**"Gyroskopiya i Navigatsiya" №4, 2009**

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| The subject of this paper is consideration of the analytical design problem for the systems of marine vehicles motion control. The complexity of this problem is de-termined by presence of an extensive population of certain dynamical conditions, requirements and restrictions that essentially hampers use of synthesis methods in framework of classical control theory. In this connection the mentioned problem can be decoupled into particular optimization problems on the base of a special multipurpose structure of control laws that is discussed in details. This structure in-cludes some varying elements which are switched on as required for the certain re-gime of motion to improve its dynamical performance indexes. Central attention is paid to the questions of dynamical correctors tuning to give desirable features for the vehicle motion under sea wave conditions. This problem is considered taking into account all the correspondent requirements and restrictions for the processes quality. A simple method of correctors synthesis is proposed with the assumption that sea waves have a regular nature. A numerical example is considered that illus-trates applicability and effectiveness of the proposed approach. |  |
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| A short review of the existing methods for the phase measurements ambiguity resolution is given. The general structure of the developed algorithms for solving relative navigation and attitude determination problems with the use of GNSS phase measurements is presented. Two GNSS receivers and a gyroscope with vertical sensitivity axis, rigidly fixed on the vehicle are supposed to be used in the attitude determination problem. For both problems the original techniques for searching integer number of phase measurement cycles are revealed. They make it possible to reduce computational costs for the ambiguity resolution in comparison with the existing methods. With the ambiguity resolution in the attitude determination problem the integer number of phase measurement cycles is matched with the known value of antenna base length. In this problem the gyroscope data are used taking uncertainty of pitch and roll angles into account. Efficiency of the developed algorithms was demonstrated basing on real single-frequency GNSS measurements and micromechanical gyroscope data on a car and onboard a ship. Reliability of the obtained solutions was approved including the ones for the relative navigation problem on the base of about 20 km and for the attitude determination problem in the conditions of frequent GNSS signal blackouts and poor geometry of the available satellites. |  |
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| Development of space-borne satellite navigation receivers is a complicated R&D task since Global Satellite Navigation Systems were not designed for the user equipment to be placed on board of satellites. This article provides the analysis results of the peculi-arities of space conditions and its influence on the design of the signal processing. The analysis was carried out for three mission types - geostationary GEO, low-earth orbiting (LEO) and high-elliptic orbits (HEO). Based on the analysis, the requirements for the signal processing in space-borne receivers are given. Furthermore, software architecture for space-borne GNSS receivers is suggested, and an original search algorithm is de-scribed. The search algorithm belongs to the truncated sequential search algorithms. Several methods of signal search organization are described, each of them satisfies one or more requirements. Approaches for tracking loops design are provided, recommenda-tions for low C/N0 and low throughput CPU are given. |  |
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| On-board station description and high positioning spread-spectrum medium-frequency band radio navigation system (RNS) for marine navigation experimental investigation results are given. The main features of RNS are the following. The first is leaving out of ionospheric reflection influence by application of spread-spectrum signals with minimum shift keying - providing signal range Dmax ≈ 600 *km.* round the clock. And the second - principal station (PS) time scale external synchronization providing by using global navigation satellites sys-tems (GNSS) GLONASS and GPS signals.Timing waveform of RNS is presented on fig. 1. RNS on-board station structure chart are shown on fig. 2. On-board station appearance is shown by fig. 3. Test op-eration was made in the region of Gulf of Finland. The datum points were based in settlements: PS1 - Lomonosov, PS2 - Viborg, PS3 - Luga (fig. 4). Pseudo range measurements results in time of anchorage (near the Gogland Island) by each of PS are given in fig. 5. On-board station coordinate measuring results are presented in fig. 6. Radio-navigation parameters measuring results in case of on-board station motion are given in fig. 7.Examined RNS provides accuracy of surface vessel coordinate measuring not bad then 15 m (root-mean-square error) in cases of geometric quotient less then 3 and signal range Dmax ≈ 600 *km.* |  |
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**International Public Association
The Academy of Navigation and Motion Control
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