**"Gyroskopiya i Navigatsiya" №4, 2000**

**CONTENTS**

***Materials of the 22nd scientific and technical conference named after N.N.Ostryakov***

**Plenary papers**

|  |  |  |
| --- | --- | --- |
| **Yu.S.Aleksandrov, V.P.Arefiev, O.A.Artemiev, M.A.Vinogradov, V.A.Zelinsky, V.M.Kostyrev, S.G.Kucherkov, A.M.Smirnov, A.V.Sorokin** | **The precision complex of command devices of the inertial control system for "Briz-M" booster on the basis of gyro devices with the gas-static support** | **11** |
| The paper presents the results of development of the precision gyro device complex, designed to be used as part of control systems for carrier rockets and boosters, and also basic inertial measuring devices involved in this complex. These devices are a single-degree-of-freedom gyro unit and a gyroscopic integrator of linear accelerations with gas-static support. Essential advantages of the gas-static support usage when designing precision inertial devices as against the floated support are stated. The results of designed complex operation as part of the booster "Briz-M" are given in the paper. | |  |
| **A.A.Odintsov, Yu.E.Naumov, V.B.Vasilieva, A.M.Barabash** | **Results of development, manufacture and test of the inertial navigation system based on conrollable magnetic gyros** | **18** |
| The results of developing the semi-analytic-type marine inertial navigation system (INS) based on controllable magnetic gyros are cited in the paper. Also mooring and nautical test results are given. Basic trends of INS modernization are shown. | |  |
| **V.L.Budkin, G.I.Dzhandzhgava, P.V.Larin, Yu.A.Minaev, S.V.Prozorov, A.K.Salomatin, V.M.Soloviov, V.A.Kalnov, V.I.Kazakov** | **Development of configuration and manufacturing technique of acceleration microtransducer** | **30** |
| The paper presents the results of works carried out in Ramenskoye Planning and Design Bureau, Physical and Technological Institute of RAS, JSC “Micron” factory” on development of the monolithic silicon micromechanical acceleration sensor to be used in navigation and control systems. The route technology of manufacturing a microsensor is considered in the paper. The results of testing acceleration microsensor specimens at different stages of the technological process are cited. | |  |
| **L.P.Nesenyuk, L.P.Staroseltsev, G.A.Parr, V.I.Kokorin, Yu.L.Fateev, S.P.Barinov, S.M.Bublik, A.A.Shashkov** | Integrated inertial/satellite orientation and navigation system with space-apart receiving antennas | **41** |
| The paper deals with the results obtained in laboratory and ship trials of goniometric equipment for a user of satellite navigation systems GLONASS and GPS - MPK-11 - developed in SRI of Radio Engineering of Krasnoyarsk State Technical University with a view to determine prospects of using this equipment jointly with the miniature strapdown measuring module developed in CSRI "Elektropribor". A complexing filter is introduced on the basis of experimentally obtained error characteristics of satellite receiver and inertial measuring instrument. The results of integrated system error simulation using trial data are given in this paper. | |  |

**Abstracts**

**Session "Sensitive elements in navigation and control systems"**

|  |  |  |
| --- | --- | --- |
| **V.L.Budkin, G.M.Vinogradov, V.I.Lipatnikov, A.V.Alekhin, V.I.Povtoraiko** | **A hemispherical resonator gyro** | **49** |
| **V.I.Kremer, A.M.Osipov, E.F.Polikovsky** | **The way of compensation of laser gyro errors caused by influence of the vibrating frequency dither** | **-** |
| **A.V.Golikov, V.E.Dzhashitov** | **Temperature errors of fiber-optical gyros** | **-** |
| **V.L.Budkin, G.M.Vinogradov, A.A.Belkin, V.P.Larin, V.I.Lipatnikov, I.V.Nazarov** | **Balancing of a hemispherical resonator gyro** | **50** |
| **B.E.Landau, S.M.Dyugurov, V.I.Zavgorodny, S.L.Levin, S.G.Romanenko, V.N.Tsvetkov** | **An electrostatic gyro with the solid rotor for strapdown navigation and orientation systems** | **-** |
| **S.M.Dyugurov, B.E.Landau, V.P.Ugarov** | **Peculiarities of solving the problem of ambiguity in measurement of angular position of ESG rotor** | **51** |
| **A.V.Bufetov, Yu.A.Gollandtsev, I.E.Gutner, N.S.Shulaev** | **Microprocessor control of the electromechanical unit of a strapdown electrostatic gyro** | **-** |
| **V.V.Sumarokov** | **Provision of possibility for stabilization of ESG rotor spin frequency by its support** | **52** |
| **N.S.Ivanova** | **Investigation of influence of gimballess ESG electric drive parameters on free gyro characteristics** | **-** |
| **L.A.Chertkov** | **Development and examination of the method and the algorithm of the angle readout system correction in a gimballess ESG** | **53** |
| **L.P.Butsyk, D.A.Egorov, O.A.Zhernakov, V.V.Svyaty** | **Effect of electromagnetic parameters of a rotor's ferrite on magnetically suspended gyro characteristics** | **54** |
| **G.B.Volfson, M.I.Evstifeev, V.G.Rozentsvein** | **Orientation of the sensor of a hole gravity variometer** | **55** |
| **V.M.Amoskov, V.N.Vasiliev, N.T.Gorbachuk, M.V.Zhelamsky, A.B.Konstantinov, V.V.Kokotkov, V.P.Kukhtin, E.A.Lamzin, S.E.Sychevsky, O.G.Filatov, E.N.Efimov-Sosnovsky, E.Z.Glushkin, G.S.Rubin** | **A precise three-component magnetometer based on EMF-Hall generators for measuring weak magnetic fields** | **56** |
| **V.N.Narver, V.D.Prikhodko, V.I.Stotyka** | **A three-component fiber-optic angular sensor for a gradiometer** | **57** |
| **V.E.Dzhashitov, V.M.Pankratov** | **Parametric disturbance of natural oscillations of micromechanical gyros** | **-** |

**Session "Gyroscopic systems"**

|  |  |  |
| --- | --- | --- |
| **B.E.Landau, V.D.Aksenenko, S.S.Gurevich, V.I.Zavgorodny, S.L.Levin, V.N.Tsvetkov** | **An orbital spacecraft orientation system based on gimballess electrostatic gyros** | **58** |
| **V.Z.Gusinsky, V.M.Lesyuchevsky, A.A.Stolbov** | **Automated calibration of instrumental errors of a precision inertial navigation system based on electrostatic gyros** | **59** |
| **A.A.Galaktionov** | **Thermal problems of reducing readiness time of an inertial navigation system based on electrostatic gyros** | **60** |
| **B.A.Blazhnov, L.P.Nesenyuk, V.G.Peshekhonov, L.P.Staroseltsev** | **Miniature integrated orientation and navigation systems for hydrographic ships and inshore survey boats** | **-** |
| **V.I.Gupalov, A.V.Mochalov, A.M.Boronakhin** | **Minimized analytical gyro levels based on one gyro and two accelerometers** | **61** |
| **V.B.Nikishin, P.K.Plotnikov** | **Quaternion equations of functioning and errors of one of strapdown orientation and navigation systems' modifications** | **-** |
| **E.V.Freiman, S.V.Krivosheev, V.V.Losev** | **Peculiarities of developing algorithms for orientation of gyroscopic inclinometers based on one-axis gyrostabilizers** | **62** |
| **P.K.Plotnikov, V.V.Nikishin, A.V.Melnikov, A.A.Skripkin** | **Algorithms and mathematical simulation of a gimballess gyro inclinometer working on the basis of micromechanical gyroscopes and accelerometers** | **63** |
| **Yu.S.Aleksandrov, A.A.Golozin** | **Calibration and initial alignment of the gyro platform of the booster "Briz-M"** | **64** |
| **L.N.Belsky, L.V.Vodicheva** | **Accuracy improvement of gyrocompassing through selection of orientations of meters' sensitive axes** | **-** |
| **S.P.Redkin** | **Investigation of gyrocompassing errors using a gyroscopic angular velocity sensor** | **65** |
| **S.A.Chernikov** | **On stability of a triaxial gyrostabilizer with attendant non-linearities in unloading circuits** | **66** |
| **M.M.Belaid, S.V.Krivosheev** | **Towards the problem of stability and optimization of powered gyro stabilizers** | **67** |
| **B.V.Dudnitsyn, O.L.Mumin, L.P.Ryabova** | **Application of microacceleration measurement system SINUS for determination of speed projection increments onboard a spacecraft** | **-** |
| **A.I.Gordienko, A.P.Makorta, M.I.Maltinsky, N.A.Minaev, V.V.Svyaty** | **An energy complex for a navigational mark** | **68** |

**Session "Navigation and motion control"**

*Algorithms of navigation systems*

|  |  |  |
| --- | --- | --- |
| **A.V.Zamorsky** | **Autocompensation of gyro systems errors in random processes** | **68** |
| **S.P.Dmitriev, A.V.Osipov** | **Integrity monitoring of a satellite navigation system using the filtration approach** | **69** |
| **A.V.Chernodarov, V.V.Enyutin** | **Predictive control and diagnosis of integrated navigation systems** | **-** |
| **M.B.Rozengauz** | **Ranking of diagnosis object check-ups using fuzzy reasonings** | **70** |

*Navigation systems and control*

|  |  |  |
| --- | --- | --- |
| **V.A.Pogorelov, M.R.Ganeev** | **On navigation system control by information criteria** | **71** |
| **V.N.Ilyin, Yu.L.Smoller, S.Sh.Yurist** | **Results of development and testing of the mobile ground-based gravimeter** | **-** |
| **A.V.Nebylov** | **Analysis of motion control efficiency near disturbed surface** | **-** |
| **L.D.Zhuravlev, V.M.Zinenko, V.F.Savik, V.E.Yanushkevich** | **Feasible vibrational effects on the periscope's head with the gyrostabilized line of sight from a viewpoint of the watch facility** | **73** |
| **V.M.Zinenko, V.F.Savik, V.E.Yanushkevich** | **Progress trends of periscope equipment** | **-** |
| **V.S.Skoblo, D.A.Bogdanov** | **Relationship between spectral sensitivity of an operator's eye and received luminous flux of navigation references' radiation** | **74** |
| **A.V.Nebylov, V.K.Fedotchenko** | **An experimental precise radar altimeter for meter heights** | **-** |

*Inertial satellite systems*

|  |  |  |
| --- | --- | --- |
| **V.L.Budkin, A.S.Prozorov, A.A.Chernomorov, N.N.Chibisova** | **A strapdown navigation system with correction by air signal system and SNS** | **75** |
| **N.G.Vakhitov, G.V.Cheremisenov** | **Adjustment of orientation of SINS based on laser gyros and gyro drifts using data from a satellite and vehicle maneuvers** | **75** |
| **A.M.Boronakhin, S.A.Lisovoy, A.V.Mochalov** | **Experimental researches of an integrated system SINS/odometer/GPS in conditions of a railway track measurement car** | **-** |
| **B.A.Blazhnov, O.A.Stepanov, D.A.Koshaev** | **Investigation of efficiency in the usage of satellite measurements of coordinate and speed while measuring gravity in a moving vehicle** | **77** |
| **V.V.Seregin, V.I.Yushchenko** | **Generalized results of investigating the problem of object orientation determination using GPS and GLONASS technologies** | **-** |

**Session "Electronics and computer facilities of onboard systems"**

|  |  |  |
| --- | --- | --- |
| **E.A.Shleifshtein, V.V.Levashov** | **Ensuring the uninterrupted work of the electronic computer "Baget-21" in control loops of gyro devices at the unauthorized stop** | **78** |
| **Yu.M.Matrosov** | **Distributed computation systems of up-to-date navigational complexes** | **79** |
| **E.A.Shleifshtein, Z.I.Tsal, L.N.Bryshkina** | **An extrapolator based on the digital signal processor KM1867BM1 for the electronic computer "Baget-21"** | **-** |
| **S.T.Khvoshch** | **The software and hardware architecture of intelligent interfaces in automatic control systems** | **80** |
| **A.Yu.Zadorin, G.B.Zakharova** | **An automation system for visual inspection of photographic masks and printed circuit boards** | **81** |
| **N.A.Lukin** | **Functionally oriented processors for SINS algorithms processing** | **82** |
| **O.K.Epifanov, A.B.Oskin, I.A.Salova, V.V.Khrushchev** | **Development of small-sized brushless module-type torque motors for modern digital gearless servo systems of navigation devices** | **-** |
| **I.E.Gutner, V.O.Nikiforov, M.S.Chezhin, A.S.Shaposhnikov** | **A microprocessor drive with compensation of torque irregularity** | **83** |
| **V.A.Afanasiev, Yu.A.Gollandtsev, I.E.Gutner** | **Thyratron inductor-jet motor design technique** | **-** |
| **Yu.A.Gollandtsev, I.E.Gutner, A.A.Kalyagin** | **A thyratron inductor-jet motor control system** | **-** |

**Session "Metrology in navigation and motion control: quality analysis of models, algorithms and data processing programs"**

|  |  |  |
| --- | --- | --- |
| **V.A.Granovsky, T.N.Siraya** | **Models, algorithms and programs of data processing in navigation: quality corroboration methodology** | **84** |
| **L.P.Nesenyuk** | **The engineering approach to synthesis of Kalman-Wiener filters** | **85** |
| **S.M.Dyugurov, B.E.Landau, S.L.Levin** | **Mathematical simulation of errors of the optical-electronic system for measuring a spherical rotor angular position of a gyro with the non-contact support** | **86** |
| **V.Z.Gusinsky, V.M.Lesyuchevsky, Yu.A.Litmanovich, A.A.Stolbov** | **The calibration algorithm for a triaxial accelerometer unit designed to be used in SINS** | **-** |
| **V.D.Aksenenko** | **Compensation of dynamic error in angle-to-code and phase-to-code servo converters with programmed realization of data processing algorithms** | **87** |
| **V.S.Anikeichev, N.A.Atamanov, E.F.Polikovsky** | **Accelerometer calibration technique** | **-** |
| **V.N.Narver, V.D.Prikhodko, V.I.Stotyka** | **Accelerometer measurement method and instrumentation when testing at the test bench of alternating linear displacements** | **-** |
| **V.L.Budkin, G.V.Zimin, V.V.Krasnov, V.P.Samokhin** | **Dynamic rotating test benches for calibration and testing of gyro systems** | **88** |
| **M.N.Burnashev, D.P.Lukianov, P.A.Pavlov, Yu.V.Filatov** | **Experimental research of the dynamic goniometer for measuring an instant angular position of test bench platforms** | **-** |
| **E.I.Tsvetkov** | **Validity of error characteristics estimation using the simulation technique** | **89** |
| **A.N.Demidov, B.V.Dudnitsyn, O.L.Mumin** | **Zero gravity simulation in ground conditions** | **-** |
| **A.I.Skalon, M.A.Shugaev** | **Influence of technological errors on metrological characteristics of micromechanical accelerometers** | **90** |
| **M.D.Kudryavtsev** | **Methods of two-speed angle-to-code converter certification using the toothed separatory table UDP-0,25 as the initial tool** | **91** |
| **T.N.Siraya** | **Pseudo-optimal linear estimates of trend parameters through random noises: criteria of consistency and efficiency** | **-** |

***Papers presented at the 7th Saint Petersburg International Conference on Integrated Navigation Systems***

|  |  |  |
| --- | --- | --- |
| **Yu.I.Bazarov, E.V.Komrakov** | **Universal automatic identification system** | **93** |
| Main technical characteristics and principles of Universal automatic identification system (AIS) functioning are given. AIS will be applied by maritime users since 2001 according to IMO Resolution MSC.74(69). It is known that radar is the main source of information in Vessel Traffic Monitoring System (VTMS) which monitors the area of maritime administration responsibility. However, VTMS provides a raw radar picture which has some disadvantages under definite circumstances: the detection range is rather short, especially for small targets; with intensive sea or rain clutter the target may not be detected; targets behind the islands or river turns are not visible; target's manoeuvre is not instantaneously detected due to the filtering and smoothing algorithms, etc. Hence the necessity occurs to overcome these drawbacks in some manner. One of the ways to remove these drawbacks is to apply the universal automatic identification system (AIS) which being the transponder transmits practically in real time scale data on the ship's coordinates determined with differential navigation satellite systems (GLONASS/GPS), such as heading, course and speed over ground. Such system is virtually free of these disadvantages. Besides, it enables automatic identification of targets, which VTMS cannot do.  TRANSAS ideology on integration of AIS information on the shipborne INS, radar, ECDIS displays is proposed. Demo test results are described. | |  |
| **V.N.Avsievich, A.V.Grebennikov, V.I.Kokorin, V.B.Novikov, I.N.Sushkin, Yu.L.Fateev** | **Global Navigational Satellite Systems' user equipment: creation experience and application prospects** | **104** |
| Creation results and application prospects of a multifunctional navigation equipment for users of global navigation satellite systems including GLONASS and GPS, which provides objects' spatial orientation determination, are discussed in the paper. The global navigation satellite system (GNSS) GLONASS provides a high precision navigation for moving objects. Along with the determination of coordinates and velocity as well as user's precision time, GNSS application is promising to determine objects' spatial orientation (angles of azimuth, pitch and heel). Over 10 years Krasnoyarsk enterprises have been cooperating successfully in the field of development and introduction of users multifunctional navigation equipment (UNE) for the GLONASS and GPS GNSS. | |  |
| **V.Calmettes, F.Pradeilles, M.Bousquet** | **Interference rejection techniques** | **112** |
| Radio Frequency Interference such as TV and FM harmonics, which occurs frequently in the environment of a GPS receiver, affects adversely its accuracy. This paper deals with the problem of interference mitigation. Classically the precorrelation techniques used for interference excision result in a prewhitening filter. These techniques do not take the statistical properties of the interference into account. Here we apply a method based on the weak signal detection theory to define the optimum receiver in the presence of non-gaussian noise. In that case the receiver differs from the conventional one. It includes a non-linearity law applied to the complex IQ signal.  This paper presents the non-linear filter and the associated receiver is compared to the conventional system. It includes a theoretical analysis that allows to evaluate the method for continuous, swept and pulsed sinusoidal interference. Also is carried out a simulation of the receiver which includes the non-linearity estimation whose shape is adapted to the jammer using a blind technique. | |  |
| **D.B.Wolfe, C.L.Judy, E.J.Haukkala, D.J.Godfrey** | **Engineering the world's largest DGPS network** | **126** |
| Radio Frequency Interference such as TV and FM harmonics, which occurs frequently in the environment of a GPS receiver, affects adversely its accuracy. This paper deals with the problem of interference mitigation. Classically the precorrelation techniques used for interference excision result in a prewhitening filter. These techniques do not take the statistical properties of the interference into account. Here we apply a method based on the weak signal detection theory to define the optimum receiver in the presence of non-gaussian noise. In that case the receiver differs from the conventional one. It includes a non-linearity law applied to the complex IQ signal.  This paper presents the non-linear filter and the associated receiver is compared to the conventional system. It includes a theoretical analysis that allows to evaluate the method for continuous, swept and pulsed sinusoidal interference. Also is carried out a simulation of the receiver which includes the non-linearity estimation whose shape is adapted to the jammer using a blind technique. | |  |

**Academy of Navigation and Motion Control  
Official information**

|  |  |
| --- | --- |
| **The 10th General meeting of the Academy of Navigation and Motion Control** | **141** |

**Information**

|  |  |
| --- | --- |
| **Russian and international conferences, symposiums and exhibitions** | **143** |
| **Recent developments of integrated spacecraft control systems (abstracts of papers)** | **144** |
| **Linear accelerometers made in SRI of physical measurements (abstract of paper)** | **146** |
| **Microsensors for mobile vehicle navigation systems (abstracts of papers)** | **148** |
| **State and prospects of gyroscopic sensors development (abstracts of papers)** | **152** |
| **D.P.Lukianov. Review of the manual by E.L.Smirnov et al. "Navigation hardware"** | **153** |