**"Gyroskopiya i Navigatsiya" №4, 2006**

**CONTENTS**

|  |  |  |
| --- | --- | --- |
| **п.б.Stepanov** | **Linear Optimal Algorithm for Nonlinear Navigation Problems** | **11** |
| The nonlinear problems of navigational data processing, the essence of which consists in estimation of time invariant vector, are considered. In the framework of Bayesian approach a linear optimal (minimum variance) algorithm is suggested. Such algorithm minimizes the root mean square criterion using linear (relative measurements) estimates. The peculiarities of the algorithm and its interrelation with the algorithm based on linearization are discussed. The efficiency of the proposed algorithm is shown. | |  |

|  |  |  |
| --- | --- | --- |
| **V.M.Slyusar (KPI, Ukraine)** | **Current Issues of Designing SINS Attitude Algorithms. Part 3. Algorithms Analysis and Synthesis with Account for Gyros Frequency Response Effect** | **21** |
| The paper develops the mathematical basis and techniques for deriving attitude algorithms, which are tailored to the frequency response of any type of gyros used. The results presented in the paper make it possible the following algorithm design problems to be treated: (1) to estimate attitude vibrational errors when gyros exhibit complex frequency responses; (2) to prove and specify gyros characteristics when developing new SINS; (3) to account for a known gyro function in the derivation of the algorithm coefficients; (4) to clarify and overcome the main practical limitations involved in such an algorithm design. The results of algorithm errors simulation are presented which support the conclusion that problems of algorithm dynamical tuning are of great importance. | |  |

|  |  |  |
| --- | --- | --- |
| **V.Z.Gusinsky, O.I.Parfenov** | **Dual Autocompensation of ESG Drift** | **37** |
| Dry friction moments in gimbal axes are among the drift sources of electrically suspended gyroscopes mounted into the gimbal. They result in errors of gimbal servo systems (rotor and housing axis misalignment) and therefore in rotor drifts being also the drift source of such ESG as error torques related to such a misalignment always exist in real gyros.The paper offers a method for autocompensation of the moments acting on ESG mounted into the gimbal. It consists in mounting of optical angular sensor following the rotor position, inclined at a calculated angle, in the gyro housing rotating around its axis. This adds coning motion to the housing rotation.The method does not require any additional mechanical devices. Such a dual autocompensation at the same time modulates the housing moments both related and unrelated to the gyro rotor and housing axis misalignment. Deduction of expression for calculation of rotor and housing axis misalignment angle is given, namely: A > Omega/w, where A is a misalignment angle, Omega - earth rotation rate, w the gyro rate. | |  |

|  |  |  |
| --- | --- | --- |
| **S.V.Smolentsev** | **Positioning the Mobile Users of GSM Cellular Networks** | **41** |
| Review of various methods for determination of mobile telephone subscriber coordinates in GSM networks is given. Coordinates determination principles are considered, examples of service realization in present GSM networks are given, problems and prospects of such systems development are shown. | |  |

|  |  |  |
| --- | --- | --- |
| **V.N.Tarasov** | **Hysteresis Synchronuous Motors of Precision Gyroscopes** | **54** |
| Results of using ac electronic motor and hysteresis-reluctance motor in precision gyroscopic devices are compared in relative units with the help of control algorithms designed. It is demonstrated that with comparison in relative units of gyroscopic device drift changes at power supply interruption the results obtained are practically the same for both driving gear types. | |  |

|  |  |  |
| --- | --- | --- |
| **V.E.Dzhashitov, V.M.Pankratov (Precision Mechanics and Control Institute, RAS, Saratov)** | **Choice of Parameters of Elastic Curvilinear Conductors for Aerospace Sensors on the Basis of Definition of Their Natural Oscillations Frequency** | **66** |
| In many classes of modern sensors of air and space instrument-making (extrasmall pressure sensors, floated-type and micromechanical gyroscopes and others) methods of thin-film technology are reshaped bridge measuring circuits. The elastic bonding contact pads of these schemes paired to contacts of a body by elastic conductors. These conductors have the composite curvilinear form, and the design of such measuring circuit represents a dynamic oscillating system with distributed parameters. Object of research - developed in Research institute of physical measurements from Penza, firm "Korpus" from Saratov, Central Scientific and Research Institute "Elektropribor" from St. Petersburg and other firms, the sensors of air and space instrument making operating in conditions of vibrational effects, and in designs which one are contained considered dynamic oscillating systems. The purposes of work are: 1. Construction and research of mathematical models for calculation of natural frequencies (and control by them) curvilinear conductors of sensors of air and space instrument-making. 2. Choice, on the basis of knowledge of natural frequencies, parameters of conductors ensuring in conditions of external vibrations, drift from resonant modes and, there by, allowing to avoid destruction of a measuring circuit of sensors. Mathematical model (1) (28) is constructed, (fig. 1, 2) and algorithms are developed for calculation of natural oscillations frequency of considered dynamic oscillatory system with curvilinear elastic conductors. The supporting software is developed for realization of the constructed mathematical model and algorithms, allowing is automated to solve tasks in view. On the basis of constructed model (1) (28) and the developed general technique, calculations of natural oscillations frequency of curvilinear gold conductors of a variable and constant curvature (fig. 3, 4 and the table) when the ends of conductors base (fig. 2) on the elastic bases a membrane and pressure seal are made.  The opportunity of the decision of problems of calculation and the analysis of natural oscillations frequency of considered dynamic oscillatory systems as functions of geometrical and physical parameters and characteristics of these systems is shown.  The opportunity of the decision and return problems, for example, problems of a choice of geometrical parameters of the oscillatory system providing set natural oscillations frequency is shown. | |  |

|  |  |
| --- | --- |
| **1st Russian Multiconference on Control Problems** | **78** |

**25th Conference in memory of N.N.Ostryakov  
Abstracts of the papers  
Session Sensors of Navigation and Control Systems**

|  |  |  |
| --- | --- | --- |
| **M.A.Barulina, V.E.Dzhashitov, V.M.Pankratov, M.A.Kalinin, б.б.Papko** | **Complex Mathematical Finite Element Model for a Micromechanical Accelerometer with Account for Temperature and Dynamic Effects** | **80** |
| **н.I.Evstifeev** | **Elastic Suspensions of Inertial Bodies in Precision Devices** | **81** |
| **ф.б.Andreeva, S.V.Bagaeva, Ya.A.Nekrasov, Ya.V.Beliaev** | **Quadrature Interference Suppression in Micromechanical Gyroscope Using the Electrodes above the Fingers Area** | **81** |
| **V.D.Aksenenko, S.I.Matveev, Yu.V.Shadrin** | **Features of Digital Signals Processing in Micromechanical Gyro** | **82** |
| **V.н.Achildiev, V.N.Drofa, V.M.Rublev** | **Application of Measurement Units Based on Micromechanical Sensors** | **82** |
| **R.L.Voskoboinikov** | **Three-Axes Gyromotor - Gyroscope on Autoexcited Rotating Electromagnetic Fields** | **83** |
| **A.G.Tscherbak, S.N.Beliaev, б.S.Udovikov** | **Microflow Processes Control during Welding of Gyrodevices' Precision Units** | **83** |
| **V.G.Peshekhonov, B.Ye.Landau** | **ESG-based Strapdown Attitude System for Low-Orbit Spacecraft** | **83** |
| **б.P.Buravlev, V.M.Kuzin** | **Theoretical and Experimental Study of Power and Accuracy Parameters of Gimballess ESG Suspension** | **83** |
| **б.б.Belash, P.Yu.Petrov, D.V.Trunov** | **ESG Rotor Run-Up Digital Unit: Development and Tests Results** | **84** |
| **S.н.Dyugurov, B.E.Landau, T.V.Panich** | **Dynamic Referencing for ESG Body Frames in Spacecraft Attitude Strapdown Inertial System** | **84** |
| **S.F.Konovalov, е.L.Mezhirizky** | **Force-Rebalanced Accelerometer Designed to Measure Accelerations up to 100 g** | **85** |
| **G.б.Pankratov, V.N.Kitaev, M.V.Mikhailov, V.N.Perebatov, V.G.Vorobiov** | **Vibrating Accelerometer with Metal Sensing Element** | **85** |
| **S.б.Vasukov, G.F.Drobyshev** | **Mathematical Model of a Cylindrical Electrostatic Suspension as a System of Charged Conductors** | **85** |
| **S.б.Vasukov, G.F.Drobyshev** | **Experimental Method to Determine Hydrodynamic Parameters of Floating Pendulous Accelerometer with Electrostatic Suspension** | **86** |
| **V.Z.Gusinsky, O.I.Parfenov** | **Drift Autocompensation for ESG Mounted in the Gymbal** | **86** |
| **S.V.Kruze, S.N.Lepe, б.V.Molchanov, Ye.F.Polikovsky** | **Calibration of Laser Gyros' Triad** | **87** |
| **Yu.Yu. Broslavets, M.A.Georgieva, б.б.Fomichev** | **Lock-in in Laser Gyroscope under Transverse Higher Order Modes Generation** | **87** |
| **б.V.Molchanov, б.Yu.Stepanov, M.V.Chirkin** | **Selection of Mirror Substrates for Optical Resonators of Laser Gyros** | **88** |
| **Ye.V.Korotitsky, б.V.Romanov, D.б.Romanov** | **Gyrocompass злм-1т** | **88** |

**Session Gyroscopic Systems**

|  |  |  |
| --- | --- | --- |
| **Yu.N.Artemenko, Yu.G.Egorov, б.б.Parshchikov, S.V.Smirnov** | **Inertial Attitude System of Radio Telescope Mirror System** | **89** |
| **V.P.Golikov, S.V.Larionov, б.V.Trebukhov, Yu.V.Bolotin, V.V.Tikhomirov, S.A.Trubnikov** | **Gimballed INS Calibration Algorithms** | **89** |
| **V.P.Golikov, S.V.Larionov, б.V.Trebukhov, б.б.Golovan** | **Results of Gimballed INS Full-Scale Initial Alignment Tests on Mobile Platform Using Data from the Ship Complex** | **90** |
| **б.P.Kolevatov, S.G.Nikolaev, Yu.A.Dolgusheva, N.V.Malgin** | **Two-Mode AHRS on Three-Component FOG: Algorithmic Compensation of Errors Caused by Thermal Gradient** | **90** |
| **S.G.Nikolaev** | **SINS Calibration Using the System Error Model** | **90** |
| **Ya.I.Binder** | **Increasing the Angular Position Accuracy for the Boreholes of Random Orientation in DG Mode** | **91** |
| **A.V.Zamorsky** | **Means of Initial Orientation in Azimuth for Land Mobile Objects** | **91** |
| **V.б.Pogorelov, ф.V.Klodina** | **On Initial Orientation of Unslaved Gyrostabilized Platform** | **91** |
| **L.D.Silayev, Ye.F.Komarov, п.N.Nikiforova** | **Mathematical Error Model for Gyrostabilized Platform for ISN** | **92** |
| **V.н.Nikiforov, Yu.V.Trunov, V.A.Nemkevich, б.I.Sapozhnikov, б.V.Naumenko** | **Terminal Control of Gyrostasbilized Platform Motion by Solution of Inverse Dynamics Problem** | **92** |
| **Ye.I.Somov** | **Local Dynamic Parameters of Gyrodin Systems with Account for Elasticity of Gyrodin Structure Their Fixation on the Spacecraft Body** | **93** |

**Session Navigation Data Processing and Motion Control**

*Inertial Satellite Systems*

|  |  |  |
| --- | --- | --- |
| **б.б.Fomichev, б.B.Kolchev, л.Yu.Schastlivets, P.V.Larionov, V.B.Uspensky** | **On Efficient Assessment of Motion Parameters Primary Errors in Integrated Inertial-Satellite Navigation System** | **93** |
| **н.B.Bogdanov, б.V.Prohortsov, V.V.Savelyev, B.V.Suhinin, б.б.Chepurin** | **Ways to Determine Attitude Parameters Using Satellite Navigation Systems** | **94** |

*Nonlinear Data Processing*

|  |  |  |
| --- | --- | --- |
| **V.б.Merkulov, б.I.Naumov** | **Estimating the Coordinates Correction Error by Search Algorithm for Correlation-Extreme Navigation** | **94** |
| **п.б.Stepanov, б.B.Toropov** | **Application of Suboptimal Kalman Type Algorithms to a Class of Nonlinear Problems. Efficiency Comparison** | **95** |
| **п.б.Stepanov, п.S.Amosov** | **Efficiency Investigation of Neural Networks and Monte-Carlo Method for Nonlinear Navigation Problems** | **95** |

*Identification, Control and Diagnostics*

|  |  |  |
| --- | --- | --- |
| **S.P.Dmitriev, б.V.Osipov, D.б.Koshaev** | **Detection and Elimination of Informational Failures Effects in Navigation Systems** | **96** |
| **T.V.Podladchikova** | **Noise Statistic Parameters Identification in Designing Navigation Filters Using Data from Dissimilar Measurement Information Sources** | **96** |
| **б.V.Osipov** | **Fuzzy Logic in Navigation Data Processing** | **97** |
| **н.Ye.Kostyaev, V.V.Savitsky, N.Yu.Tikhomirov** | **Optimal Algorithm for Data Secondary Processing in Short-Range Sonar Mode with Account for the Probing Beam Scanning** | **97** |
| **н.B.Rosenhaus** | **A Method to Estimate Results of Navigation Complexes Diagnostics Using Fuzzy Measure** | **98** |

*Special Data Processing and Control*

|  |  |  |
| --- | --- | --- |
| **б.Ye.Gorodetsky, V.V.Dubarenko, б.Yu.Kuchmin** | **Gyroscopic Guide in Radiotelescope Guidance System** | **99** |
| **B.V.Griasev, V.V.Savelyev, V.A.Smirnov** | **Errors in LOS Stabilization and Guidance System Caused by the Platform Linear Displacement and Method for Their Compensation** | **100** |
| **S.Ye.Somov** | **Dynamics of Initial Modes of Elastic Geostationary Satellite with Pulse-Width Control for Motors and Rotor Run-Up in Moment Gyroscopic Stabilizer** | **100** |
| **I.Ye.Gutner, L.D.Zhuravlev, Ye.N.Zvorykin, б.б.Molochnikov, н.V.Orlov** | **Generation Algorithm for Current Glide Slope Angle Relative to the Aircraft Carrier Deck to Be Commanded to Stabilization Drive** | **100** |
| **Yu.н.Sazykin, п.п.Barabanov, L.P.Barabanova** | **Methods and Algorithms of Topographic Referencing** | **101** |
| **б.н.Boronakhin, V.I.Gupalov, N.S.Filipenia** | **Inertial Methods and Means for Rail Track Diagnostics** | **102** |
| **S.Yu.Yermakov, б.S.Smirnov** | **Solving the Navigation Tasks Using Standard Acoustic Antennas of Submarine Sonar Complex** | **102** |
| **н.S.Vinogradov** | **Analytical Expression for Gradient Computation Using the Maximum Abscissas in the Object Broadband Noise Correlation Function Determined by Acoustic Signal Multipath Propagation in Water** | **103** |

*Adaptive and Robust Methods*

|  |  |  |
| --- | --- | --- |
| **б.P.Kurdiukov, н.н.Chaikovsky** | **Software Support for Anisotropic Analysis and Synthesis Tasks** | **104** |
| **G.н.Bakan, б.V.Sholokhov** | **On Building the Robust Algorithm for Guaranteed Estimation of Linear Controlled System States** | **104** |
| **S.б.Brodsky, б.V.Nebylov, б.I.Panferov** | **Parameters Control and Stabilization of Elastic Vibrations for Complex Objects and Structures** | **105** |
| **Ye.I.Somov** | **Robust Digital Gyromoment Stabilization of Elastic Spacecraft Motion** | **105** |

*Control Problems*

|  |  |  |
| --- | --- | --- |
| **S.N.Vasilyev, б.V.Lakeev, N.N.Maksimkin** | **Study of Dynamic Features for Formations and Systems with Variable Structures** | **106** |
| **б.Ye.Barabanov, D.V.Romaev** | **Helicopter Autopilot Using TV Observations** | **106** |
| **V.V.Baranov, S.S.Vladimirova, б.S.Fursov** | **Image Processing Methods in Real Time to Control the Mobile Robot** | **107** |
| **V.B.Uspensky** | **Kinematic Models for Solid Body Rotation and Their Application to Navigation and Attitude Control** | **107** |
| **Ye.G.Zhanzherov, б.R.Ziatdinov, I.б.Kashina** | **Methods to Control Aeroballistic Aircraft Motion** | **107** |

**Session Electronics and Computing Devices of Onboard systems**

*Computing Systems and Complexes: Organization Principles. Design Theory. Simulation*

|  |  |  |
| --- | --- | --- |
| **N.A.Lookin** | **Optimization Synthesis of Function-Specific Processors' Architecture for Onboard Computation Systems: Theory and Application** | **108** |
| **N.V.Kolesov, н.V.Tolmacheva** | **Planning the Computation Process in Marine Navigation Complexes** | **109** |
| **н.V.Tolmacheva** | **Information System for Planning, Monitoring and Analysis of Computation Process in Navigation Complex** | **109** |
| **б.V.Nebylov, б.V.Samokish, K.D.Smolin, P.б.Sumbarov** | **Using SIMULINK for Simulation of Onboard Computing Devices** | **110** |
| **D.б.Parashchenko, б.б.Shalyto, F.N.Tsarev** | **Automata-Based Programming for Simulation of Group Motion Control of an UAV Class** | **110** |

*Complexes, Systems and Units Hardware Support*

|  |  |  |
| --- | --- | --- |
| **I.V.Kruzhaev, Ya.V.Antimirov** | **Small-Sized Onboard Control Computing Complex: Development and Application Results** | **111** |
| **V.н.Antimirov, V.V.Telitsyn** | **Preparation for Pulse Action Tests of Complex Computing Systems** | **111** |
| **D.V.Aksenenko** | **Systems Design for Digital Processing of ESG Signals** | **112** |
| **Ya.V.Antimirov, M.B.Trapeznikov, I.V.Kruzhaev** | **Structure Optimization of Optical Correction Channel Subsystem** | **113** |
| **S.G.Shestakov, R.Ye.Lysak** | **Development of Miniature Onboard Computer Resistant to Ionizing Radiation** | **113** |
| **M.G.Maksimov, б.N.Shevchenko** | **Computerized Adjusting and Control of ESG Embedded Thermostabilization System** | **113** |

**Session Metrology in Navigation and Motion Control.   
Traceability Methods and Means**

|  |
| --- |
|  |

|  |  |  |
| --- | --- | --- |
| **S.B.Berkovich, N.I.Kotov, A.V.Sholokhov, V.A.Liventsev** | **Periodically Corrected Land Navigation Systems: Estimating Data Adequacy with Account for External Data Induced Errors** | **114** |
| **A.S.Buravlev, S.B.Orlov, Yu.N.Kirilichenko, K.V.Krinkin** | **Automated Test Bench for FOG Tests and Acceptance Inspection** | **115** |
| **N.б.Kaldymov, L.Ya.Kalihman, D.M.Kalihman, б.V.Polushkin** | **System Spektr Modernization and Development of Methods to Control Frequency and Gyromotors Vibration Levels Registration** | **115** |
| **K.V.Koreshkov, б.V.Popov, б.I.Skalon, L.б.Chertkov** | **Study of Krechet Test Bench Characteristics in Dynamic Mode** | **116** |
| **K.V.Koreshkov, A.V.Popov, б.I.Skalon, L.б.Chertkov** | **Virtual Measuring Devices to Estimate Oscillation Test Bench Characteristics in Dynamic Mode** | **116** |
| **E.I.Tsvetkov** | **Adaptive Measurements with Correction Applied** | **117** |
| **.б.Granovsky, б.I.Skalon** | **A MEMS Metrological Problem and Methodological Base for Its Solution** | **117** |
| **п.B.Basun, M.D.Kudriavtsev, N.L.Yavorovskaya** | **Object Modelling to Ensure Monitoring of High-Precision Parts of Navigation Equipment during Their Manufacturing** | **118** |
| **V.V.Korchevsky** | **Acoustic Emission to Control Dimensional Stability of Precision Devices** | **119** |
| **V.N.Ostrovsky, ф.N.Siraya, N.L.Yavorovskaya** | **Metrological Assurance for Product Quality: Process Approach** | **119** |
| **б.M.Barabash, б.V.Belov, V.V.Vasilyev, V.б.Granovsky, ф.N.Siraya** | **Analysis of Experimental Data Obtained during Tests of Appassionata type NC to Compare and Explain Methods for NC Accuracy Control** | **120** |

**International Public Association  
The Academy of Navigation and Motion Control  
*Official information***

|  |  |
| --- | --- |
| **ииII General Meeting of the Academy of Navigation and Motion Control** | **121** |
| **Papers abstracts** | **122** |

**Information**

|  |  |
| --- | --- |
| Joint Conference on control applications in Munich (CCA/CACSD/ISIC-2006) | **125** |
| Russian and international conferences, symposiums and exhibitions | **128** |

|  |  |
| --- | --- |
| **Abstracts of the papers published** | **131** |

|  |  |
| --- | --- |
| **List of the materials published in the journal Gyroscopy and Navigation in 2006** | **133** |