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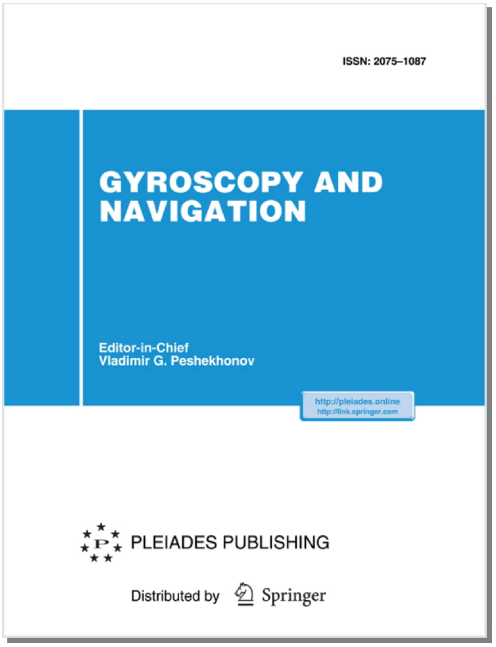

Dear readers!

We are glad to announce a new issue of the journal **Gyroscopy and Navigation, 2019,** with 16 research papers published.

The journal issue starts with the paper by researchers from S.P. Korolev Rocket and Space Public Corporation Energia [1] under leadership of the General Designer, academician of the Russian Academy of Sciences, E.A. Mikrin. The study makes an approach to the problem of circumlunar spacecraft navigation using the measurements from the global navigation satellite systems (GNSS) GLONASS, GPS, Galileo and BeiDou. Algorithms have been developed for determining the orbits of low- and high-orbit circumlunar spacecraft, based on the method of dynamic filtering of pseudo-range measurements from "reverse" navigation satellites. The solution to the navigation problem has been simulated by the measurements from four GNSS, and by those from the NS of GLONASS and GPS only. Accuracy and dynamic characteristics of the obtained solutions have been determined and compared to similar solutions for geostationary spacecraft.

In the paper "GLONASS-Aided High-Precision Navigation of Space Geodetic Systems" [2] the most relevant information on the system is presented straight from the source (one of the authors, S.N. Karutin, is the Chief Designer of GLONASS). The paper considers the methods of high-precision navigation of space geodetic systems. A technology of determining the orbit parameters by kinematic and dynamic methods using GLONASS signals is proposed. It is for the first time that experimental estimates of position errors have been obtained in a study case of Geo-IK-2 spacecraft, with the measurement residuals of the global quantum-optical network being at the level of 0.06 m.

The paper [3] by leading scientists of the Institute of Systems Optimization, Karlsruhe Institute of Technology, focuses on an autonomous unmanned aerial vehicle (UAV) approaching a target which is selected in a reference image. A robust matching algorithm is proposed to reliably project the selected point in the reference image into the live images of a quadrotor helicopter. The authors succeeded in achieving high detection rates even for image sequences with large viewpoint changes. Therefore, the presented algorithm can be used for UAV motion control.

One more paper is also presented by the German scientists – the authors from the Institute of Flight Guidance of Braunschweig Technical University [4]. The paper gives the brief review of positioning methods based on image analysis, used for aircraft landing. The authors describe a method of vision-aided integrity monitoring during final approach and landing, which assumes application of optical sensors as additional positioning aid. Investigations and developments in this field over the past few decades are discussed, as well as some ideas of applying positioning methods, based on image analysis, along with INS and GNSS.

The authors from the Bauman Moscow State Technical University [5] made a comparative analysis of the efficient application of extended Kalman filter (EKF) and sigma-point Kalman filter (SPKF) in the problem of SINS/GNSS integration on the basis of loosely-coupled integration scheme. Complete stochastic measurement models of MEMS inertial sensors are considered. The efficiency of the EKF and the SPKF is evaluated using real experimental data on complex motion from a MEMS-based SINS.

The paper "Micronavigation System to Support a Radar with Synthetic Aperture aboard a Small UAV"[6], written by Saint Petersburg specialists from the Special Technological Center, LLC, considers a problem of constructing an integrated SINS/GNSS navigation system for supporting a side-looking synthetic aperture radar, located aboard a small-sized unmanned aerial vehicle (UAV). Flight test results are presented, including the estimates of MEMS-based micronavigation system accuracy. The analysis is based on the radio signals reflected from corner reflectors, as well as radar images obtained by constructing a matched filter based on the micronavigation system data.

The paper [7], presented by the authors from the Center for Operation of Space Ground Based Infrastructure of the Research Institute of Applied Mechanics named after Acad. V.I. Kuznetsov (Moscow), gives the results of studying a fiber-optic gyroscope prototype with 0.01–0.001 deg/h precision class. To increase the accuracy of the prototype gyroscope up to the level of 0.001 deg/h, it is proposed to use the fourth and the fifth feedback loops which will suppress the parasitic effects in integrated optic phase modulators.

The paper [8] of the well-known scientists from three Russian institutions considers the possibility of the design and circuitry of a single-gyro sensor for measuring three angles of a moving object rotation. The physical basis of the proposed engineering solution consists in generation of rotational and single- or two-component translational motion of an electrostatically suspended rotor with the use of a torquer and a force transducer.

The authors from the research institutions of Hyderabad (India) have presented the paper [9], which considers the method of suppressing the effect of vibration component of a ring-laser gyro signal, using the techniques of multiresolution Wavelet Transform (WT). Five level multiresolution analysis is carried out with various types of wavelets like Discrete Meyer and Daubechies 45 (db45) etc. With none of the standard wavelets, the original and reconstructed signals are matched. The problem is proposed to be solved using a new synthesized wavelet. The required signal can be reconstructed back using the approximation coefficients at level 5. The dither signal is attenuated by 107.0 dB, and the phase characteristics are found to be linear in the pass band. The computational complexity is also less, compared to the three stage combined filter reported earlier.

The paper by N.N. Vasilyuk [10] addresses the practical implementation of a calibration algorithm for a magnetometer integrated in an electronic device, using synchronous measurements of a gyroscope. (Refer to the paper by the same author in the journal https://doi.org/10.1134/S2075108719020081). Recurrent expressions have been derived for accumulating the intermediate matrices, due to which there is no need for accumulating the full set of primary measurements of vector counters. An algorithm has been formulated for determining the time point when accumulation stops and calculation of calibrated parameters starts.

The scientists from the Concern CSRI Elektropribor, JSC, in their paper [11] discuss the method that was proposed earlier to provide nonperturbation of dead reckoning (DR) owing to a single-channel inertial vertical, constructed with the use of a triad of accelerometers and a single free gyroscope, as well as compensation for the effect of inertial accelerations directly in computed dead-reckoned coordinates using the data from an external speed meter (a log). The DR method errors specific to this scheme are analyzed, in particular, those conditioned by the fact that, in the general case, positions of the accelerometers and the log for marine underwater and surface vessels do not coincide either with each other or the center of the vessel motion. Analytical calculations and the simulation results are given to show that the level of DR method errors is insignificant for the class of the objects under consideration.

The authors from the Academician N.A. Semikhatov Scientific and Production Association of Automatics (Yekaterinburg) in their paper [12] describe the technique for calibration of sensors in a strapdown inertial measurement unit on a relatively coarse turntable. The proposed technique successively combines direct and indirect methods of calibration.

The paper [13], written by the international team of authors, presents the experimental results of using UWA modems for autonomous underwater vehicles (AUV) positioning, namely UWA modems equipped with chip-scale atomic clocks (CSAC), that allow estimation of delays (ranges) of UWA signals propagation to their georeferenced sources. The experimental results are presented for accuracy of chip-scale clocks operation in various situations which are of practical interest; as well as positioning accuracy of AUVs having UWA modems with integrated CSACs. Also given are practical recommendations on how to "discipline" (steer) CSACs and provide their phase synchronization with a source of timekeeping signals.

The team of authors from the Institute for Automation and Control Processes, Far Eastern Branch of the Russian Academy of Sciences (Vladivostok) in their paper proposes a new algorithm and a method of coordinate referencing of an unmanned autonomous underwater vehicle (AUV) to underwater objects using stereo images for automated inspection of bottom industrial infrastructure facilities [14]. Computational experiments have been carried out using a modeling simulator based on a hybrid multiprocessor computing architecture. The proposed solutions have been estimated in terms of efficiency.

In the paper [15] Professor O.A. Babich from the Moscow Institute of Electromechanics and Automatics proposes an algorithm for calculation of ECEF coordinates as a complementary part to the basic strapdown INS algorithm, which functions from aircraft takeoff to landing. The Earth-centered, Earth-fixed frame does not have any specific points in the near-Earth space; therefore, it can be used as the basic one for navigation in the Polar Regions. The aircraft control law that supports flights on the point-to-point principle is based on calculation of ECEF coordinates in the Polar Regions.

The team of authors from the Saint Petersburg State University of Aerospace Instrumentation presents their paper [16] which considers modification of a reaction wheel current control loop based on a fuzzy controller trained by a genetic algorithm. The control logic maintains the motor current which can be represented as a sum of two components, one of which is proportional to the input signal, and the other one corresponds to the error of control moment implementation. It is shown that the system with a fuzzy controller, which implements the variable gain on the error channel, eliminates the torque pulsation and reduces the time of transient processes while adjusting the control actions. The system operation has been simulated by means of MatLab Simulink software to confirm viability of the proposed control loop. The results of the work can be used in developing the advanced systems of spacecraft attitude control.

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