

THE IMPORTANCE OF A NAVIGATION SYSTEM FOR UAV

Hashimov E.G., Muradov S.A.
National Defense University, Baku, Azerbaijan

The flight of UAVs from one point to another is ensured with the help of its navigation systems, which is the most important stage for all types of missions. Despite its complexity, air navigation systems have been developed and brought to an autonomous mode today. With the help of both external navigation tools and onboard systems, it allows us to control any UAV with high accuracy at a distance of hundreds of kilometers.

When the pilot-operator prepares the UAV for flight, they first check that the elements of their navigation system are working and constantly monitor them through the monitor before and during the flight.

Navigation systems must be stable and accurate for all phases of flight. At the same time, they should also allow obtaining the distance to the destination and the exact coordinates of the current targets. As a result of research, the use of UAVs with stable navigation systems is more effective in recent wars. It also allows commanders to make the right decisions and keep the battlefield under stable surveillance, leading to the immediate destruction of important enemy targets. If UAVs transmit completely wrong coordinates during REW application, it leads to loss of control and flying in different directions, and as a result of wrong planning, numerous personnel losses or defeat. Therefore, it is very important to carry out combat missions with UAVs that have stable navigation systems in all phases of war [1].

The control of UAVs is based on the complex navigation systems found in other aircraft. Navigation systems allow UAVs to take off and land, fly parallel to the ground, turn, move to designated points, and more. The most dangerous stage for a UAV pilot is take-off and landing, and for the commander in charge of the battle, the most important thing is obtaining reliable real-time intelligence information, accurate coordinates of targets, and aerial observation of the battle. Both of these depend on the stability and accuracy of the navigation systems.

The global navigation satellite system consists of a system of satellites that continuously transmit space and time information from space to receivers. Based on that information, the UAV can determine its location, height, speed, time, etc. The receiver antenna must receive signals from at least 4 satellites. The receiver antenna is mounted on top of the UAV, continuously providing satellite data to the avionics, autopilot, or navigation systems. It is also used to find the UAV, return to the runway when contact is lost, automatically fly to any point, and determine precise coordinates to avoid collision with high terrain.

GPS receivers receive signals from satellites and use a three-dimensional mathematical principle to determine the location of the UAV. The signal from the satellite sends the satellite location and transmission time to the receiver. Since the signal is equal to the speed of light, the distance, time and location from the UAV to the satellite are instantly calculated [2]. GPS systems allow UAVs to be

deployed day and night, in various weather conditions, indoors and anywhere in the world except for REW systems.

There are certain delays when the signals transmitted by the global navigation satellite system are received by the receiver antennas. These delays lead to an error of more than 1-5 meters in determining the coordinates. These measurements, which create certain limitations for the reconnaissance and strike capabilities of UAVs, do not satisfy users, as more accuracy is required. RTK (Real-Time Kinematic) devices are used in UAVs to make more accurate measurements based on satellite signals. RTK is a high-precision device used to determine the location of the UAV using signals received from international satellite systems such as GPS, GLONASS, Galileo and BeiDou. With the help of RTK devices, signals help to make real-time measurements with an accuracy of less than 2 cm horizontally and 4 cm vertically [3]. RTK units perform aerial reconnaissance on UAVs, enabling more accurate coordinates determination and striking.

The GPS system provides UAVs with several advantages: determining the exact coordinates of the UAV or the target; automatically navigating from one point to another, returning to the runway on a predetermined route when the communication link is lost; tracking of stationary as well as moving objects; creation of accurate maps of the territory; accurate time measurements [4].

Therefore, to enable UAVs to successfully perform reconnaissance tasks in all conditions, it is essential to obtain stable navigation systems that ensure uninterrupted UAV flight and enable accurate identification, regardless of satellite signals, in closed areas or during REW application.

Currently, the most significant research effort is focused on affecting and disabling the navigation systems of UAVs, which can prevent their flights. Therefore, new research is being conducted to detect, identify, and neutralize UAVs. Anti-jamming systems for GPS signals are being developed, and false spatial deviation is being applied to overcome these challenges. Considering these methods, new stable navigation systems should be created for UAVs to enable them to perform reconnaissance tasks successfully in REW conditions and without satellite signals.

References

1. Libya's deadly game of drones: [Electronic resource]. URL: <https://www.timesaerospace.aero/features/defence/libyas-deadly-game-of-drones>.
2. Kevin J. Walchko, "Low cost Inertial Navigation: Learning to Integrate Noise and Find Your Way" A Thesis Presented to The Graduate School of The University Of Florida in Partial Fulfillment of The Requirements For The Degree of Master of Science (2002): [Electronic resource]. URL: https://www.researchgate.net/publication/229061435_Low_cost_inertial_navigation_learning_to_integrate_noise_and_find_your_way
3. George T. Schmidt. INS/GPS Technology Trend // Advances in Navigation Düyğacs and Integration Technology, Published February 2004.
4. Geotab team, what is GPS?: [Electronic resource]. - 22.05.2020, URL: <https://www.geotab.com/blog/what-is-gps/>