Airborne mapping with an Unmannend Aerial Vehicle

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Key words: survey, UAV, Unmanned Aerial Vehicle, photogrammetry

SUMMARY

The increasing demand of orthophotographs and Digital Terrain Models (DTM) gives rise to airborne mapping using an Unmanned Aerial Vehicle (UAV). Depending on the size of the terrain, an unmanned helicopter (for a relatively small terrain) or an unmanned airplane (for bigger areas) can be used.

After the preparation of a flight plan, the vehicle, provided with an accelerometer, flies over the terrain to make a sufficient amount of high-resolution pictures. Specialised software is then used to create a photo-mosaic of all the obtained pictures. To calibrate this photo-mosaic, ground control points are measured by surveyors. This can occur before the flight, using marks that will be photographed during the flight, or after the flight, and focussing on clearly recognisable elements on the pictures.

The overlap of the pictures ensures the ability to extract height information using parallax differences. A height model or DTM with the necessary grid density can hence be generated. Furthermore, lens distortions and parallax shifts can be eliminated by projecting the photo block. This creates an orthopicture suitable for measuring and digitalisation, as underlay for a drawing or measurement or it can be draped over the DTM.

Airborne mapping is the solution for inaccessible terrains such as swamps, areas which are home to dangerous animals or large areas in general. In those cases, airborne mapping is often the cheapest and even the only way to map it. It is furthermore the most recent situation, compared to older satellite data and with a higher pixel resolution. It holds promising potential for engineering companies, contractors, and dredging companies.

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1. INTRODUCTION

Airborne mapping is an solution to create maps that exist for many decades. Since the World Wars, first pigeons and later airplanes were used to make photos from above battlefields. Later on, the technique to create maps accurate and quick, where used for general military use: topographical maps. Now, aerial photos are used to make several kind of maps for instance GISmaps and the information must be accurate and up to date.

2. DATA ACQUISITION

2.1 Unmanned Aerial Vehicle

2.1.1 <u>Microdrone mds4-1000</u>

In this case, the Microdrone mds4-1000 is used. It’s a helicopter with four propellers which contribute to a very stable aerial vehicle. The drone is fully load with sensors such as accelerometer, gryroscopes, magnetometer, barometer, thermometer an humidity sensor. These sensors both with a GPS-unit are combined into a Inertial Navigation System so the microdrone can flight, take-off and land autonomous. Also some security features are built-in to prevent crashes or loss of the vehicle. The drone will return automatically when the radiosignal between basestation and drone will be lost or when the batterypower drops down. The flight time is approximately 20 minutes depending of several factors such as loadweight, temperature, wind.

Figur 1: Microdrone mds-1000

The drone is very useful to make aerialphotos at any time when the weather is optimal. It can also be used above rough terrain or terrain that is difficult to reach such as swamps. Pictures taken with the drone are always up to date compared to satellite-images.

2.1.2 Flightplan

Before take-off, a flight plan is made by defining the area that must be overflown on a map, based on Google Earth. The microdronesoftware automatically generated the flightplan based on several parameters, such as altitude, overlap, camerasettings,… . The groundresolution of the taken photos is determined by the used camera underneath the drone and the flightheight above the surface. For instance: a camera of 14 megapixels on a flightheight of 50 meter results in a groundresolution of approximately 1cm by 1 cm.

Figur 2: Microdrone Software

2.2 Ground Control Points – GCP

To calibrate the photo-mosaic is it important to measure some ground control points. It could be marks that will be placed on the surface before the flight or it could be clearly recognizable points on the picture. This marks/points must be measured very accurate and exact by a surveyor. The measurement could be done by GPS with some RTKcorrections to georefer the photos or it could be measured in a local coordinatesystem, just to generate some good photo-mosaic.

3. DATA PROCESSING

First of all, the lens distortions of the camera will be correct by specific software. In special photogrammetric software, the ground control points will be pointed on each photo. Based on the known coordinates of these GCPs and the overlap of the photos ensure the ability to extract height information using parallax differences. A heightmodel or Digital Terrain Model (DTM) with the necessary grid density can be generated. Furthermore, orthophotos can be created and draped over the DTM. Also 3D-visualisations can be made for an realistic view of the surface.

4. CONCLUSION

Airborne mapping with unmanned aerial vehicle is the solution for inaccessible terrains such as swamps, areas which are home to dangerous animals or large areas in general. In those cases, airborne mapping is often the cheapest an even the only way to map it. It is furthermore the most recent situation, compared to older satellite data and with a higher pixel resolution. Data acquisition and data processing is very similar as the classic photogrammetry, with the only difference that the photos could be taken easily, cheap and up to date.

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