

Soviet and Japanese Aerospace Literature

Throughout 1988 the *AIAA Journal* will carry selected abstracts on leading research topics from the Soviet aerospace literature and, as space permits, from similar Japanese literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features Dynamics, Control, and Sensing from the USSR and Aircraft, Spacecraft, and Laser Propulsion from Japan.

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Soviet Aerospace Literature This month: *Dynamics, Control, and Sensing*

A88-33906 Algorithms for planning the spatial trajectories of robots in the case of incomplete information about obstacles (Algoritmi planirovaniia traektorii robotov v prostranstve pri nepolnoi informatsii o prepiatstviakh) VLADIMIR ANTOL'EVICH IL'IN *Elektronnoe Modelirovanie* (ISSN 0204-3572), Vol. 10, Mar.-Apr. 1988, pp. 62-65. 10 Refs.

Trajectory planning for manipulator and transport robots is considered under conditions when the goal of the movement is given but information about obstacles is collected gradually in the course of the movement. Algorithms for reaching the goal are proposed which can construct preliminary paths and correct them as information about obstacles comes in.

A88-34664 Searching for optimal laws of control force variation in dynamic system control problems (O poiske optimal'nykh zakonov izmeneniia upravliaiushchikh sil v zadachakh upravleniia dinamicheskimi sistemami) L. M. ARTIUSHIN, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 24, March 1988, pp. 98-104. 9 Refs.

A search procedure for finding optimal control force changes for a linear dynamic system is described which is based on the solution of an inverse problem in dynamics. By prescribing the desired motion path, the optimal control problem is reduced to a nonlinear programming problem. The problem of the configuration of a mechanical system within a minimum period of time and with minimum energy is solved as an example.

A88-34021 Optimization of quasi-linear control systems (Optimizatsiia kvazilineinykh sistem upravleniia) A. I. KALININ, *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 28, March 1988, pp. 325-334. 11 Refs.

The paper is concerned with a quasi-linear terminal control problem with constraints on the right end of the trajectories. An algorithm for the approximate (in the asymptotic sense) solution of the problem is proposed. It is then shown how the asymptotic approximations can be used for obtaining an exact solution to the problem for a given value of the small parameter in the nonlinearity term.

A88-36200 Evaluation of the adequacy of models of controlled dynamic systems (Otsenka adekvatnosti modelei upravliaemykh dinamicheskikh sistem) V. K. ABROSIMOV and N. IU. ANISIMOV, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Feb. 1988, pp. 119-126. 7 Refs.

An approach to the evaluation of the adequacy of mathematical models of controlled dynamic systems is proposed which is based on the treatment of adequacy as a fuzzy relation between two dynamic systems. It is shown that, by using specially designed criteria and adequacy functions, the adequacy of models can be evaluated under various conditions. The efficiency of the approach proposed here is illustrated by an example.

A88-36199 Field methods for studying nonlinear dynamic systems. II (O polevykh metodakh issledovaniia nelineinykh dinamicheskikh sistem. II) V. P. ZHUKOV, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Feb. 1988, pp. 56-69.

New field methods are presented for investigating nonlinear dynamic systems described by a system of ordinary differential equations of arbitrary order or by a vector differential equation. Criteria are identified which allow the efficient analysis of various aspects of the dynamics of nonlinear systems. The discussion is illustrated by examples.

A88-36198 A system of continuous search optimization with identification (Sistema nepreryvnoi poiskovoi optimizatsii s indentifikatsiei) E. E. GACHINSKII and M. IU. CHERKASHIN, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Feb. 1988, pp. 47-56. 6 Refs.

A system for the control of an extremal inertial system is examined which combines continuous search optimization with the identification of dynamic parameters on the basis of an analysis of the system response to a test action. The optimization strategy used here provides for a high speed of response under conditions of insufficient a priori information on the controlled system. The control method may be implemented on micro- or minicomputers.

A88-36061 The least squares method and fast algorithms in variational identification and filtering problems (The variational identification method) (Metod naimen'shikh kvadratov i bystrye algoritmy v variatsionnykh zadachakh identifikatsii i fil'tratsii/metod VI) A. O. EGORSHIN, *Avtometriia* (ISSN 0320-7102), Jan.-Feb. 1988, pp. 30-42. 14 Refs.

A variational approach to the solution of dynamic system modeling and identification problems is proposed. A fast computational method is presented for solving Lagrange's discrete variational problem with constraints in the form of ordinary differential equations or difference equations with constant but unknown parameters. The approach is based on symmetric fast algorithms that do not include the Riccati equation and on special rapidly converging iteration procedures.

A88-36060 Effect of measurement error correlation on the precision of a discrete Kalman filter (Vliianie korrelirovannosti oshibok izmerenii na tochnost' raboty diskretnogo fil'tra Kalmana) V. P. SIZOV, *Avtometriia* (ISSN 0320-7102), Jan.-Feb. 1988, pp. 23-30.

The Kalman filter algorithm has been supplemented by recursive relations for the analytical determination of the correlation matrix of the error of the filter-formed quasi-optimum estimates of the state vector of a discrete linear dynamic system in the case of correlated measurement errors. An example is presented which demonstrates that the added recursive relations improve the performance of the Kalman filter under conditions of correlated measurement errors.

A88-36059 Factored recursive instrumental variable methods for dynamic system identification (Faktorizovannye rekurrentnye metody instrumental'nykh peremennykh dlia identifikatsii dinamicheskikh ob'ektov) V. I. MELESHKO and T. V. TKACHENKO, *Avtometriia* (ISSN 0320-7102), Jan.-Feb. 1988, pp. 17-23. 9 Refs.

New factored recursive instrumental variable algorithms are proposed for the identification of dynamic systems with correlated noise. Recursive formulas for the conversion of nonsymmetric factorizations are derived. Recursive factored identification algorithms are presented which do not include an analog of the Gaussian transformation and therefore are characterized by a high degree of numerical stability.

A88-33847 Regularization of the problem of the synthesis of optimal discrete regulators for multidimensional stabilization systems (Regularizatsiia zadachi sinteza optimal'nykh diskretnykh reguliatorov mnogomernykh sistem stabilizatsii) L. A. SEVEROV, *Priroostroenie* (ISSN 0021-3454), Vol. 31, Feb. 1988, pp. 81-85. 5 Refs.

The problem of the synthesis of practical optimal discrete regulators for multidimensional discrete-continuous stabilization systems is solved on the basis of the least complexity principle. A regulator synthesis algorithm is formulated which guarantees the implementation of a specialized calculator without using the inaccessible measurements of the direct differences of the output signals.

A88-33846 An adaptive control algorithm of the gradient type in the problem of stabilizing regulator synthesis (Algoritim adaptivnogo upravleniia gradientnogo tipa v zadache sinteza stabiliziruiushchikh reguliatorov) V. I. TERTYCHNYI, *Priroostroenie* (ISSN 0021-3454), Vol. 31, Feb. 1988, pp. 66-69. 11 Refs.

A method is proposed for constructing a stabilizing algorithm for the adaptive control of a dynamic system. With this method, no additional analysis of the Liapunov function is required in the formation of a control system with dissipation properties. The efficiency of the adaptive algorithm constructed by the approach proposed here is illustrated by an example.

A88-33845 Adaptive control with an implicit reference model based on the least squares method (Adaptivnoe upravlenie s neiavnoi etalonnoi model'iu na osnove metoda naimen'shikh kvadratov) I. B. IADYKIN, *Priroostroenie* (ISSN 0021-3454), Vol. 31, Feb. 1988, pp. 57-65. 29 Refs.

A synthesis procedure and adaptive control algorithms are proposed for discrete multivariable controlled systems. The approach to the synthesis and control used here employs standard least-squares algorithms of current identification and adjustment of the parameters of a regulator of a given structure. A structural diagram of an adaptive control system with an implicit reference model is included.

A88-33843 Parametric control systems. Development and application trends (Sistemy parametricheskogo upravleniia. Tendentsii razvitiia i primeneniia) S. A. DOGANOVSKII and N. A. OZERIANI, *Priroostroenie* (ISSN 0021-3454), Vol. 31, Feb. 1988, pp. 33-42. 25 Refs.

The concept of the parametric control system is examined, and the general design and implementations of parametric control systems are reviewed. A classification of parametric control systems is proposed, and various types of coordinate-parametric control systems are briefly characterized. Finally, the principal applications of parametric control systems and some new trends are discussed.

A88-29951 Approximate maximum principle in finite-difference control systems (Approksimativnyi printsip maksimuma v konechno-raznostnykh sistemakh upravleniia) B. SH. MORDUKHOVICH, *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 28, Feb. 1988, pp. 163-177. 15 Refs.

An analysis is made of problems involving the optimal control of finite-difference systems with constraints on the control and phase variables. Necessary conditions are obtained for these problems in the form of an approximate maximum principle without any assumptions on the linearity or convexity of the control system. Constructive methods for the approximation of phase constraints are substantiated which provide for the stability of the Pontryagin maximum principle in computer calculations of continuous-time systems.

A88-29912 Determination of the radio-brightness distribution of extended sources by methods of statistical decision theory (Vosstanovlenie raspredeleniia radiolarkosti protiazhennykh istochnikov metodami teorii statisticheskikh reshenii) S. E. FAL'KOVICH and I. V. SHKVARKO, *Radiotekhnika i Elektronika* (ISSN 0033-8494), Vol. 33, Feb. 1988, pp. 295-304. 10 Refs.

Methods of maximum likelihood and maximum a posteriori probability are used to synthesize algorithms for spectral-wave analysis of radio fields with reference to radio-brightness imaging and radio holography. The energy spectrum of the intrinsic incoherent emission of the sensed surface is estimated according to a complex realization of the received field, registered in a finite region of space-time observation. It is shown that sequential statistical analysis can be achieved through the formation of a generalized three-dimensional periodogram and its optimal smoothing by the spectral-wave window operator, matched with the model structure of the maximum-entropy a priori distribution of the radio brightness.

A88-30009 Optimal control and inverse dynamics problems (Optimal'noe upravlenie i obratnye zadachi dinamiki) N. V. GORBACHEV and A. V. SAFONOV, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Jan. 1988, pp. 160-163.

A parametric family of algorithms is proposed which combines control optimized for speed of response and algorithms based on the concepts of inverse dynamics problems. The two types of algorithms correspond to the extreme values of the parameters. The sensitivity of the system to inaccuracies decreases with the approach to the inverse dynamics algorithms, while the speed of response increases with the approach to optimal control.

A88-30008 A peaking effect in stationary linear systems with multidimensional inputs and outputs (Effekt 'vspleska' v statsionarnykh lineinykh sistemakh s mnogomernymi vkhodami i vykhodami) R. N. IZMAILOV, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Jan. 1988, pp. 52-60. 12 Refs.

In closed-loop systems whose parameters have been selected for maximum stability, a transient process can reach a high value in a short period of time, resulting in a peaking effect. Here, the peaking effect in such systems is investigated analytically, and unimprovable asymptotic estimates of this effect are presented.

A88-30007 Optimization of the motion of a nonlinear system on the basis of a prediction model (Optimizatsiia dvizheniia nelineinogo ob'ekta na osnove prognoziruiushchei modeli) V. N. BUKOV and V. G. CHUDINOVA, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Jan. 1988, pp. 38-45. 8 Refs.

Prediction algorithms are presented which make it possible to efficiently control complex nonlinear dynamic systems without prior simplification and transformation of the system models. Particular attention is given to the possibility of allowing for the nonlinear properties of the system irrespective of their number and nature. The discussion is illustrated by an example concerning the control of flight simulator drives.

A88-28443 Selection of parameters for a nonlinear instrument servomechanism in a general control circuit (Vybor parametrov nelineinogo pribornogo servomekhanizma v obshchem konture upravleniia) V. V. PETROV, A. A. GORDEEV, and L. V. SIMONOVA, *Priroostroenie* (ISSN 0021-3454), Vol. 31, Jan. 1988, pp. 12-16.

For a class of closed-loop high-order systems, the parameters of a nonlinear instrument servomechanism are selected as a function of the controlled system parameters. An analysis of the phase-plane portraits on a reduced plane makes it possible to determine, in analytical form, bifurcation expressions for the servomechanism parameters for which the dynamic characteristics of the control circuit satisfy specified requirements.

A88-28244 Optimization of hierarchical correlation algorithms of image analysis (Optimizatsiia ierarkhicheskikh korreliatsionnykh algoritmov analiza izobrazhenii) V. A. GOROKHOVATSKII and V. V. SHLIAKHOV, *Radioelektronika* (ISSN 0021-3470), Vol. 31, Jan. 1988, pp. 28-33.

The optimization of hierarchical algorithms for automatic object recognition on images is considered. Attention is given to the advantages of hierarchical algorithms in cases of frequency-screening and fluctuation noise. These algorithms are shown to have high noise immunity with respect to local noise as well as good properties with respect to fluctuation noise.

A88-34667 Absolute stability of dynamic simulation systems in the first approximation (Absoliutnaia ustoichivost' imitatsionnykh dinamicheskikh sistem v pervom priblizhenii) V. V. ALEKSANDROV, *Akademii Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 299, no. 2, 1988, pp. 296-301. 11 Refs.

Theoretical results are presented on the absolute stability of dynamic simulation systems. As an example, an error evaluation is carried out for a controlled gyro stabilized platform serving as a simulation stand for an inertial navigation system.

A88-34666 Estimation of the control-vector norm in binary automatic systems (Ob otsenke normy upravlyaiushchego vektora v binarnykh avtomaticheskikh sistemakh) S. V. EMEL'IANOV, I. A. BUROVOI, and F. I. LEVADA, *Akademii Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 299, no. 2, 1988, pp. 288-291.

The change in the upper-bound estimate of the current value of the control-vector norm along the system trajectory is investigated for a binary system for controlling a nonlinear nonstationary dynamic plant. It is shown that the control system can be synthesized in such a way that redundant control actions can be avoided at the initial stage of the control process.

A88-32792 Maximum principle for abnormal optimal control problems (Printsip maksimuma dlia abnormal'nykh zadach optimal'nogo upravleniia) E. R. AVAKOV, *Akademii Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 298, no. 6, 1988, pp. 1289-1292. 7 Refs.

A class of abnormal, or irregular, optimal control problems is defined, and an approach to the analysis of abnormal regimes for extremes is proposed. In accordance with this approach, the necessary first-order conditions are obtained in the form of a maximum principle, a natural extension of the Pontriagin maximum principle to the abnormal case.

A88-37550 Multilevel control of dynamic systems (Russian book) (Mnogourovnevoe upravlenie dinamicheskimi ob'ektami) VLADIMIR IVANOVICH VASIL'EV, IURII MATVEEVICH GUSEV, VLADIMIR NIKOLAEVICH EFANOV, VIKTOR GRIGOR'EVICH KRYMSKII, VLADISLAV IUL'EVICH RUTKOVSKII et al. *Moscow, Izdatel'stvo Nauka*, 1987, 312 pp. 126 Refs.

The book is concerned with the organization, architectures, and synthesis of multilevel control for dynamic systems. To solve the problem of multilevel system optimization on the basis of a vector efficiency criterion, algorithms for the synthesis of the structure and parameters of lower-level control are developed with allowance for nonlinear and nonstationary characteristics of the elements. Decentralized control algorithms for multilevel systems are also proposed which provide high efficiency under conditions of both normal and abnormal operation of individual subsystems. Problems of identification and adaptation in multilevel control systems are discussed.

A88-29980 Optimization of correction devices in the self-adjustment circuits of adaptive systems with a model (Optimizatsiia korrek-tivnykh ustroistv v konturakh samonastroiki adaptivnykh sistem s model'iu) B. G. IL'IASOV, I. S. KABAL'NOV, E. V. RASPOPOV, and V. I. RUTKOVSKII, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Dec. 1987, pp. 131-142. 11 Refs.

The paper is concerned with the synthesis of physically realizable correction devices in the self-adjustment circuits of adaptive systems with a model on the basis of the condition of the minimum of a quadratic quality functional. The first term of the functional allows for the adaptation error, while the second term characterizes, in an indirect manner, the limits on the energy resources of the regulator. The analysis is illustrated by an example.

A88-29979 Some approaches to the problem of the adaptive suboptimal control of nonstationary systems (O nekotorykh podkhodakh k zadache adaptivnogo suboptimal'nogo upravleniia nestatsionarnymi ob'ektami) V. N. AFANAS'EV and A. N. DANILINA, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Dec. 1987, pp. 117-130. 6 Refs.

The paper is concerned with methods for the synthesis of adaptive control systems that provide for the suboptimal operation of the controlled system, in terms of a specified performance functional, under conditions of incomplete a priori information on the system parameters, its state, and effective noise characteristics. Various structural schemes for the suboptimal control of linear systems with Gaussian perturbations are examined. Modeling results are presented for specific examples.

A88-29977 Eigenvectors of asymptotic identifier matrices (O sobstvennykh vektorakh matrits asimptoticheskikh identifikatorov) R. N. IZMAILOV, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Dec. 1987, pp. 34-41. 7 Refs.

A new method is proposed for determining the eigenvectors of matrices in problems of linear system identification. Formulas are presented for matrix eigenvectors that are convenient for the study of transient processes.

A88-21842 Time optimization of algorithms in real-time simulation systems (for aircraft control) (Vremennaia optimizatsiia algoritmov v modeliruiushchikh sistemakh real'nogo vremeni) IGOR' EVGEN'EVICH EFIMOV, *Elektronnoe Modelirovanie* (ISSN 0204-3572), Vol. 9, Nov.-Dec. 1987, pp. 14-18. 6 Refs.

The paper examines the definition of the optimal sequences of the execution of the steps of algorithms for the operation of real-time computing-control systems. The proposed approach is applied to the optimization of an algorithm for defining full-scale flight simulation control according to an accuracy criterion.

A88-26233 Optimal filtering in systems with a random structure and discrete time (Optimal'naia fil'tratsiia v sistemakh so sluchainoi strukturoi i diskretnym vremenem) E. A. KLEKIS, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Nov. 1987, pp. 61-70. 11 Refs.

A solution is presented to the optimum filtering problem for Markovian systems with a random structure and discrete time, with structural changes described by a Markov chain with transition probabilities that are either dependent or independent on the system's phase coordinate vector. The filtering algorithm proposed here can be implemented with finite computational resources. The use of this filtering approach for process filtering in linear dynamic systems is illustrated by a numerical example for the case where noise contains overshoots.

A88-19621 Numerical method for multistep optimization problems with stepwise calculation of descent directions (Chislennyi metod dlia mnogoshagovykh zadach optimizatsii s poshagovym vychisleniem napravlenii spuska) A. M. VALUEV, *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 27, Oct. 1987, pp. 1474-1488. 12 Refs.

The paper is concerned with nonlinear problems of discrete optimal control with mixed constraints. An allowable control variation form is proposed whereby the determining quantities are selected independently at different steps of the process. The necessary optimality conditions are determined. An optimization algorithm is developed in terms of the method of possible directions, and its convergence is demonstrated. Results of numerical experiments are included.

A88-17959 Physical models of neuronal networks (Fizicheskie modeli neironnykh setei) A. V. LUKASHIN, A. A. VEDENOV, and M. D. FRANK-KAMENETSKII, *Biofizika* (ISSN 0006-3029), Vol. 32, Sept.-Oct. 1987, pp. 918-928. 40 Refs.

Experimental data on the processes of learning and memory on the levels of small neuronal systems, isolated synapses, and individual neurons are discussed together with models of the neuronal network with associative memory. Special consideration is given to the basic bilayer model, one layer of which corresponds to the short-term memory, while the other to the long-term memory; patterns are stored in terms of the synaptic strength matrix. The interaction among the layers creates a number of novel stable states which are not part of the learning pattern. On the basis of this model, a simulation of another element of the brain function, the 'idea generator' is proposed. It is shown that the spontaneous appearance of synthetic images can occur as a consequence of short-term and long-term memory interactions in the basic neuronal network.

A88-17857 Application of a spectral approach to the synthesis of adaptive systems for the complex processing of navigation data (Ob ispol'zovanii spektral'nogo podkhoda k sintezu adaptivnykh sistem kompleksnoi obrabotki navigatsionnoi informatsii) V. K. PONOMAREV and A. I. PANFEROV, *Prirodoostroenie* (ISSN 0021-3454), Vol. 30, Oct. 1987, pp. 56-62. 5 Refs.

Adaptive algorithms for the complex processing of signals in navigation systems are developed on the basis of the spectral characteristics of a renewed-process signal in a Kalman filter. The design of an adaptive circuit on the basis of spectral analyzers is considered as an example. The results are of interest in connection with signal processing in inertial navigation systems.

A88-17955 Effect of the amplitude quantization of the test signal on the parametric identification of linear dynamic systems (Vliianie amplitudnogo kvantovaniia testovogo signala na protsess parametricheskoi identifikatsii lineinykh dinamicheskikh sistem) A. V. SHARONOV, *Prirodoostroenie* (ISSN 0021-3454), Vol. 30, Sept. 1987, pp. 20-24. 8 Refs.

The effect of the amplitude quantization of the test signal on the accuracy of the parametric identification of linear stationary dynamic systems with a single input and a single output is investigated analytically. It is shown that the amplitude quantization of the test signal results in biased estimates. A model example is presented to illustrate the results of the analysis.

A88-21680 The dynamics of fuzzy discrete-time systems (O dinamike nechetkikh diskretnykh sistem) G. S. BRITOV and L. K. REZNIK, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Aug. 1987, pp. 185-188. 6 Refs.

The paper presents an analysis of the dynamics of state variables and indices of their fuzziness in fuzzy discrete-time dynamic systems. Consideration is given to a number of conditions for the straightforward verification of the stability of fuzzy systems where the fuzziness is expressed as an approximate equality. The stability of fuzzy systems is shown to depend on the system structure.

A88-21678 Adaptive locally optimal control (Adaptivnoe lokal'no-optimal'noe upravlenie) M. M. KOGAN and I. I. NEIMARK, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Aug. 1987, pp. 126-136. 18 Refs.

The paper examines the behavior of discrete-time linear dynamic processes in the case of locally optimal control laws which minimize the effectiveness-function increment along the system trajectory. Under conditions of indeterminacy, these control laws and a parameter adjustment algorithm are used to synthesize adaptive control laws for the stable locally optimal control of both minimum-phase and nonminimum-phase processes.

A88-21677 Potential noise immunity of correlation-extremum systems of image correlation (Potentsial'naia pomekhozashchishchenost' korrelyatsionno-ekstremal'nykh sistem sovmeshchenia izobrazhenii) A. F. DANILKINA and P. M. IUKHNO, *Avtomatika i Telemekhanika* (ISSN 0005-2310), Aug. 1987, pp. 90-97. 7 Refs.

The potential noise immunity is estimated for correlation-extremum systems of image correlation by finding the limiting noise which maximizes errors in the estimation of the image-bias parameter with subsequent computation of the error expectation. Cases of constrained intensity and noise margin are examined.

A88-18096 Characteristics of the integral-adaptive self-scanning mode in multielement photodetectors (K svoistvam integral'no-adaptivnogo rezhima samoskanirovaniia v mnogoelementnykh fotopriemnikakh) B. G. PODLASKIN, *Zhurnal Tekhnicheskoi Fiziki* (ISSN 0044-4642), Vol. 57, Aug. 1987, pp. 1610-1616. 7 Refs.

The possibility of achieving self-scanning in multielement photodetectors adaptive to input illumination distributions and changes is examined. The self-scanning mode is based on the continuous comparison of the integral photocurrent values from different areas of the photodetector and accumulation of a difference signal. As a result, an aperture with adaptive parameters is formed, and a constant S/N ratio is maintained for the full scanning range. The self-scanning mode could be used in the vision circuits of automatic control and industrial robot systems.

A88-13717 Synthesis of robot manipulator control by the direct Liapunov method (Sintez upravlenii robotom-manipulatorom priamym metodom Liapunova) A. A. BRAGINA, G. S. CHERNORUTSKII, and V. F. SHTAKAN, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), July-Aug. 1987, pp. 76-81. 5 Refs.

The problem of manipulator control synthesis and manipulator stability analysis is solved using the direct Liapunov method, with a manipulator driven by armature-controlled electric motors used as an example. The fact that the system examined here has nine generalized coordinates (six electrical and three mechanical) is considered in the derivation of the dynamics equations. The problem of compensation for external effects is examined.

A88-12122 Analytical construction of a linear controller and a multidimensional analog of equations of rigid body dynamics (Analiticheskoe konstruirovaniie lineinogo reguliatora i mnogomernyi analog uravnenii dinamiki tverdogo tela) L. E. FAIBUSOVICH, *Avtomatika i Telemekhanika* (ISSN 0005-2310), July 1987, pp. 82-90. 10 Refs.

For a fixed method of synthesis (analytical construction of a linear controller), a set of matrices A is described which results in a closed $F(A)$ system with a specified spectrum. This set is separated into bundles of invariant tori of a fully integrable Hamiltonian system. Applications of this result are examined.

A88-12121 Image segmentation - State of the problem (Segmentatsiia izobrazheniia /Sostoiannie problemy/) V. I. BORISENKO, A. A. ZLATOPOL'SKII, and I. B. MUCHNIK, *Avtomatika i Telemekhanika* (ISSN 0005-2310), July 1987, pp. 3-56.

Methods for dividing halftone digital images into homogeneous regions (image segmentation) are examined with reference to recent published work in this field. The principal segmentation algorithms, such as clustering, building up, fragmentation, boundary analysis, and combined algorithms, are presented. Some specific operations involved in the processing of wave-type images are discussed.

A87-51068 Hybrid coding of images using vector differential PCM (Gibridnoe kodirovaniie izobrazheniia pri pomoshchi vektornoi differentsial'noi impul'snoi kodovoi modulatsii) I. A. KHMURNY and I. A. MIGALIK, *Radioelektronika* (ISSN 0021-3470), Vol. 30, July 1987, pp. 53-55. 7 Refs.

The principle behind vector differential pulse code modulation (VDPCM) for the coding of spectral coefficients is described. The optimization of hybrid coding systems on the basis of VDPCM is described, and theoretical results on the optimization of different versions of these systems are presented.

A88-12120 Synthesis of adaptive control systems for nonlinear singularly perturbed processes (Sintez adaptivnykh sistem upravleniia nelineinymi singuliarno vozmushchennymi ob'ektami) A. L. FRADKOV, *Avtomatika i Telemekhanika* (ISSN 0005-2310), June 1987, pp. 100-110. 24 Refs.

A method based on a steepest gradient algorithm is proposed for the synthesis of adaptive control systems for nonlinear singularly perturbed processes described by differential equations containing small parameters. Stability conditions for the synthesized systems are determined, and estimates of the permissible values of the small parameter are obtained. Analytical expressions are derived which define the applicability limits of the method.

A88-17851 Information and its theory in problems of the design of artificial-intelligence systems (Informatsiia i ee teorii v zadachakh postroeniia sistem iskusstvennogo intellekta) I. G. ROSTOVTSSEV, *Priboroostroenie* (ISSN 0021-3454), Vol. 30, Oct. 1987, pp. 8-16. 17 Refs.

Consideration is given to the question of determining the place of the concepts of information and information theory among the concepts of cybernetics, informatics, and philosophy in connection with the design of artificial-intelligence systems. The investigation is based on notions of semiotics using the techniques of traditional logic and the logic of names.

A88-17778 Cosmic weather and cybernetics (Kosmicheskaiia pogoda i kibernetika) SERGEI IVANOVICH AVDIUSHIN, ALEKSEI DMITRIEVICH DANILOV, and FISHEL' L'VOVICH DLIKMAN, *Priroda* (ISSN 0032-874X), Sept. 1987, pp. 18-27. 6 Refs.

The use of computer techniques to study cosmic weather (i.e., manifestations of solar activity in near-earth space, the ionosphere, and the lower atmosphere) is examined. A scheme of observational facilities for the acquisition of data on cosmic weather is described; the basic types of observations that yield information on the state of the ionosphere at different altitudes are considered; and the role of computers in the prediction of cosmic weather is assessed.

A87-35838 Filtering, control, and detection in the case of a sudden failure (of complex cybernetic system) (Fil'tratsiia, upravlenie, obnaruzhenie pri vnezapnoi razladke) I. A. BOGUSLAVSKII, *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 293, no. 1, 1987, pp. 45-47.

The allowance for sudden failure (SF) in optimal algorithms of data processing and control for complex cybernetic systems is examined. Three problems are solved in discrete time for SF conditions: (1) the determination of the vector of the a posteriori expectation of the vector of the phase coordinates of the linear system; (2) the synthesis of optimal control; and (3) the detection of the random moment of failure. It is shown that the solution of the first two problems does not require the solution of the third problem, which is considered necessary only when the detection of failure can produce a counteraction to the failure.

A87-10426 Stability with respect to a given number of variables (for rotational motion damping of asymmetric rigid body) (Ob ustoiichivosti po zadannomu chislu peremennnykh) V. I. VOROTNIKOV, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 50, May-June 1986, pp. 353-359. 15 Refs.

The paper is concerned with stability with respect to a specified number of variables in the case where the set of the variables changes as a function of the initial conditions. Stability conditions are derived by using the Liapunov method. The problem of the damping of rotational motions relative to the center of mass of an asymmetric rigid body is then investigated, and it is shown that the twisting of the body relative to one of the main axes of its ellipsoid can be achieved by using a single fixed jet engine for any initial perturbations, however large they may be.

A87-20365 Synthesis of the structure of complex entities (A combinatorial logic approach) (Russian book) (Sintez struktury slozhnykh ob'ektov /Logiko-kombinatornyi podkhod/) GEORGII I ANKUDINOV, Leningrad, Izdatel'stvo Leningradskogo Universiteta, 1986, 200 pp. 97 Refs.

A combinatorial logic approach is presented for the problem of selecting the structure of various cybernetic entities, such as individual elements, units, components, devices, algorithms, and systems. In accordance with this approach, structural elements are combined by using the formalism of Boolean functions and multidimensional grammars to obtain a compact representation of structural alternatives for the efficient solution of synthesis problems. The approach proposed here is examined from the standpoint of improving the quality and reducing the time of systems design.