Technological verification of the satellite module for precise determination of the position of satellites in orbit

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Keywords: global navigation satellite systems; precise point positioning (PPP), low earth orbits (LEO); artificial neural network (ANN)

Abstract. Today, nanosatellite constellations are increasingly used in various missions. Given the complexity of these missions, more precise positioning and maneuvering is required for all constellation components. Recently positioning solutions are based on Global Navigation Satellite Systems (GNSS), such as the Global Positioning System (GPS), the European GALILEO system, which have complied the stringent requirements of satellite constellations.

This paper proposes the development of a low-cost, COTS, point-precise positioning (PPP), multi-constellation, multi-frequency GNSS satellite receiver module for technology verification, enabling positioning accuracy of the order of cm on low earth orbits (LEO). In addition, this satellite module will integrate orbit determination algorithms and positioning modes, which would provide low power consumption, an accurate orbit propagator and an embedded artificial neural network (ANN).

The objectives of the current proposal are to verify the technology demonstration mission, which is of great interest both regionally and internationally: to assess the feasibility of using a GNSS COTS receiver payload module for accurate positioning determination of satellites in LEO orbit. It will be verified that these features increase positioning accuracy when PPP corrections are not available or when lower power consumption is required.

The novelty of this mission also consists in the development of the ANN architecture, which is designed to better exploit information from both an orbit propagator (OP) and GNSS measurements. GNSS measurements alone are typically not accurate enough to allow complex orbital maneuvers such as inspection and formation controlled flight, providing only approximations of the satellite's true position and velocity. The OP's idea is to estimate the position and velocity of the Earth-orbiting satellite at any time in LEO orbits.

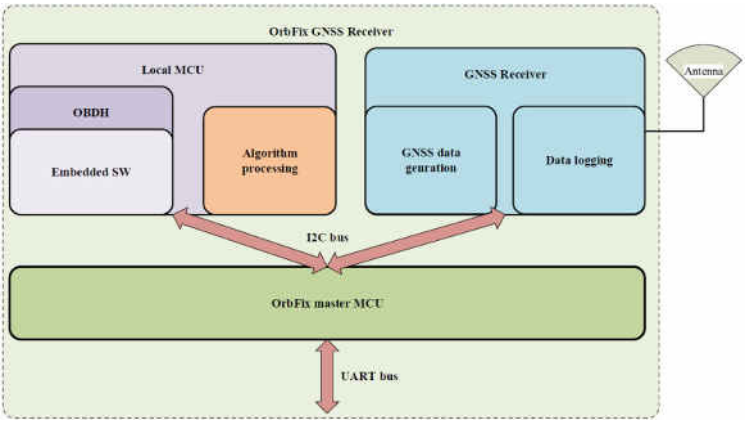

Figure 1. GNSS payload diagram.

Acknowledgment. This paper is funded by the Moldavian Ministry of Education and Research project ”Satellite systems and platform for monitoring plantations and aquatic surfaces using space and drone technologies”, code 020401.

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