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EXPERIENCE IN USING AIS EQUIPMENT ON-BOARD A CUBESAT SPACECRAFT

Abstract

The plan for the development of the infrastructure of the Northern Sea Route until 2035 includes tasks focused on ensuring the navigation safety and developing a system for space monitoring of ships in non-radar areas, particularly using an automatic identification system (AIS).

In June 2023, two spacecraft (CubeSat 6U type) equipped with AIS test receivers of our design were launched into orbit. Currently, we received over 280,000 AIS messages from the "Hors" 1 (NoradID 57188) and "Hors" 2 (NoradID 57196) satellites, with an average of 2,600 messages per day from both spacecraft. These messages include details about the vessel's location, speed, and course. The satellite data was cross-checked with AIS data from the "Victoria NEXT" system (FSUE "Morsviazsputnik") and MarineTraffic ship tracking sources.

The AIS system was developed using a previously designed circuit board based on a radio modem utilized in the CubeSats "Yarilo" 3 and "Yarilo" 4. The successful experience of this radio modem in operating these satellites allowed us to confidently employ it to create a reliable radio receiver. The equipment passed all required climatic and vibration tests successfully. To enhance radio packet reception efficiency, we took several measures to improve the electromagnetic compatibility of the developed product with other spacecraft systems. Also, during work, we tested our software and hardware complex for receiving ship signals using a specialized simulation stand based on the ship's AIS system transmitter. We developed special software for processing, analyzing, and visualizing the received data.

During the flight tests, we analyzed the distribution of received messages number concerning the distance between the ship and the spacecraft, as well as the number of messages relative to the Doppler shift. We detected some anomalies: the number of messages received by "Hors" 1 were 2 times less than by "Hors" 2; "Hors" 1 spacecraft primarily receives messages in channel A, while "Hors" 2 receives messages mainly in channel B. Currently, an AIS software has been prepared for experiments measuring the electromagnetic noise level and adjusting receiver parameters. According to the anomalies, studies are ongoing regarding the impact of the AIS receiver's central frequency on the number of received messages.

Currently, AIS equipment on the "Hors" 1 and "Hors" 2 satellites remain active, collecting data continuously.