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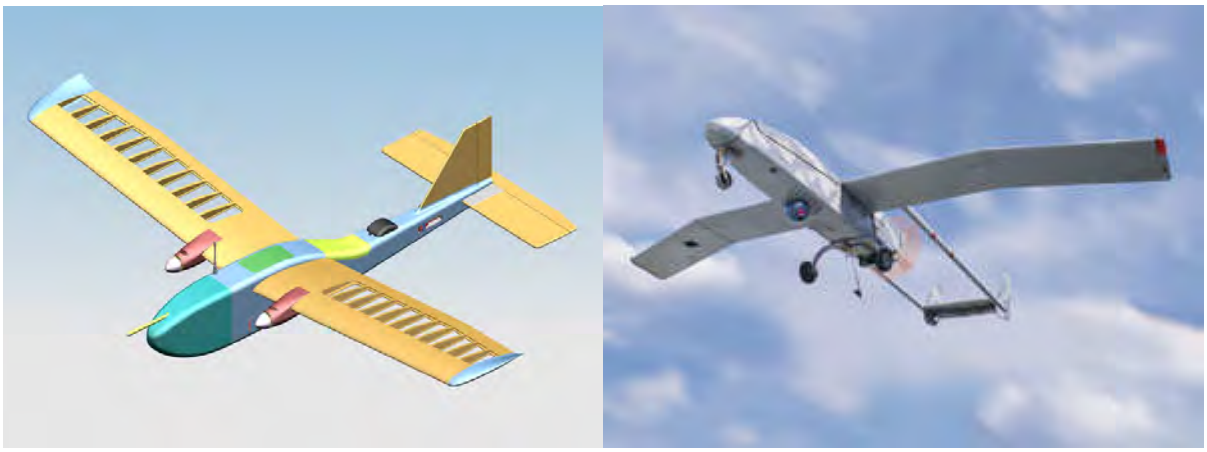
LOW-ALTITUDE IMAGES APPLICATION FROM CREWLESS AIR VEHICLES FOR QUICK GEOINFORMATION UPDATING

Development of air-technology, data communications and remote sensing involves the interest in applications of small Crewless Air Vehicles (CAV) in different subjects of economy. Hence the idea of the application of low-altitude images (taken from heights below 200 m) from crewless air vehicles for quick geoinformation update of local (small) areas by photogrammetric methods.

Project and research.

Photogrammetric low-altitude flights realized by small Crewless Air Vehicles - CAV (like small airplane tested in our Photogrammetry and Remote Sensing Institute, at the Agricultural University – Pic.2.) are an interesting alternative for traditional collecting of geoinformation data, particularly in local, small areas (1).

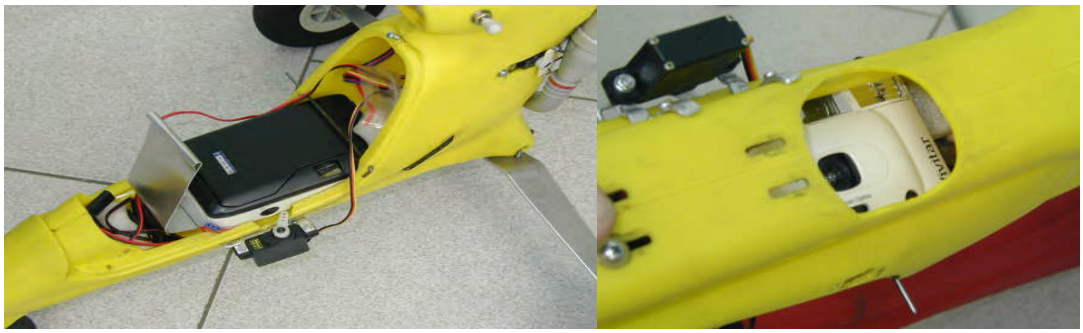
We are searching for various CAV for photogrammetry application (Pic.1.) .



Pic.1. Various CAV seeking for photogrammetry: left- polish CAV, made by Air Force Institute of Technology " Hob-bit" (span:1.7 m), double electric motors 2x350 W; right- american SHADOW 600 with camera, span: 5.8 m.

Polish professional CAV, made by Air Force Institute of Technology ” Hob-bit” , span:1.7 m is one of possible choice for described method .

Therefore our project suggests the application of small CAV (Pic.2.) to replace traditional collecting of geoinformation data in local areas (Pic.3.), particularly in case of dynamic changes of terrain objects, when quick geoinformation update is needed.



Pic.2. Small, radio-controlled, amateur aircraft with Vivitar SP-1500 - focus fixed analog camera, f =25mm, realized photos over tested area (next photo) - own research.

In this areas enhanced resolution of digital orthophoto is required therefore we suggest low-height flights (50 – 200 m) of local significance, realized images in 1:500 to 1:5000 scale for supplementing information .

Pic. 3.Exemplary 4 aerial pairs of photos from low-altitude flight approx.50m (own research).

Comparative researching - photogrammetric elaboration of stereo-photopairs with direct measurement (2) on tested area of Agricultural University - indicates several centimeters differences (X; Y; H) in objects location .

Pic.4. One from 50 stereopairs of low-height photos realized on tested area of Agricultural University, Balicka-street in Cracow – elaborated by VSD.

Exemplary fragment of calculation and elaboration of stereopair (Pic.4.):

********** Absolute orientation (by Video Stereo Digitizer calculation) **********
Number of points: 4
Scale : 2.3958
Model pole: -5.2223 2.5486 0.0627
Terrain pole: 96.9650 124.3275 217.1725
Left photo central point of projection : 98.7297 137.9713 220.2720
Right photo central point of projection: 123.4327 143.6702 227.8349

Turn matrix :
0.5680517588 0.7520805082 -0.3342036932
0.7966010735 -0.6044726554 -0.0062879648
0.2067460496 0.2626551313 0.9424798953 -1.00000
1
Pnt_mod -8.455 4.505 0.129
Pnt_mod' -8.494 4.540 0.158
Err_mod -0.0387 0.0349 0.0285
Pnt_ter 96.010 115.130 217.090
Pnt_ter' 96.020 115.084 216.973
Err_ter 0.0103 -0.0462 -0.1174
2
Pnt_mod -3.154 2.078 0.023
Pnt_mod' -3.122 2.017 -0.093
Err_mod 0.0316 -0.0615 -0.0166
Pnt_ter 99.020 129.010 217.300
Pnt_ter' 98.987 129.054 217.281
Err_ter -0.0331 0.0439 -0.0187
3
Pnt_mod -3.652 0.630 0.021
Pnt_mod' -3.655 0.716 0.040
Err_mod -0.0031 0.0860 0.0186
Pnt_ter 95.670 129.970 217.020
Pnt_ter' 95.684 129.923 217.066
Err_ter 0.0139 -0.0472 0.0458
4
Pnt_mod -5.608 2.960 0.067
Pnt_mod' -5.598 2.901 0.037
Err_mod 0.0102 -0.0594 -0.0303
Pnt_ter 97.110 123.100 217.150
Pnt_ter' 97.127 123.158 217.245
Err_ter 0.0172 0.0582 0.0946

Mean errors of coordinates: x, y, z : 0.0269 0.0344 0.0607

Coordinates of control points from VSD:

Nr	X	Y	H
19	100,603	109,824	217,258
21	98,957	117,557	217,143
23	100,449	126,398	217,412
29	94,253	142,029	217,521

Coordinates of control points from direct measure:

Nr	X	Y	H
19	100,64	109,88	217,37
21	99,02	117,51	217,22
23	100,39	126,41	217,32
29	94,22	142,09	217,45

Nr	Coord.-direct measure			Coord.-photogrammetric measure			Differences		
Nr	X	Y	H	X	Y	H	ΔX	ΔY	ΔH

19	100,64	109,88	217,37	100,60	109,82	217,26	0,04	0,06	-0,11
21	99,02	117,51	217,22	98,96	117,56	217,14	0,06	-0,05	0,08
23	100,39	126,41	217,32	100,45	126,40	217,41	-0,06	0,01	-0,09
29	94,22	142,09	217,45	94,25	142,03	217,52	-0,03	0,06	-0,07

Mean coordinates differences:
$\Delta Xm = \Sigma \Delta X / n = 0{,}002m$
$\Delta Ym = \Sigma \Delta Y / n = 0{,}020m$
$\Delta Hm = \Sigma \Delta H / n = -0{,}048m$

Affirmative result of this test confirms utility of showed method for quick collecting and updating of geoinformation data on local, small areas – like supplement of some others photogrammetric and direct methods.

This project is developing for now and for the future.

The author's suggestion is digital camera application. For more precision – before every photo-flight session – quick calibration of camera is recommended (photos of calibration image – for example like Topcon PI-3000 software) but not always needed (low altitude).

Visual control of flight (like the one tested by the author) is often insufficient, hence the idea of images parameters controlling in real time by TV or cellular 3-G UMTS system parallel to images collecting by main (basic) camera.

Additionally GPS (for centre of projection registration) and flight control system (realized pre-programmed flight path with centre of projection points of images) with 3-axial giro-sensors for flight stabilization - improving technological process of photogrammetric elaborating.

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THE DIGITAL ORTHOPHOTOMAP AS MATERIAL FOR EVALUATION OF CHANGES IN CULTURAL SCENERY

Application possibility of orthophotomap for evaluation of changes in cultural scenery was explored on an example village, Kasinka Mała .

INTRODUCTION

The scenery in the present interpretation applies to spatial and the material dimension of earthly reality and means a complex system composed of the following forms: relief ,vegetation and waters (Zonneveld 1990).