A Technique for the Current Control of Availability of Navigation Definitions of GPS/GLONASS Users Based on Data of the Wide Area Differential System

V. V. Demyanov

Irkutsk Military Aviation Engineering Institute, Irkutsk, Russia

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Abstract—A technique for the on-line monitoring of the availability of navigation support of objects has been considered using the wide area differential subsystem of GPS/GLONASS satellite radio navigation systems. This technique is based on estimating the total probability of solving the problem of navigation determinations with the specified level of accuracy and continuity. The technique developed can be used for enhancing the efficiency of algorithms of monitoring the integrity of satellite radio navigation systems and their differential supplements under conditions of exposure to sudden unfavorable geophysical factors.

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INTRODUCTION

Since the equipment of satellite radio navigation systems (SRNS) has an extraordinary wide field of applications, the strict requirements are imposed on the accuracy and continuity of navigation and timing determinations (NTD) of users. The enhanced accuracy of coordinate determinations is achieved by using the wide area differential subsystems (WDSS). In combination with built-in integrity control algorithms (receiver autonomous integrity monitoring (RAIM)) the efficient monitoring of the current status of the system is performed with the help of WDSS and in the majority of cases it ensures a timely warning of the user about dangerous reduction of the accuracy of navigation determinations or unavailability of the navigation service at the required level [1, 2].

However, the problem of constructing an efficient technique for monitoring and prediction of the availability of navigation determinations under conditions of exposure to sudden geophysical factors still needs its final solution. The specified factors include geomagnetic perturbations of the medium in the near-Earth space (NES) and short-term bursts of high-power solar radio noise. Hence, as noted in paper [2], geomagnetic perturbations often cause the tracking loss of signals of GPS navigation satellites (NS) at the second frequency. This leads to the prohibition of using a two-frequency technique for measuring the ionospheric errors of range measurements at the WAAS reference stations of WDSS. This results in unavailability of the high-accuracy service of providing the user with the system of compensating corrections. As was shown in paper [3], during the high-power solar radio bursts on the 6th and 13th of December 2006 numerous short-term malfunctions in measuring the radio navigation parameters occurred in GPS and GPS/GLONASS receivers at numerous stations of the IGS global network.

The technique of ongoing monitoring of the availability of navigation determinations for WDSS users of SRNS under conditions of exposure to such factors would have been a valuable supplement to the existing system of integrity control. The ongoing monitoring of the NTD availability under conditions of exposure to random unfavorable factors should be based on a quantitative indicator making it possible to provide an adequate estimate of the availability of navigation determinations at the stage of solving the problem with due regard for the specified requirements to the accuracy and continuity. In this connection the purpose of the present paper includes the development of quantitative indicator and technique for the ongoing monitoring of the availability of navigation determinations under conditions of exposure to sudden unfavorable geophysical factors.