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SELECTION OF DIGITAL CAMERAS FOR PERFORMING AERIAL PHOTOGRAPHS USING UNMANNED AIRCRAFT

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ABSTRACT
The article describes the choice of unmanned aerial vehicles and digital cameras, one of the most widely used technologies in cartography. Since cartography is one specific area, there are clear objectives based on technical and regulatory documents. Aerial photography is one of the most effective methods for creating topographic maps, and it is worth discussing the features of calculating UAV image parameters. A method for determining the quality of cameras used for aerial photography from UAVs is described, and recommendations for the quality of aerial photography products are developed.

KEYWORDS: unmanned aerial vehicles; aerial photography; aerial photograph; camera; cartography.

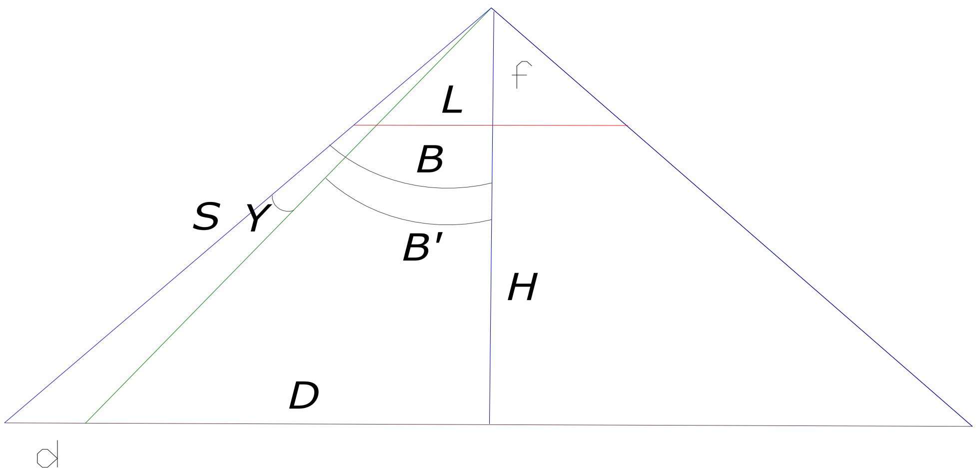
INTRODUCTION
Unmanned flying devices are widely used in the field of cartography, that is, the work of astrophotos. Accurate based parameters lead to an increase in the quality of the image, the correct flight area to compensate for astrophotos once in flight.

PURPOSE OF THE STUDY
In the first place, we consider it permissible to pass Cartographic Information with special emphasis on the cameras in the sheep due to the need of a camera for a complete and accurate picture. As an example, the world-famous cameras can be mentioned Nikon D800, Sony RX1, Phase One IXU 150 manufacturers of these cameras have a special emphasis on image quality and the geometrical characteristics of the picture by producing photo camera in the professional aero camera approach using[1].

Table 1The main technical indicators of digital cameras

Name of cameras	Matrix length, pks.	Matrix width, pks.	Matrix length, mm.	Matrix width, mm.	1 pixel, mm	Focusing distance, mm	Lens light power	Weight, g.
Nikon P7000	3648	2736	8.0	6.0	0.0022	28(экв)	2.8	360
Samsung EXI	3648	2736	8.0	6.0	0.0022	24(экв)	1.8	356
Panasonic DMC-LX5	3648	2736	8.4	6.3	0.0023	24(экв)	2.0	231
Sony NEXS	4592	3056	23.4	15.6	0.0051	16	2.8	297
Canon Power Shoot S95	3648	2736	8.0	6.0	0.0022	28(экв)	2.0	170
Samsung NX100	4592	3056	23.4	15.6	0.0051	20	2.8	282

Research methods. The data on the above flight parameters were calculated as a result of the expert elements of foreign specialists [1]. The linkage of the place where the edge pixel size of the picture is drawn is shown in Figure 1.



1-picture. The link between the place and the pixel size in the photo.

f - 35 mm. the focal length of the camera in the frame equivalent; L is the half length of the matrix diagonal, 35 mm. Its value in the frame is 21.6 mm. constitutes; H - flight altitude during aerial photography; D is the half-length of the image diagonal in place; d is the marginal pixel size of the image;

The criterion of the permissible quality of the image is calculated in pixels at the outermost point of the frame centre, based on Figure 1, we express the maximum height of the image as follows:

$$S = \frac{d \cdot \cos(\gamma - \beta)}{\sin\gamma} \qquad (1)$$

$$H_{max} = S \cdot \cos\beta \qquad (2)$$

where the bangle depends on the individual performance of the camera and the focal length is 35 mm. can be calculated from the equivalent value equal to.H〗 _max is the maximum allowable height of the aerial photography

We can calculate the distance between the routes and apply the following formula to have a 30% cross-section

$$\beta'' = \operatorname{arcctg}\left[\frac{f}{L_{кўндаланг}}\right], \qquad (3)$$

where L_transverse - half the value of the frame width,

The flight altitude is determined using the following formula, taking into account the barometer error;

$$H_{учиш} = H_{max} - 20\text{ м.} \qquad (4)$$

The half-width of the camera is calculated by the following formula:

$$D = H_{учиш} \cdot tg\beta'' \qquad (5)$$

Ideally, the distance between routes can be expressed as follows:

$$B_{y\prime} = 2 \cdot P_y \cdot D \qquad (6)$$

where P_y = 0.7, in the transverse coverage of 30% of the images value

The minimum half-width of the camera's coverage is calculated by adding the errors of the navigation data and the flight device during the minimum aerial survey:

$$D_{min} = \left(H_{учиш} - 15\text{м}\right) \cdot tg(\beta - 5'') - 10\text{ м.} \ (7)$$

The deviation limit between the two routes is equal to;

$$\delta D = 2 \cdot (D - D_{min}) \qquad (8)$$

The distance between the routes is calculated by the following formula, taking into account the transverse displacement of the unmanned aerial vehicle relative to the route axis, the flight altitude and the angle of inclination of the camera:

$$B_y = B_{y'} - \delta D. \quad (9)$$

The distance between the shooting centres on the route is calculated similarly to the calculation of the distance between the routes:

$$B_x = B_{x'} - \delta D. \quad (10)$$

The number of images required to cover one square kilometre of land with photographs idetermined by the formula (11):

$$N_{сур} = \frac{1000000 \text{ м.кв}}{B_y \cdot B_x} \quad (11)$$

When creating a photoplan at a scale of 1: 2000, the performance of digital cameras per square kilometre and the centre of the image on the aerial photography route, the distance between the routes are calculated by formulas (1) - (11) for selected cameras (Table 2) [1,2]

Table 2 Results of calculation of parameters of aerial photography when performed with unmanned aerial vehicles to create a photo plan at a scale of 1: 2000

Camera name	Shooting working height, m	Distance between routes, m	Distances of the centre of the images between the routes, m	1 sq. km. the number of images in the field
Nikon P7000	285	84	78	152
Samsung EXI	221	76	68	194
Panasonic DMC-LX5	221	76	68	194
Sony NEXS	282	102	92	107
Canon PowerShoot S95	285	84	78	152
Samsung NX100	402	112	108	83

ANALYSIS OF THE OBTAINED RESULTS

Based on the above results, we recommend using Sony NEXS, Canon PowerShot S95, Samsung NX100 digital cameras when it is considered optimal to perform aerial photography [2].

By choosing the right physical and optical properties of the camera, we can achieve an increase in the quality of the photographed material.

Since the unmanned aerial vehicle is not stable, we assume that the maximum angular rotation speed of the device is 1 rad / s, and the shooting height is about 200 m.

$$t_ф = \frac{\delta_w}{wH_ф} = \frac{0{,}05 \text{ м}}{\frac{1рад}{с} х \ 200м} = \frac{1}{4000} \text{ с}.$$

As can be seen from the results obtained, it is necessary to pay attention to the fact that the angular wiper is several times higher than the linear wiper, due to its dependence on the height of this filming [3,4].

CONCLUSION

With the help of drone-pilot devices, we would have recommended that the designers who install the camera and equipment should have been put in place to improve the quality of the image:

• Use of calibrated cameras.
• Take photos at speeds not exceeding 1/250S.
* Focus apply a clearly defined lens.
• Increase the percentage of cross-and longitudinal coatings cover %
(80% - longitudinal, 60 % - transverse).
• Central zoom camera application.
• Using a different method of installation and measurement of two frequency GPS receivers on the device Board.
• Apply IMU-system.[3,4,5]

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