GEOLOCATION AND GEODETIC MEASUREMENT TECHNOLOGIES FOR MILITARY NEEDS

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In executing tasks assigned to various branches of the military, precise geolocation information is necessary. Currently, the Armed Forces of Ukraine utilize various software and hardware tools designed for the automatic display of user (target) location on an electronic map or providing their coordinates. Among such software-hardware tools are the "Kropyva" software, GIS situational awareness program "Delta," "Virazh-Tablet" software, "TOPO" software, hardware tool SN3003M "Basalt," and others. The operation of these tools is based on the use of GPS systems.

Typically, the accuracy of modern GPS receivers in the horizontal plane is 5-10 meters, and in the vertical plane - 10-20 meters. However, under certain conditions, the computed position may temporarily differ significantly. GPS receiver manufacturers define position error as follows: no worse than 5 meters 50% of observation time and no worse than 8 meters 90% of the time, with a velocity determination error not exceeding 0.06 m/s. The declared accuracy in most cases meets the needs of the Armed Forces. However, there are situations where higher accuracy is required. To enhance coordinate determination accuracy, the existing network of permanent GPS stations (GNSS stations) in Ukraine can be utilized. The Ukrainian GNSS station network, comprising around 140 stations, was created to improve the accuracy of geodetic measurements in the country and tie Ukraine's coordinate system to the International Terrestrial Reference Frame.

Dual-frequency geodetic-class receivers are installed on permanent base GNSS/GNSS stations, which form a network. In the event of a state of war, the Armed Forces have unrestricted access to commercial networks. Additionally, in December 2022, by Presidential Decree No. 884/2022, restrictions on the operation of ground-based GNSS correction stations were introduced.

A permanent satellite base station can provide accurate coordinates for geodetic measurements, topographic surveys, setting out points in the field by known coordinates, and so on. Currently, real-time kinematic (RTK) mode is available in base station networks. The RTK base station network consists of several permanently operating GPS/GNSS receivers that combine satellite data and generate RTK corrections for moving receivers. The distance between stations should not exceed 70 km. Such networks minimize coordinate determination errors when moving within the network.

Research on various software complexes and data processing technologies for static and kinematic positioning based on satellite observations showed that the accuracy of static station positioning depends on inter-base distances up to 100 km. For kinematic positioning in the network zone with inter-base distances up to 150 km and from the nearest base station - 50–90 km, coordinate determination errors were approximately 1-3 cm in the plan and 3-5 cm in height. Beyond the coverage zone, the positioning errors were approximately 4-6 cm and 8-10 cm, respectively.