey by Ant-Plane is possible in the calm wind.

The party of the 49th Japanese Antarctic Research Expedition took Ant-Plane 4-3 and 4-4 to Syowa Station (Japanese Antarctic Station) for the metrological and aeromagnetic surveys. Ant-Plane4-4 took off up to 150 m in altitude by manual control, and then it flew by autonomous control system. However, the plane suddenly fell dawn and was crashed due to the engine stop on the way to the survey area. The party succeeded in the autonomous flight by Ant-Plane 4-3 on Dec. 18, 2008. The flight was planned with onboard meteorological devices in the area of 1.5x1.5 km at altitudes of 200, 400, 600, 800 and 1000 m. The plane faithfully followed the planned course and measured the temperature and humidity. As the course was fairly disturbed in the descending process from 800 to 600 m, the plane was landed by the manual control. The total flight time is 1 hour and the distance was 110 km in this flight. This success is the first UAV flight in Antarctica, and means applying of the various airborne geophysical surveys by Ant-Plane.

We did a flight to measure the meteorological data using Ant-Plane4-1, and the temperature, humidity and number and size of aerosol from the ground to 4000 m were obtained. A high-definition video camera was installed in Ant-Plane5-1 (3.6 m span and 2.4 m length with 2-cycles 47cc gasoline engine), and the lake ice condition was observed. These results by Ant-Plane will be introduced.