RESEARCH TESTS

Long-range Hybrid Drone "CICADA" with using atom magnetometer for identification Unexploded Ordnance (UXO).

LLC “Ukrainian Multirotor Technologies”

the city of Kamianets-Podilskyi
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1.OBJECT OF RESEARCH TESTS

The object of the research tests is the unmanned aerial vehicle “Tsikada” (hereinafter - UAV) of the development of LLC "Ukrainian Multirotor Technologies" (Fig. 1.1).

According to the operational documentation, the UAS designed to perform long-range multi-purpose aerial surveillance application based unmanned aerial vehicle (UAV), which allows exploration in the interests of small units on large and endurance terrains.

Figure 1.1 - General view of UAV "Cicada" with an atomic magnetometer. This basic kit for aeromagnetic application.

The unmanned aerial system is serviced and used by a unit of two operators, who divide the tasks assigned to them.

According to DSTU B 7371: 2013 “Military aviation technology. Unmanned aerial vehicles. Basic terms, definitions and classification ”Cicada UAV is classified as follows:
● by purpose - multi-purpose;
● on the scale of tasks - battlefields;
● at the place of landing - ground landing place;
● on the principle of creation of lift - aerodynamic, multirotor;
● in the normal aerodynamic scheme - hexacopter multirotor;
● by number of applications - multiple;
● the number of engines - multi-engine;
● by type of engines in the power plant - electric aviation engine powered by an onboard gasoline generator (ICE carburetor, two-stroke, single-cylinder);
● by way of take-off - vertically;
● by landing method - vertically;
● by type of flight control system - combined;
● on maneuverability - maneuverable;
● by type of target equipment - intelligence (television, infrared); search and sighting (television, infrared); airborne relay facilities

The composition of UAS "Cicada" was submitted for control tests:

1. Unmanned aerial vehicle (Fig.1.2) .................................................. 2 pcs
1.1 UAV transport box ............................................................... 2 pcs
1.2 Ground Control Station....................................................... 1 pcs
1.3 Starter in case................................................................. 1 pcs
1.4 Folding table................................................................. 1 pcs

On the basis of a separate assignment of the acting Head of the Main Directorate of Operational Support of the Armed Forces of Ukraine dated July 11, 2019 No. 342/5777, the research tests of the UAV "Cicada" with an atomic magnetometer were conducted to search for explosive objects.

Five test flights were completed during the flight test, 1 hour 32 minute flight time. The flight part of the research tests is fully implemented.

Table 1.1 - UAS's raid during test flights

<table>
<thead>
<tr>
<th>№ task</th>
<th>Time in the air</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>8 min</td>
</tr>
<tr>
<td>2</td>
<td>19 min</td>
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<tr>
<td>3</td>
<td>24 min</td>
</tr>
<tr>
<td>4</td>
<td>21 min</td>
</tr>
<tr>
<td>5</td>
<td>17 min</td>
</tr>
<tr>
<td></td>
<td>Total flying time</td>
</tr>
</tbody>
</table>
2. PURPOSE OF RESEARCH TESTS

2.1 Possibility of detecting explosive objects using a UAV with an atomic magnetometer.

3. RESULTS OF RESEARCH TESTS

Meteorological conditions +25 degrees Celsius, Southwestern wind, atmospheric pressure 742 mm Hg, wind speed 2 m / s, humidity 55%.

For research tests was presented UAV "Cicada" with magnetometric equipment "MagPike". Fig. 3.1.

Fig. 3.1 - Cicada UAV with MagPike magnetometer device

Four anti-tank (Fig.3.2) and 2 anti-personnel landmines were laid in the first training ground.
During the research, 3 magnetic field anomalies were found, corresponding to the location of anti-tank mines. Since 2 mines were located near (1.5 meters) - images of their anomalies merged into one (Fig. 3.3) «Старт», «Кінець» - the place where magnetometric search begins and ends.
The second training place stated:

1. Mortar mine of 120 mm caliber (Fig.3.4)
2. Armor-piercing high-explosive tank shot -125mm (Fig.3.5)
3. Mont-90 antipersonnel mine (Fig.3.6)
4. 76 mm anti-tank artillery shot (Fig.3.7)
5. OZM-72 antipersonnel mine (Fig.3.8)
6. Mine-100 antipersonnel mine (Fig.3.9)
7. TM-62-P3 anti-tank plastic mine (Fig.3.10)
8. Mortar mine - 82 mm (Fig.3.11)
9. Mine-50 antipersonnel mine (Fig.3.12)
Fig. 3.5 Armored and high-explosive tank shot of 125 mm caliber

Fig. 3.6 Anti-personnel mine Mont-90

Fig. 3.7 Anti-tank artillery shot 76 mm
Fig. 3.8 OZM-72 antipersonnel mine

Fig. 3.9 Mine-100 antipersonnel mine

Fig. 3.10 TM-62-P3 anti-tank plastic mine
To accomplish the tasks of searching for explosive objects in the second training place, a UAV "Cycada" route with an atomic magnetometer was drawn up (Fig.3.13). UAV flight to search for explosive objects was performed in automatic flight mode at the height of the magnetometer 2-4 meters (depending on the terrain).
Fig. 3.13 Scheme of the flight route of the UAV "Cicada" in search of explosive objects

The input of the studies revealed a cluster of magnetic anomalies (Fig. 3.14).

Fig. 3.14 Schematic diagram of the location of magnetic anomalies obtained with the Cicada UAV with an atomic magnetometer
As a result of data processing, 9 separate magnetic anomalies were detected, (Fig.3.15) some of which correspond to the placement of mines laid on the second training field.

Fig. 3.15 Schematic diagram of the location of magnetic anomalies obtained with a magnetometer

4. CONCLUSIONS

4.1. As a result of the research tests, the possibility of using the Cicada UAV with an atomic magnetometer for carrying out technical examination of the presence of explosive objects in suspiciously dangerous areas was confirmed during humanitarian demining, which corresponds to item 5.1 of DSTU (IMAS) 08.20.

4.2 The use of Cicada UAV with an atomic magnetometer for technical inspection for the detection of artillery shells, anti-tank and mortar mines - it is advisable to use on areas of land where vegetation does not exceed 2-3 meters because at higher altitudes the sensitivity of detection is less sensitive. - decreases.

4.3 Consider using Cicada UAVs in conjunction with high-resolution thermal imaging sensors and camcorders, or other accessories that will extend Cicada UAV capabilities to perform technical survey areas of past combat operations or other engineering tasks.