Selected Abstracts from Soviet Aerospace Literature

Throughout 1987 each issue of the *AIAA Journal* will carry selected abstracts on leading research topics from the Soviet aerospace literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features recent structural mechanics. Support for assembling and publishing the selected abstracts has been provided by the Innovative Science and Technology Directorate of the Strategic Defense Initiative Organization (SDIO), with the cooperation and technical management of the abstract service by the Office of Naval Research (ONR). Abstracts in this listing—identified by the "A" numbers preceding them (which should be used for identifying and ordering material)—have been taken from the semimonthly abstract journal International Aerospace Abstracts (IAA), published by the American Institute of Aeronautics and Astronautics (AIAA) in cooperation with the National Aeronautics and Space Administration (NASA) under Contract No. NASW-4112. Additional material can be obtained through searching the Aerospace Database—available on DIALOG—or NASA RECON. Paper copies and microfiche of documents are available from AIAA Library, Technical Information Service, American Institute of Aeronautics and Astronautics, Inc., 555 W. 57th St., New York, NY 10019 (212) 247-6500, ext. 231. Again, use the "A" number to identify material you want.

Please direct questions concerning this abstract section of the *AIAA Journal* to John Newbauer, AIAA Administrator, Technical Publications.

A86-10736 **Determination of hydrodynamic responses acting on a vibrating profile (K opredeleniiu gidrodinamicheskikh reaktsii, deistvuiushchikh na kolebliushchiisia profil').** D. N. GORELOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), July-Aug. 1985, pp. 189-192.

Reference is made to Sedov's (1966) formulas for calculating integral hydrodynamic responses of an ideal fluid to a vibrating profile. These formulas are expressed in terms of contour integrals containing a complex potential of nonstationary flow past the profile. New formulas for calculating the same quantities are then proposed which are based on a representation of the fluid velocity component along the contour of the vibrating profile. It is shown that in certain cases, these formulas can be more useful than those of Sedov.

A86-11747 **Minimum-mass composite shells of revolution with constraints on natural frequencies (Sostavnye obolochki vrashcheniia minimal'noi massy s ogranicheniiami na sobstvennye chastoty).** N. V. ERMOLAEV, V. P. MALKOV, and V. L. TARASOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), July-Aug. 1985, pp. 161-165. 11 refs.

The objective of the study is to find a law of thickness distribution along the meridian of a composite shell of revolution that would satisfy the condition of minimum mass, with constraints on the minimum natural frequency. A numerical approach is proposed whereby the variational problem is reduced to a nonlinear programming problem which is then solved using a modified gradient projection method. The vibration frequencies and modes are determined by numerically integrating equations of linear shell theory and applying Godunov's orthogonal difference factorization procedure.

A86-11748 **Sensitivity analysis and optimal design of structures operating under dynamic loading (Analiz chuvstvitel'nosti i optimal'noe proektirovanie konstruktsii, rasschityvaemykh na dinamicheskie vozdeistviia).** N. V. BANICHUK, S. IU. IVANOVA, and A. V. SHARANIUK, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), July-Aug. 1985, pp. 166-172. 10 refs.

The paper is concerned with the optimization of a thin-walled composite structure whose behavior is described by using its finite-element representation. The mass and rigidity characteristics of the structural elements are used as the design variables; a procedure for minimizing the maximum deflection, used as a measure of the structure rigidity, is presented. The sensitivity of the maximum deflections to the variation of the mass and rigidity characteristics is analyzed for specified dynamic loads. Results of a numerical solution to the optimization problem for a dynamically loaded thin-walled laminate structure, with flow of an ideal gas around it, are presented.

A86-12545 **Characteristics of the design and fabrication of large aircraft components in composite materials (Osobennosti proektirovaniia i izgotovleniia krupnogabaritnykh agregatov letatel'nykh apparatov iz kompozitsionnykh materialov).** A. A. DUDCHENKO, V. I. REZNICHENKO, V. A. KOZLOV, and O. N. KOCHETKOVA, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 2, 1985, pp. 77-79.

A procedure for the design of thin-walled reinforced composite structures of the wing- and tail-unit type is presented. The approach used here involves separating the stress-strain state into the main, slowly varying stress-strain state and the edge effect. The main stress-strain state is analyzed using an updated version of the beam theory; the edge effect is treated on the basis of the Vlasov method. The design procedure is illustrated by a specific example.

A86-16695 **Anisotropy of the dissipative properties of fiber composites (Anizotropiia dissipativnykh svoistv voloknistykh kompozitov).** P. A. ZINOVEV and IU. N. ERMAKOV (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR) *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1985, pp. 816-825. 17 refs.

A mathematical model describing energy dissipation in multilayer fiber composites is presented, with dissipation constants assumed to be independent of the vibration amplitude of the composite. A structural model of a unidirectional composite is then examined which makes it possible to relate the dissipation coefficients of the fiber and the matrix, structural parameters of the material, and the elastic characteristics of the components to the dissipative characteristics of the material as a whole. It is shown that the dissipative properties of a transversally isotropic unidirectional composite are fully described by means of three independent dissipation coefficients. Expressions are presented for determining the dissipative properties of multilayer composites of arbitrary structure under conditions of plane stressed state.

A86-16699 **Minimum-weight design of composite panels for several loading schemes (Proektirovanie kompozitnykh panelei minimal'noi massy pri neskol'kikh sluchaiakh nagruzheniia).** A. A. KRIKANOV (Moskovskii Aviatsionnyi Tekhnologicheskii Institut, Moscow, USSR) *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1985, pp. 868-872.

The paper is concerned with the problem of the minimum-weight design of reinforced composite panels exposed to several load systems under conditions of plane stressed state. In the context of a filament model, it is shown that the optimum structure contains a maximum of three layers and that stresses in each layer reach the strength limit during at least one loading cycle. Algorithms for solving the problem are developed and implemented in computer software. The approach proposed here is illustrated by examples.

A86-16697 Applied theory of composite shells (Prikladnaia teoriia kompozitnykh obolochek). V. V. VASILEV (Moskovskii Aviatsionnyi Tekhnologicheskii Institut, Moscow, USSR) *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1985, pp. 843-852. 12 refs.

Equations of the general theory of orthotropic layered shells are obtained which allow for transverse shear and changes in the metric properties of the layers in the thickness direction. A theory of composite beam deflection is developed; the effective shear stiffness of layered composites is determined by averaging transverse tangential stresses and strains across the thickness. General problems involved in the development of an applied theory of composite shells are discussed.

A86-17465 Applied problems in the strength of thermally stressed structural elements (Russian book) (Prikladnye zadachi termoprochnosti elementov konstruktsii). V. S. ZARUBIN, *Moscow, Izdatel'stvo Mashinostroenie,* 1985, 296 pp. 64 refs.

Methods are presented for solving applied problems arising in the design and analysis of the performance of structures working under conditions of high thermal and mechanical stresses. The methods proposed here are based on current physical concepts of the structure of materials and of the micromechanisms of deformation and fracture at elevated temperatures. The methods can be used for the optimum design of structures and for the development of computer-aided design systems. An algorithm describing the inelastic deformation of a structural material under nonisothermal uniaxial loading and a computer program in FORTRAN implementing this algorithm are presented.

A86-17598 Bearing vibration (Russian book) (Vibratsiia podshipnikov). K. M. RAGULSKIS and A. IU. IURKAUSKAS, *Leningrad, Izdatel'stvo Mashinostroenie* (Biblioteka Inzhenera: Vibratsionnaia Tekhnika, No. 4), 1985, 120 pp. 57 refs.

The factors affecting the performance characteristics of bearings are analyzed, and the principal methods and equipment for measuring the processes occurring inside the bearings are described. In particular, analytical methods for determining vibrations and rotation resistance moments with allowance for the effect of the hydrodynamic oil film are discussed, as are methods for determining the elastic and damping characteristics of bearing and bearing assemblies. Experimental data for roll bearings are presented, and methods of their statistical analysis are discussed.

A86-18235 A method for optimizing thin-walled structures on the basis of variations in state space (Metod optimizatsii tonkostennykh konstruktsii na osnove variatsii v prostranstve sostoianiia). A. S. LIBERZON, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Sept.-Oct. 1985, pp. 141-149. 12 refs.

A method is proposed for the numerical solution of a class of optimal control problems that is relevant to many practical design problems. The method proposed here employs the formalism of consecutive variations in state space, with local strength conditions automatically satisfied at each step. The method is illustrated by examples involving the generalized plane stressed state and bending of elastic plates.

A86-18733 Aeroelasticity and dynamics of the helicopter structure (Russian book) (Aerouprugost' i dinamika konstruktsii vertoleta). O. P. BAKHOV, *Moscow, Izdatel'stvo Mashinostroenie*, 1985, 176 pp. 23 refs.

Methods for calculating and selecting helicopter parameters with allowance for the dynamics of the helicopter structure are presented. In particular, attention is given to the analysis of the self-oscillations of rotors mounted on an elastic structure, selection of stiffness and weight characteristics, and methods for the design optimization of the structures of heavy twin-rotor helicopters of transverse arrangement and tail rotors. Methods of experimental studies of helicopters and dynamically similar models are also examined.

A86-22587 Stability of aluminum alloy columns during compression in the elastic-plastic region (Ustoichivost' stoek iz aliuminievykh splavov v uprugoplasticheskoi oblasti pri szhatii). M. KH. MULLAGULOV and R. R. MAVLIUTOV (Ufimskii Aviatsionnyi Institut, Ufa, USSR) *Problemy Prochnosti* (ISSN 0556-171X), Dec. 1985, pp. 95-100. 8 refs.

Experimental critical stress diagrams are presented for a series of Duralumin-type aluminum alloys loaded in compression in the elastic-plastic region. Determinations are made of the coefficients of Yasinskii's (1952) formula, and graphs describing their dependence on the yield strength of the materials are plotted. A more accurate formula for the stability analysis of compressed columns in the elastic-plastic region is proposed. The case of a group of concentrated forces acting in the elastic-plastic region is analyzed, and formulas are obtained for calculating both individual and combined values of critical loads and the stability margin.

A86-18739 An introduction to the theory of nonlinear vibrations of aircraft structures (Russian book) (Vvedenie v teoriiu nelineinykh kolebanii aviakonstruktsii). R. E. LAMPER, *Moscow, Izdatel'stvo Mashinostroenie,* 1985, 88 pp. 12 refs.

The book is concerned with some typical problems encountered in the study of nonlinear vibrations of aircraft structures, such as skin panels, adjustable stabilizer, landing gear struts, and bluff parts of the airframe. Both qualitative methods of analysis on a phase plane and analytical methods are examined. Particular attention is given to small-parameter methods, including the Krylov-Bogoliubskii-Mitropolskii asymptotic method and the Van der Pol method. Finally, the principal characteristics of parametric vibrations are discussed.

A86-23651 The problem of optimizing the final design modifications of stochastic oscillatory systems (K zadache optimal'noi 'dorabotki' sluchainykh kolebatel'nykh sistem). S. V. ARINCHEV and V. V. BYSTROV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 3, 1985, pp. 3-7. 6 refs.

The problem of optimizing the final design modifications of flight vehicle structures is formulated in mathematical terms with allowance for random factors. The optimization problem consists in ensuring a specified degree of system reliability with minimum design changes. An algorithm for solving the problem is proposed, and an example is included.

A86-23676 The CREEP software pack for the finite element solution of structural creep problems (Programmnyi kompleks CREEP dlia resheniia zadach polzuchesti konstruktsii metodom konechnykh elementov). A. I. TEMNIKOV and N. M. IUNGERMAN, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 3, 1985, pp. 102-106.

A finite-element iteration algorithm for solving creep problems is presented, and a software pack, CREEP, based on this algorithm, which has been designed for solving a wide variety of structural creep problems, is briefly characterized. The program allows a maximum of 99 super-elements, with 24 degees of freedom per node and 3000 variables for each super-element. Solutions to several model problems, that have been obtained using the CREEP code, are presented as an example.

A86-23680 An example of the design of a crack-resistant plane composite loaded in tension (Primer proektirovaniia treshchinostoikogo rastianutogo ploskogo kompozita). A. K. MALMEISTER (AN LSSR, Institut Mekhaniki Polimerov, Riga, Latvian SSR) *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Nov.-Dec. 1985, pp. 977-983.

An optimal reinforcement scheme is developed for a plane fiber composite in order to achieve high crack resistance during tensile loading. It is shown that under conditions of plane tensile loading, about 25% of the reinforcing fibers should be oriented in the direction of the higher principal stress, 25% in the transverse direction, and the remaining 50% should be arranged in a criss-cross pattern at 45 deg to the main stresses.

A86-24287 Nonlinear integro-differential aeroelasticity equations (Nelineinye integrodifferentsial'nye uravneniia aerouprugosti). I. S. ASTAPOV, A. S. BELOTSERKOVSKII, and V. I. MOROZOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Nov.-Dec. 1985, pp. 61-70. 7 refs.

Nonlinear integro-differential nonstationary aeroelasticity equations are obtained for the general case of the three-dimensional motion of an elastic flight vehicle with loads in a nonstationary gas flow. Cauchy formulas for the Volterra integro-differential equations, unresolved with respect to the derivative, are presented. The formulas presented here are used for analyzing the stability, in the sense of Liapunov, of solutions to the integro-differential nonstationary aeroelasticity equations in the case where the integral kernels are replaced by approximation functions, with allowance made for the nonlinearity and motion parameters that are explicitly time-dependent.

A86-27076 Energy dissipation connected with vibrations of mechanical systems (Rasseianie energii pri kolebaniiakh mekhanicheskikh sistem). G. S. PISARENKO, Ed. *Kiev, Izdatel'stvo Naukova Dumka*, 1985, 312 pp. For individual items refer to A86-27077 – A86-27086.

Results of analytical and experimental studies of the vibrations of various elastic systems under both steady-state and transient conditions are presented, with particular attention given to the effect of energy dissipation. Topics discussed include dissipative properties of cyclically deformed materials, vibrations of machine parts and components, and aerodynamic damping of the vibrations of various mechanical systems. In particular, papers are presented on the nonlinear vibrations of rectangular plates with allowance for energy dissipation; vibrations of shells of imperfectly elastic materials with allowance for geometrical nonlinearity; mathematical models for studying aircraft vibrations with allowance for structural hysteresis; and the effect of a periodic aerodynamic load on the dynamic stress level of the rotor blades of a turbomachine.

A86-27081 Mathematical models for studying aircraft vibrations with allowance for structural hysteresis (Matematicheskie modeli dlia issledovaniia kolebanii samoleta s uchetom konstruktsionnogo gisterezisa). A. N. KOBTSEV, IN: Energy dissipation connected with vibrations of mechanical systems (A86-27076 11-39), *Kiev, Izdatel'stvo Naukova Dumka*, 1985, pp. 83-90.

Mathematical models are presented which have been developed for the analysis of the dynamic loading of nonlinearly elastic aircraft during their arbitrary spatial motion. The models proposed here reproduce the nonlinear properties of the chassis and the internal damping of the aircraft structure. Some modeling results are presented, with particular attention given to the effect of hysteresis and damping parameters on the dynamic loading and fatigue damage of the airframes of several kinds of commercial aircraft.

A86-27086 The effect of a periodic aerodynamic load on the dynamic stress level of the rotor blades of a turbomachine (Vliianie periodicheskoi aerodinamicheskoi nagruzki na uroven' dinamicheskikh napriazhenii rabochikh lopatok turbomashiny). IU. I.MITIUSHKIN and A. V. PEREVOZNIKOV, IN: Energy dissipation connected with vibrations of mechanical systems (A86-27076 11-39), *Kiev, Izdatel'stvo Naukova Dumka,* 1985, pp. 301-307. 7 refs.

Results of an analytical and experimental study of the forced vibrations of the rotor blades of an axial-flow turbine due to the intersection of the wakes behind the nozzle vanes are reported. It is shown that the quasi-stationary inharmonic variable aerodynamic load acting on a rotor blade can be represented by an odd trigonometric series with the number of harmonics limited to three. Under resonance vibrations at the first and third harmonics, a decrease in the reactivity gradient and the out-of-phase action of the periodic aerodynamic load lead to a decrease of the dynamic deflection stress on a rotor blade.

A86-27102 Optimization of the axisymmetric thermoelastic stresses and displacements of a thin circular plate (Optimizatsiia osesimetrichnikh termopruzhnikh napruzhen i peremishchen' krugloi plastini). V. M. VIGAK and A. V. IASINSKII (AN USSR, Institut Prikladnykh Problem Mekhaniki i Matematiki, Lvov, Ukrainian SSR) *Akademiia Nauk Ukrain'skoi RSR, Dopovidi, Seriia A Fiziko-Matematichni ta Tekhnichni Nauki* (ISSN 0002-3531), Dec. 1985, pp. 24-26.

The paper is concerned with the problem of the optimal control, by means of internal stationary heat sources, of the axisymmetric thermoelastic stresses and displacements of a thin circular plate heated from outside by convective heat transfer or by heat fluxes. By assuming the existence of a precise lower bound on a quadratic optimality criterion, the optimization problem is reduced to that of solving Fredholm's integral equation of the first kind. An analytical solution to the equation is obtained along with the necessary condition for the controllability of the thermally stressed state of the plate.

A86-28316 Problems in the dynamics of aircraft structures exposed to intensive acoustic loading (Zadachi dinamiki konstruktsii letatel'nykh apparatov pri intensivnykh akusticheskikh vozdeistviiakh). A. V. KARMISHIN and I. G. KILDIBEKOV, IN: Problems in aircraft reliability (A86-28303 12-38). *Moscow, Izdatel'stvo Mashinostroenie*, 1985, pp. 188-03. 42 refs.

The current theoretical and experimental research related to the strength of aircraft structures subjected to acoustic loading is briefly reviewed. In particular, attention is given to characteristics of the behavior of thin-walled structural elements under intensive acoustic loading, nonlinear characteristics of panels, and the effect of acoustic loading on the fatigue life and the bearing capacity of structural elements. The importance of considering acoustic loading in evaluating the reliability of aircraft structures is emphasized.

A86-44625 A method for the analysis of a cylindrical panel in a nonlinearly elastic medium under impulsive loading (K odnomu metodu rascheta tsilindricheskoi paneli v nelineino-uprugoi srede pod deistviem impul'sivnykh nagruzok). N. H. THINH (Rostovskii Inzhenerno-Stroitel'nyi Institut, Rostov-on-Don, USSR) *Akademiia Nauk Armianskoi SSR, Izvestiia, Mekhanika* (ISSN 0002-3051), Vol. 39, No. 1, 1986, pp. 38-46.

The stress-strain state of an impulsively loaded cylindrical panel in a nonlinearly elastic medium is analyzed for the case of an ideal dense medium and a multicomponent liquid medium characterized by the absence of tangential stresses. In particular, the interaction between the panel and the medium is investigated as a function of the panel and the medium is investigated as a function of the panel stiffness and of the parameters of an equation describing the behavior of the medium. It is shown that the effect of elastic deformations and velocities of panel surface points on the interaction between the panel and the medium becomes more pronounced with decreasing panel stiffness and increasing parameters of the equation of the medium behavior.

A86-28319 The life of reinforced thin-walled structures in a random force field (Dolgovechnost' tonkostennykh podkreplennykh konstruktsii v pole sluchainykh sil). V. N. MOSKALENKO, IN: Problems in aircraft reliability (A86-28303 12-38). *Moscow, Izdatel'stvo Mashinostroenie,* 1985, pp. 236-245.

Solutions are presented for problems of the natural vibrations of periodic and quasi-periodic systems in gas flow, as well as problems concerned with the determination of the life of reinforced structures. The properties of the frequency spectra and of the modes of the natural vibrations of periodic and quasi-periodic systems are discussed. It is noted that excitation generally occurs at the frequencies corresponding to the pass band of the elastic skin and at the frequencies corresponding to the preferred vibrations of the acoustic volume.

A86-28519 Theory and analysis of layered structures (Russian book) (Teoriia i raschet sloistykh konstruktsii). V. V. PIKUL, *Moscow, Izdatel'stvo Nauka,* 1985, 184 pp. 70 refs.

The principles governing the development of the two-dimensional theory of layered structures are presented, and the methods currently used in developing this theory are analyzed quantitatively and qualitatively. In particular, attention is given to layered structures of moderate thickness, including plates, geometrically nonlinear shallow shells, and shells of revolution. A method for calculating homogeneous and layered structures using series expansions is proposed which makes it possible to obtain a solution for arbitrary boundary conditions. Examples of analysis of beams, plates, and shells are presented.

A86-29842 Strength analysis of flight vehicles (Russian book) (Raschet na prochnost' letatel'nykh apparatov). A. S. AVDONIN and V. I. FIGUROVSKII, *Moscow, Izdatel'stvo Mashinostroenie,* 1985, 440 pp. 42 refs.

Applied methods of static strength analysis of flight vehicles, including aircraft, rockets, and spacecraft, are presented. In particular, attention is given to the analysis of loads acting on flight vehicles in flight and during landing; the heating of flight vehicle structures; and methods of the strength analysis of wings of various configurations, including finite element analysis in displacements and forces. The discussion also covers the strength analysis of wings and tail units, chassis, engine installations, fuselage, and other structures; minimum-weight design; and fatigue strength analysis.

A86-30914 Derivation of simplified equations in nonlinear dynamics of plates and shallow shells using the averaging method (Postroenie uproshchennykh uravnenii nelineinoi dinamiki plastin i pologikh obolochek na osnove metoda osredneniia). I. V. ANDRIANOV, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 50, Jan.-Feb. 1986, pp. 171-175. 26 refs.

A systematic procedure based on the averaging method for obtaining equations of the Berger type for rectangular and circular isotropic plates and isotropic and sandwich shells is described. It is shown that the smallness of the second deformation tensor invariant is of stochastic nature and that the Berger's (1955) hypothesis, in its pure form, is valid only for isotropic single-layer and transversally isotropic sandwich plates. For the systematic construction of a simplified theory of the Berger type, the concept of averaging is essential.

A86-30986 Three-dimensional theory of the stability of deformable bodies-Stability of structural elements (O trekhmernoi teorii ustoichivosti deformiruemykh tel Ustoichivost' elementov konstruktsii). A. N. GUZ, (AN USSR, Institut Mekhaniki, Kiev, Ukrainian SSR) *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 22, Feb. 1986, pp. 3-17. 21 refs.

A comparative analysis is made of the critical loads for thin-walled structures calculated by using three-dimensional linearized stability theory for deformable bodies and an approximate approach based on the three-dimensional stability theory. Results are also compared with those obtained by applying a series of refined two-dimensional theories. It is found that in the general case the use of the approximate approach is justified if an accuracy limited by that of the Kirchhoff-Love hypothesis is acceptable.

A86-30989 Solving axisymmetrical problems in the dynamics of cylindrical shells by numerical methods (K resheniiu osesimmetrichnykh zadach dinamiki tsilindricheskikh obolochek chislennymi metodami). P. Z. LUGOVOI and V. F. MEISH (AN USSR, Institut Geofiziki, Kiev, Ukrainian SSR) *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 22, Feb. 1986, pp. 29-33. 7 refs.

Difference methods for solving axisymmetric problems in the dynamics of elastic cylindrical shells are examined. The motion of a shell element is described by Timoshenko equations which allow for the effect of transverse shear and rotation inertia. These equations are solved using explicit and implicit finite-difference schemes. By analyzing the stability of these schemes on the basis of the spectral factor, the possibility of using an implicit difference scheme that does not require iteration is demonstrated. The approach proposed here is illustrated by a numerical example.

A86-35982 Efficient reinforcement of cylindrical shells by frames of varying stiffness under external pressure (Ratsional'noe podkreplenie tsilindricheskikh obolochek shpangontami peremennoi zhestkosti pri vneshnem davlenii). A. S. GORBATOV and IU. M. POCHTMAN, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 4, 1985, pp. 29-33.

A mathematical model for the weight optimization of reinforced cylindrical shells is developed with allowance for the moment nature of the subcritical state and the discrete nature of the reinforcement. The resulting nonlinear programming problem is solved on a computer using a random search method. Recommendations are given concerning the use of the results in shell design.

A86-39693 Technical stability of parametrically excited distributed processes (Tekhnicheskaia ustoichivost' parametricheski vozbuzhdaemykh raspredelennykh protsessov). K. S. MATVIICHUK, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 50, Mar.-Apr. 1986, pp. 210-218. 19 refs.

A study is made of the technical stability over a finite period of time of parametrically excited processes with distributed parameters, i.e., processes described by partial differential equations with time-dependent coefficients. Sufficient conditions for technical stability with respect to a specified measure are obtained by using the comparison method along with the second Liapunov method. The results obtained are applied to a problem concerning a clamped strut loaded by a longitudinal force that is periodic in time.

A86-41432 The conversion operator method in the problem of parametric identification of nonlinear mechanical systems (Metod preobrazuiushchego operatora v zadache parametricheskoi identifikatsii nelineinykh mekhanicheskikh sistem). S. F. REDKO, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Mar.-Apr. 1986, pp. 55-60. 10 refs.

The paper is concerned with the determination, from experimental data, of the coefficients of differential equations describing oscillations of nonlinear multiple-mass mechanical systems. The external perturbation forces, generally of stochastic nature, and system responses (displacements or velocities of its individual points), that are determined experimentally over a finite time interval, are used as the initial data on the motion of the system to be identified. An algorithm for solving the identification problem with minimum error is developed using the conversion operator method.

A85-49772 The effect of the impulsive nature of loading on the optimum material distribution in shells (Vpliv impul'snogo kharakteru navantazhennia na optimal'nii rozpodil materialu v obolonkakh O. V. ZHMURO, IU. M. POCHTMAN, and G. V. FILATOV (Dnepropetrovskii Khimiko-Tekhnologicheskii Institut, Dnepropetrovsk, Ukrainian SSR) *Akademiia Nauk Ukrain'skoi RSR, Dopovidi, Seriia A Fiziko-Matematichni ta Tekhnichni Nauki* (ISSN 0002-3531), July 1985, pp. 35-38.

A study is made of the effect of axial compressive impulsive loads on the optimum (with respect to weight) distribution of material in smooth cylindrical shells. The problem is formulated in terms of nonlinear programming, and a solution is obtained on the basis of the Kuhn-Tucker theorem.

A85-46141 Dynamic fracture mechanics (Russian book) (Dinamicheskaia mekhanika razrusheniia). V. Z. PARTON and V. G. BORISKOVSKII, *Moscow, Izdatel'stvo Mashinostroenie,* 1985, 264 pp. 86 refs.

The analytical, numerical, and experimental methods of dynamic fracture mechanics are reviewed in a systematic manner. Solutions are presented for problems concerning the harmonic vibrations of bodies of various configurations; the stress intensity factors under impact loading are determined analytically and numerically. The characteristics of steady-state and unsteady crack propagation are discussed, as are numerical and experimental methods for determining stress intensity factors for bodies with nonstationary cracks.

A86-44292 Mechanics of deformable solids (Russian book) (Mekhanika deformiruemogo tverdogo tela) IA. G. PANOVKO, *Moscow, Izdatel'stvo Nauka*, 1985, 288 pp. 82 refs.

Some new concepts in the mechanics of deformable solids are examined, as are some paradoxes and errors to be found in the literature on the subject. In particular, attention is given to the static deformation of elastic systems (the paradoxes of structure strengthening, "negativism" of elastic systems, and unexpected effects during passage to the limit) and problems in dynamics (e.g., Cambridge problems of chain motion, dynamics of elastic rotors, and passage to the limit in oscillation theory).

A86-45313 A method for solving problems in the nonlinear dynamics of plates and shells (Ob odnom metode resheniia zadach nelineinoi dinamiki plastin i obolochek). IU. N. KOPERNAK, I. N. PREOBRAZHENSKII, and V. I. RIZUN (Kommunarskii Gorno-Metallurgicheskii Institut, Kommunarsk, Ukrainian SSR) *Problemy Prochnosti* (ISSN 0556-171X), June 1986, pp. 92-95. 9 refs.

A new method for solving problems in the nonlinear dynamics of plates and shells is proposed which employs auxiliary functions and the Bellman-Kalaba quasi-linearization method. As an example, an analysis is made of the behavior of a closed cylindrical shell hinged at the outer edge and weakened by holes of arbitrary shape. Calculations are carried out for duralumin shells.

A86-44636 Principal elasticity equations in stresses and displacements (Osnovnye uravneniia uprugosti v napriazheniiakh i peremeshcheniiakh). E. G. SAIFULLIN, A. V. SACHENKOV, and R. M. TIMERBAEV, *Issledovaniia po Teorii Plastin i Obolochek* (ISSN 0578-9575), No. 18, 1985, pp. 66-79.

It is shown that, in the case of the real stress-strain state, there are seventeen forms of solutions to the Maxwell equilibrium equation. A stress function is then examined in the context of the principal form of solution, and it is shown that this function makes it possible to reduce the solution of three-dimensional elasticity problems to solving a single equation for the function. It is further shown that the solution of dynamic equations in displacements can be reduced to solving an equation for a single function whereby all displacement components are expressed in differential form.

A85-46061 The development of chaos in dynamic structure ensembles (Razvitie khaosa v ansambliakh dinamicheskikh struktur). I. S. ARANSON, A. V. GAPONOV-GREKHOV, and M. I. RABINOVICH (AN SSSR, Institut Prikladnoi Fiziki, Gorki, USSR) *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (ISSN 0044-4510), Vol. 89, July 1985, pp. 92-105. 23 refs.

The collective chaotic motions of a group of coupled dynamic structures are investigated theoretically. The organization of the dynamic structures was described using a discrete analog of the Ginzburg-Landau equation. The range of parameters is found in which all motions having the shape of a stationary travelling wave are unstable. It is shown that the instability of the motions is sufficient to cause complex regular regimes, in addition to chaotic regimes which appear as multidimensional strange attractors. Estimates of the upper limits of random entropy and the dimension of the strange attractor are given. The dependence of the coupling parameters between one- and two-dimensional structures on random motion entropy motion and the dimension of the strange attractor is calculated, and the results agree with the numerical estimates of Starobinets et al. (1984).

A85-49756 Influence of thermoelastic effects on the dynamics of gravity gradient spacecraft (Vliianie termouprugikh effektov na dinamiku gravitatsionnykh kosmicheskikh apparatov). E. M. POTAPENKO, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 23, July-Aug. 1985, pp. 560-573. 12 refs.

Equations of motion are obtained for a spacecraft with allowance for heat-induced deformations under the effect of solar radiation and thermoelastic oscillations of the reaction-boom gravity-gradient stabilizer. The influence of thermoelastic effects in the stabilizer on the spacecraft dynamics is investigated, and situations in which the thermoelastic oscillations can be unstable are defined. It is shown that damping systems adjusted toward libration damping have only a slight effect on the elastic oscillations. Analytical relationships are obtained which make it possible to optimize the damping of the elastic oscillations through the use of damping systems.

A86-41441 Stationary motion of a crack in a unidirectional composite (Statsionarnoe dvizhenie treshchiny v odnonapravlennom kompozite). A. M. MIKHAILOV and L. I. SLEPIAN, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Mar.-Apr. 1986, pp. 180-187. 16 refs.

The problem considered here concerns steady-state propagation of a free crack growing in the direction normal to the fibers in a discrete unidirectional composite. A long-wave approximation of the solution to this problem describes the motion of a crack in a homogeneous medium with certain effective characteristics resulting from an averaging of the elastic and inertial properties of the fibers and the matrix over the structure period. A comparison between the long-wave approximation and an exact solution yields an expression relating the effective surface energy which characterizes the fracture toughness of the medium, to the structural parameters of the composite and the crack growth rate.