UDC 623.77

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Predicting a Russia's military satellites passage over Ukrainian territory in order to take measures to cover up significant information

Using open sources and satellite simulator software a method of prediction of the passage of Russia's military satellites has been proposed. This method must be useful for future planning of moving logistic and military equipment and reduce its losses.

Role of satellites in war on Ukrainian territory.

As a matter of routine, satellites are obviously irreplaceable. Without the Internet we won't have the ability to keep in touch with relatives and friends from other cities or even countries. Without a weather forecast we won't know whether it will be raining or not. But the one thing that everyone should know is that there won't be such a progress in routine life, if there isn't any progress in the military sphere.

Unfortunately, we can see it with our eyes, because there's no secret that among all the satellites - the military ones are used for destroying our military equipment, which can take a decisive role on the battlefield. The latest launch of the "BARS-M" announcement [1] has made editorial office "ФОКУС", and on the 3rd of May journalists of Daily Mail wrote that a top-secret radar satellite, called Kosmos-2555, had been sent into orbit to be used during the Russian invasion of Ukraine. That's why to reduce the losses from our side, a method of prediction of the passage of Russia's satellites over Ukrainian territory was proposed.

Proposed method

The idea of a method for prediction and forming a schedule of enemy satellites passage consists of several main steps. They are following: finding names and international designators of military space vehicles directly or potentially assigned as spy satellites. After that search in catalogues of space objects orbital parameters of these satellites and based on that data calculating their ground track for estimating time intervals of passing over Ukrainian territory.

First of all, using open sources, a list of Russia's reconnaissance satellites [2] was found. Among given satellites were found following kinds of satellites:

Optical imaging surveillance, for Earth imaging satellites:

- "Araks"
- "Bars-M"
- "Zenit"
- "Kondor"
- "Kosmos-2175", "Kosmos-2480", "Kosmos-2486" and "Kosmos-2506"
- "Orlets-1"
- "Persona"
- "Resurs-DK No.1"
- "Yantar" series

Missile early warning, for providing warning of an attack by detecting ballistic missile launches:

- "Oko"and "Oko-1"
- "Tundra"
- "Liana"
- "Kosmos-2422", "Kosmos-2552"

Electronic reconnaissance:

- "Kosmos-1805", "Kosmos-2428", "Kosmos-2455", "Kosmos-2549"
- "Lotos-C"

For the further investigations optical imaging surveillance satellite, called Kosmos-2486, and electronic reconnaissance satellite, called Kosmos-2549, were chosen in order to investigate the time and day where it is desirable to refrain from moving significant equipment. According to the information [3] Kosmos-2486 was launched on the 7th of June in 2013 and is running so far. The satellite was used for optical reconnaissance during the military conflicts in Ukraine and Syria, that's why it must be dangerous and useful to investigate. The Kosmos-2549 [4] satellite was launched on the 2nd of February in 2021 for passive electronic intelligence. To simulate the track of these satellites the WXTrack Satellite Tracking software [5] was used. The WXTrack Satellite Tracking is a tool that enables to keep track and predict the paths of the satellites and even provide images produced by them when scanning the ground. Using CelesTrack [6] site needed data with .tle extension were used.

Projecting satellites

For the experiment, as the days of investigation were taken the days of conference organisation (28-30th of September).

Table 1.

Results of covering Ukraine's territory by Kosmos-2486

Date	Time of beginning taking information	Time of ending giving information	Maximum elevation
28th of September	02:34 UTC 05:49 UTC 07:28 UTC 16:07 UTC	02:45 UTC 06:04 UTC 07:37 UTC 16:23 UTC	4.6° 27.7° 4° 16.3°
29th of September	03:19 UTC 04:56 UTC 16:53 UTC	03:33 UTC 05:12 UTC 17:09 UTC	15.5° 74.6° 45.9°
30th of September	04:03 UTC 05:41 UTC 15:15 UTC	04:19 UTC 05:56 UTC 15:31 UTC	37.3° 31.7° 61.5°

As the results from the Table 1 shows, the time when Kosmos-2486 covers all the Ukraine's territory is approximately 15:00 UTC - 17:00 UTC and from 2:00 UTC till 17:00 UTC is the time when the satellite covers the Ukraine partially. The interesting fact is that after 16:00 UTC it doesn't cover the territory. So, in case only for Kosmos-2486, safe moving of significant equipment is after 17:00 UTC.

Table 2.

Results of covering Ukraine's territory by Kosmos-2549

Date	Time of beginning taking information	Time of ending giving information	Maximum elevation
28th of September	00:45 UTC 13:13 UTC 23:07 UTC	01:02 UTC 13:23 UTC 23:16 UTC	22.1° 3.6° 1.6°
29th of September	00:47 UTC 13:17 UTC 23:10 UTC	01:05 UTC 13:26 UTC 23:22 UTC	29.1° 0.7° 4.6°
30th of September	00:51 UTC 11:37 UTC 23:13 UTC	01:10 UTC 11:50 UTC 23:26 UTC	38.1° 20.2° 8°

According to Table 2, the investigation shows that the safe time is approximately from 14:00 UTC till 23:00 UTC, and only on the 30th of September the time where the satellite doesn't cover Ukraine is from 12:00 UTC to 23:00 UTC.

Conclusion

Unfortunately, we live in difficult times. But thanks to the Armed Forces of Ukraine, we are still Ukrainians, and our main aim, as Ukrainians, is to make our contribution, to help the situation become better. Such method may not make an essential changes on the battlefield, but still can reduce the losses and help save much more equipment, which may play a significant role in our freedom fight.

References

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