

# Soviet Aerospace Literature

## This month: *Aviation Technology*

Throughout 1987 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 aviation technology.

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**A87-42152** An algorithm for specifying the directrix in the design of transition surfaces (for wing-fuselage joints) (Algoritm zadaniia napravliaushchei linii pri proektirovanii sopriagaiushchikh poverkhnostei). V. A. OSIPOV, F. K. CHISTIakov, and A. A. DUBANOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 1, 1987, pp. 114-116.

An algorithm for calculating transition surfaces, such as fillets, is proposed which is based on the structural-kinematic approach to the generation of cyclic surfaces. The method, which is valid for any analytically specified mated surfaces, is demonstrated by calculating a transition surface between a wing and a fuselage. A flow diagram of the algorithm is presented.

**A87-42151** Calculation of viscous incompressible flow past an airfoil (Raschet obtekaniiia profil'ia potokom v'iazkoj neszhimaemoi zhidkosti). Z. KH. NUGMANOV, V. A. OVCHINNIKOV, and V. G. PAVLOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 1, 1987, pp. 112, 113. 13 Refs.

An approximate method is presented for calculating viscous incompressible flow past an airfoil in the absence of a local separation zone. The approach described here uses a simple method for constructing the stagnation zone which is based on solving the inverse problem of determining the flow boundary from two specified boundary conditions (constant velocity and flow function in the separation zone). The direct problem of velocity determination is solved by using the method of basis functions, which makes it possible to significantly reduce the number of equations to be solved.

**A87-41914** Determination of the life of a typical filament-wound section of a helicopter rotor using a continuity criterion (Opredelenie dolgovechnosti tipovoi chasti namotannoi lopasti vinta vertolet'a po kriteriiu monolitnosti). G. P. ZAITSEV, (Moskovskii Aviatsionnyi Tekhnologicheskii Institut, Moscow, USSR) *Problemy Prochnosti* (ISSN 0556-171X), April 1987, pp. 19-23. 6 Refs.

A method is proposed whereby the fatigue life of a filament-wound helicopter rotor section is determined as a function of the winding angle using a continuity criterion characterizing the presence of defects, such as delamination or cracks, in the composite. A method is also presented for plotting a fatigue diagram for a material with a given winding angle. The diagram is plotted on the basis of a given number of cycles to fracture with allowance for the linearity criterion under short-term loading and the continuity criterion under cyclic loading.

**A87-24401** The structure and properties of binary magnesium-lithium alloys during die casting (Struktura i svoistva dvoynykh magnievoli'tievnykh splavov pri lit'e pod davleniem). L. V. NIKULIN, G. L. LYKASOVA, and N. M. SHKLIAEVA, (Peronskii Politekhicheskii Institut, Perm, USSR) *Metallovedenie i Termicheskaiia Obrabotka Metallov* (ISSN 0026-0819), No. 10, 1986, pp. 59-62.

The structure and mechanical properties of binary Mg-Li alloys are investigated experimentally with a view to developing new structural alloys for die casting. In particular, the mechanical properties and the hardness of Mg-Li alloys are determined as a function of Li content. It is shown that an optimum combination of strength and ductile characteristics is obtained in die-cast alloys with an alpha-beta structure. The higher strength of die-cast specimens in comparison with permanent-mold cast specimens is explained by the higher degree of grain refinement in the former. It is also noted that beta Mg-Al alloys, which are characterized by high specific strength, are of particular interest from the standpoint of the production of ultralight cast aircraft components.

**A87-40329** Low-power electric mechanisms of aircraft (Russian book) (Aviatsionnye elektromekhanizmy maloi moshchnosti). ISSAK IOSIFOVICH CHERNITSKII and IOSIF LAZAREVICH POTUPIKOV, Moscow, Izdatel'stvo Mashinostroenie, 1986, 264 pp.

The functions, principle of operation, and the main components of the low-power electric equipment of aircraft are examined, with attention given to electric motors, reducers, transmission mechanisms, safety mechanisms, and control and switching devices. The discussion covers the assembly, maintenance, and repair of low-power electric mechanisms, as well as testing and storage of electric hardware. Repair procedures for several types of electric motors and mechanisms are presented as an example.

**A87-36588** Flight testing of flight control and navigation equipment (Russian book) (Letnye ispytaniia sistem pilotazhno-navigatsionnogo oborudovaniia). EVGENII GRIGOREVICH KHARIN, ED. Moscow, Izdatel'stvo Mashinostroenie, 1986, 136 pp.

Most documents available from AIAA Technical Library Journal Announcement: IAA8715 The book contains methods and procedures for the flight testing of the principal flight control and navigation systems. The discussion covers an evaluation of the accuracy of automatic flight control systems from test data; flight testing and evaluation of gyroscopic and astronavigation systems; and determination of corrections for pitot-static tubes. Attention is also given to the testing of danger-warning systems and radio navigation and landing systems.

**A87-25268 Technology and the service life of aircraft (Russian book) (Tekhnologiya i obespechenie resursa samoletov).** LEON DAVIDOVICH BRONDZ. Moscow, Izdatel'stvo Mashinostroenie, 1986, 184 pp. 67 Refs.

The book is concerned with the problem of ensuring the required service life of aircraft components and structures through careful selection of materials-processing technology. Topics discussed include the physical aspect of the service life of aircraft, principal mechanisms of fatigue damage, and selection of materials for critical structures. The discussion also covers stress concentration, interaction of stress raisers, and localized stressed state; the effect of processing technology on materials and structures; and structural means and processing techniques for ensuring the required service life.

**A87-25265 Theory and analysis of aircraft turbomachines (2nd revised and enlarged edition) (Russian book) (Teoriya i raschet aviatsionnykh lopatochnykh mashin).** KONSTANTIN VASILEVICH KHOLSHCHEVNIKOV, OLEG NAUMOVICH EMIN, and VLADILEN TIKHONOVICH MITROKHIN. Moscow, Izdatel'stvo Mashinostroenie, 1986, 432 pp. 63 Refs.

The book is concerned with the theoretical fundamentals of turbines and with the characteristics of the working process of axial-flow, centrifugal, and combined compressors and of axial-flow and centripetal turbines. In particular, attention is given to the mathematical models and principal equations of turbomachines, similarity and modeling in the theory of turbines, thermodynamic processes in turbomachines and their efficiency, and the aerodynamics of flow and losses in the flow path of turbomachines. Also discussed are the performance characteristics of turbomachines and methods of their experimental determination, unstable operation of compressors, and optimization of the parameters of turbines of various types.

**A87-25227 The effect of the surface nonisothermality of a thin profile on the stability of a laminar boundary layer (Vliianie neizotermichnosti poverkhnosti tonkogo profil'na na ustoychivost' laminarnogo pogranichnogo sloia).** A. V. KAZAKOV and A. P. KURIACHII. Akademiya Nauk SSSR, Izvestiya, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), Sept.-Oct. 1986, pp. 36-42. 12 Refs.

A study is made of the possibility of delaying the turbulent transition by creating a nonuniform temperature distribution over the surface of thin profiles in the case where the presence of an unfavorable pressure gradient in external flow has a destabilizing effect on the boundary layer. Calculations are presented to show that, even in the presence of an unfavorable pressure gradient in external flow, the heating of a part of the profile surface near the leading edge and the generation of a certain temperature distribution over the body surface make it possible to increase the rise time of unstable perturbations and to delay the laminar-turbulent transition.

**A87-15229 Calculation of aerodynamic force coefficients (K raschetu koeffitsientov aerodinamicheskikh sil).** O. P. SIDOROV. Aviatsonnaia Tekhnika (ISSN 0579-2975), No. 2, 1986, pp. 109-112.

The graphic relationships based on experimental and theoretical data which have been used in several earlier studies to determine the aerodynamic characteristics of flight vehicles are presented here in analytical form. In particular, analytical expressions are given for the friction coefficient of the fuselage, aerodynamic braking coefficients in the region of the front and tail lifting surfaces, Mach number at the front and tail lifting surfaces, profile drag coefficient of the lifting surfaces, and wave-drag coefficient of the tail unit.

**A87-17599 The dynamics of gas turbine engine components in the presence of damage (Dinamika elementov gazoturbinnnykh dvigatelei pri nalichii povrezhdenii).** I. F. OBRAZTSOV, A. S. VOLMIR, and A. E. TIKHOMIROV. Akademiya Nauk SSSR, Doklady (ISSN 0002-3264), vol. 289, No. 6, 1986, pp. 1329-1331. 10 Refs.

A study is made of the dynamic characteristics of the individual components of gas turbine engines having cracks of varying length and different orientations. The modes and frequencies of such components are determined and compared with the parameters of the corresponding damage-free structures. In particular, results are presented for a defect-free turbine blade, a turbine blade with a transverse crack, and a turbine blade with a longitudinal crack.

**A87-21863 Repair of aircraft and helicopters (Russian book) (Remont samoletov i vertoletov).** K. IA. ORLOV and V. A. PARKHIMOVIKH. Moscow, Izdatel'stvo Transport, 1986, 296 pp. 8 Refs.

The basic principles and methods of the maintenance and repair of aircraft and helicopters are presented. In particular, attention is given to the organization of maintenance and repair processes, production and control documentation, quality assurance, and ground and flight testing. The diagnostic techniques discussed include visual identification of defects, capillary methods, magnetic inspection techniques, defect identification by the eddy current method, acoustic, radiographic, electronographic, and other methods of nondestructive evaluation. The discussion also covers defect classification methods for repairing specific aircraft components.

**A87-21670 Conditions for the excitation of torsional flutter in the blades of turbomachines with allowance for nonlinear factors (Uslovia vzbuzhdeniia krutil'nogo flattera lopatok turbomashin s ucheto nelineinykh faktorov).** V. A. BALALAEV and A. A. KAMINER. (AN USSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) Problemy Prochnosti (ISSN 0556-171X), Sept. 1986, pp. 81-86. 9 Refs.

A nonlinear model for torsional flutter excitation in turbine blades is proposed which makes it possible to investigate theoretically the conditions leading to the excitation of self-oscillations in the cascade-flow system using the small parameter method. The nonlinear factors accounting for the finite nature of the profile vibration amplitude are considered by retaining nonlinear terms in the expression for the aerodynamic damping moment. The conditions for the excitation of torsional flutter are determined both for the case of free torsional vibrations of the cascade and for the case of a small forcing sinusoidal moment acting on the system with a frequency that is far from resonance.

**A87-20401 A study of heat release in the primary zone of the combustion chamber of a gas-turbine engine (Issledovanie teplovydeleniia v pervichnoi zone kamery sgoraniia GTD).** V. G. CHUMACHENKO. Aviatsonnaia Tekhnika (ISSN 0579-2975), No. 3, 1986, pp. 82-84.

The effect of the mixture composition in the combustion chamber on heat release in the primary zone is investigated experimentally as a function of the primary zone length and burner location within the zone. It is shown that in combustion chambers using a prevaporized fuel, a reduction in the length of the primary zone from 0.68 to 0.35 gauge does not affect heat release within the chamber. Heat release in the primary zone is shown to decrease abruptly with mixture enrichment starting with an air excess ratio of 0.6.

**A87-20400 A method for evaluating the effect of the radial clearance on the efficiency of the turbocompressor during the selection of process parameters for a turbofan engine (Metod otsenki vliianiia radial'nogo zazoru na KPD turbokompessora na etape vybora parametrov rabochego protsessa TRDD).** E. D. STENKIN. Aviatsonnaia Tekhnika (ISSN 0579-2975), No. 3, 1986, pp. 79-82. 13 Refs.

Formulas are obtained for determining the polytropic and isentropic efficiency of the compressors and turbines of turbofan engines with allowance for the effect of radial clearances. Calculations based on these formulas indicate that radial clearances significantly effect the efficiency. It is noted that the use of the method is limited to the stage of preliminary design at which the rotor parameters are selected. New turbine designs with variable radial clearances, currently under development, will make it possible to minimize the clearances at cruising speeds and to stabilize them in operation; they will also call for a further refinement of the methods for evaluating the effect of the clearance on the efficiency.

**A87-20394 Optimization of a process for the surface hardening of structural parts using the fatigue limit criterion (Optimizatsiia tekhnologii poverkhnostnogo uprochneniia silovykh detalei po kriteriiu predela vyinosivosti).** G. N. KRAVCHENKO and I. N. CHILIKIN. Aviatsonnaia Tekhnika (ISSN 0579-2975), No. 3, 1986, pp. 63-65. 6 Refs.

Plastic surface treatments are commonly used for increasing the fatigue strength of aircraft structures. Here, an analytical-experimental method is proposed for selecting the principal parameters of shot blasting using a criterion based on the fatigue limit of the treated component. A block diagram of the procedure for determining the conditions of a shot blasting treatment is presented. The initial data for optimization include the mechanical characteristics of the part material, geometrical parameters of the part, the principal parameters characterizing the initial condition of the surface layer and characteristics of the shot blasting equipment.

**A87-20383 Invariance of the lateral disturbed motion of VTOL aircraft with a vector control system (Ob invariantnosti bokovogo vozmushchennogo dvizheniia SVVP s vektornoii sistemoi upravleniia).** V. I. PENTIUKHOV. Aviatsonnaia Tekhnika (ISSN 0579-2975), No. 3, 1986, pp. 32-35.

The principal properties of the lateral channels of a vector system for the control of the disturbed motion of VTOL aircraft are investigated for near-zero velocities. Conditions are determined under which the lateral channels of the vector control system are capable of ensuring the invariance of the angles of roll and yaw with respect to lateral wind gusts.

**A87-36088 Three-dimensional hypersonic flow of a dusty gas past a wing (O prostranstvennom obtekanii kryla giperzvukovym potokom zapylennogo gaza).** V. N. GOLUBKIN. PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Jan.-Feb. 1987, pp. 15-20. 12 Refs.

Three-dimensional hypersonic flow of a gas containing solid particles past a low-aspect-ratio wing is investigated analytically using the method of a thin shock layer. The analysis allows for the mutual effect of the solid and gas phases. The corresponding similarity parameters are defined, and the effect of a solid impurity on the pressure distribution over the wing is determined.

**A87-31730 Geometrically nonlinear theory for thin-walled rods (Geometricheskie nelineinaya teoriia tonkostennykh sterzhnei).** A. S. SAFONOV, *Aviatsionnaya Tekhnika* (ISSN 0579-2975), No. 4, 1986, pp. 51-54.

Reference is made to an earlier study (Pavlov and Safonov, 1983) in which a method was proposed for calculating thin-walled reinforced aircraft structures on the basis of a deformation scheme allowing for finite displacements of the structure axis. In the present study, this approach is further developed to allow the use of nonlinear deformation relationships for the main supporting elements of a structure. In this case, the resolvent equations of the method become nonlinear, providing for more rigorous determinations of the stress-strain state of thin-walled structures of the type commonly used in aircraft.

**A87-17587 Viscous flow past a wing profile (Obtekanie profilia kryla potokom вязкой zhidkosti).** I. V. ZELENOV and V. I. A. SHKADOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), July-Aug. 1986, pp. 29-36. 14 Refs.

Flow of an incompressible viscous fluid past a wing profile at low Reynolds numbers is investigated by solving numerically full Navier-Stokes equations. Stationary nonseparated and separated flows are determined, as are periodic regimes with the formation of a vortex street in the wake. The relationship between the Strouhal and Reynolds numbers determined from this linear dimension depends only slightly on the angle of attack and profile shape and is close to an experimentally obtained relationship for circular cylinders.

**A87-31722 Rheological characteristics of parts of MR material used in gas turbine engines (porous metallic wire analog of resin) (Reologicheskie kharakteristiki izdelii iz materiala MR, primeniamykh v GTD).** A. I. BELOUSOV, and A. A. TROINIKOV, *Aviatsionnaya Tekhnika* (ISSN 0579-2975), No. 4, 1986, pp. 16-20. 7 Refs.

A study is made of the rheological characteristics of the vibration-damping components of gas turbine engines made of MR material, a nonwoven porous material made of cold-pressed spiral wire. During the manufacture of damping elements, the diameter of the spiral increases by 1-3 percent and its stretch pitch decreases by 2-3 percent due to creep. The pressing of MR damping elements is accompanied by stress relaxation and creep (up to 10 percent); cold-pressed specimens partially recover their geometrical dimensions up to 2-4 percent. The linear dimensions of statically stabilized specimens increase in the direction of the pressing force by 1-2 percent. The rheological characteristics of the damping elements are examined during operation under static and dynamic loading.

**A87-26332 Vibrations of a cylindrical panel in a turbulent pressure pulsation field (Kolebaniia tsilindricheskoi paneli v pole turbulentnykh pul'satsii davleniia).** B. M. EFIMTSOV, *Akusticheskii Zhurnal* (ISSN 0320-7919), vol. 32, July-Aug. 1986, pp. 536-538. 6 Refs.

Experimental data are presented on the vibrations of a cylindrical panel of small curvature located at the surface of an aircraft in a zone where its vibrations are determined by the effect of the pressure pulsations of a turbulent boundary layer. An expression is obtained which provides an accurate description of the effect of the spatial-temporal structure of the field of the wall pressure pulsations of the turbulent boundary layer on the induced vibrations of thin plates and shells. This expression makes it possible to determine, with a high level of confidence, the vibrations of thin-walled structures in a turbulent boundary layer for arbitrary Mach numbers (at least, for Mach 1.61 or less) if they are known for any other (e.g., low) Mach number.

**A87-26313 Asymptotic expansions for thin axisymmetric cavities (Asimptoticheskie razlozheniia dlia tonkikh osesimmetrichnykh kav-ern).** A. G. PETROV, *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Sept.-Oct. 1986, pp. 45-49. 8 Refs.

The axisymmetric problem of cavitation flow is considered for small cavitation numbers. By using thin body theory, the problem of calculating the free boundary is reduced to that of solving an integrodifferential equation. An expression is obtained for an energy functional whose extremum is represented by a free boundary equation. The properties of the integral operator in the equation are investigated, and general-purpose asymptotic expansions are obtained which determine the free surface and the resistance coefficient and are independent of the cavitator shape. The Gurevich-Levinson law is refined for the case of asymptotic jet expansion.

**A87-39080 Theoretical foundations of a method for the strength analysis of fuselage frames (Teoreticheskie osnovy metoda rascheta na prochnost' shpangoutov aviakonstruktsii tipa fiuzeliiazha).** I. U. V. VASIL'EV and OL'GA I. MARTIN, *Revue Roumaine des Sciences Techniques, Serie de Mecanique Appliquee* (ISSN 0035-4074), vol. 31, Nov.-Dec. 1986, pp. 647-666.

A method for the strength analysis of fuselage frames is developed which is based on the minimum principle of additional potential strain energy of the elastic system considered. The calculation model is composed of a finite number of elements into which is divided the half of the frame that is symmetric with respect to the vertical axis. A functional is derived for the additional potential strain energy of the system, expressed through forces and moments in the elements of the calculation model; the overall stress state is divided into symmetric and asymmetric components, which are examined separately. The solution is obtained via the CADRO program.

**A87-20380 Construction of wing profiles on the basis of the theory of inverse boundary value problems using the method of quasi-solutions (Postroenie krylovykh profilei na osnove teorii obratnykh kraevykh zadach metodom kvazireshenii).** A. M. ELIZAROV, N. B. ILINSKII, and A. V. POTASHEV, *Aviatsionnaya Tekhnika* (ISSN 0579-2975), No. 3, 1986, pp. 18-22. 12 Refs.

A new method is presented for satisfying the closure conditions for a wing profile in the inverse boundary value problem in hydro- and aerodynamics. In this problem, an isolated wing profile is constructed on the basis of the velocity distribution specified on its surface as a function of the arc abscissa in the case of plane steady flow of an ideal incompressible fluid past the profile. Results of calculations illustrating the possibilities of this approach are presented.

**A87-39175 Theory and design of turbocompressors (2nd revised and enlarged edition) (Russian book) (Teoriia i raschet turbokompressorov).** KONSTANTIN PAVLOVICH SELEZNEV, IURII BORISOVICH GALERKIN, SERGEI ALEKSANDROVICH ANISIMOV, V. P. MITROFANOV, and I. U. S. PODOBUEV, *Leningrad, Izdatel'stvo Mashinostroenie*, 1986, 392 pp.

Problems related to the theory and design of turbocompressors are examined in the context of the gasdynamic theory of cascades. In particular, attention is given to the thermodynamic principles of turbomachine theory; fundamentals of gas dynamics; elements of wing theory; flow past plane, circular, annular, and three-dimensional cascades; and the design of turbocompressor stages. The discussion also includes the mathematical modeling of working processes in the flow path of turbocompressors.

**A87-36583 Aircraft assembly processes (Russian book) (Tekhnologiya sborki samoletov).** VLADISLAV IVANOVICH ERSHOV, VIKTOR VLADIMIROVICH PAVLOV, MIKHAIL FILIPPOVICH KASHIRIN, and VADIM SERGEEVICH KHUKHOREV, *Moscow, Izdatel'stvo Mashinostroenie*, 1986, 456 pp. 18 Refs.

The theory of aircraft assembly and the principal assembly processes are reviewed with particular attention to methods of computer-aided manufacture. Topics discussed include mathematical modeling of aircraft assembly organization; interchangeability of structural elements during assembly; typical assembly processes; and automatic control of the specialized equipment of assembly shops. Attention is also given to the evaluation of the cost effectiveness of aircraft assembly processes; design of assembly processes; and software support of CAD/CAM systems.

**A87-17564 Controlling the elastic vibrations of aircraft structures by means of control moment gyroscopes (Upravlenie uprugimi kolebaniiami aviatsionnykh konstruktsii pri pomoshchi silovykh giroskopov).** R. I. VINOGRADOV, O. I. GAINUTDINOV, I. U. V. PETROV, and I. U. PETROV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), July-Aug. 1986, pp. 41-43. 9 Refs.

The possibility of using control moment gyroscopes for the damping of the elastic vibrations of the structural elements of the airframe is examined with reference to the basic schemes of gyroscopic damping systems, mathematical and physical models of aircraft equipped with such systems, and methods for selecting system parameters. The gyroscope stabilization systems discussed are systems based on the rate gyroscope and those based on the spring gyro pendulum. The problem of improving the flutter characteristics of the Ilyushin aircraft is considered.

**A87-15569 Radio-navigation meters based on the K588 series microprocessor unit (Radionavigatsionnye izmeriteli na osnove MPK serii K588).** G. N. GROMOV, V. V. GAVRISHCHUK, R. V. DROZDOV, I. U. T. KRIVORUCHKO, B. V. PONOMARENKO, et al. *Radiotekhnika* (ISSN 0033-8486), July 1986, pp. 77-80. 14 Refs.

It is demonstrated that a unified family of onboard radio-navigation search-tracking meters can be built on the basis of the K588 series microprocessor unit. These meters provide for real-time signal processing and meet modern requirements on the organization of aircraft navigation instruments and the standardization of engineering solutions and software. The design of meters on the basis of a microcomputer with a parallel pipeline interface makes possible the independent improvement of the meter modules while retaining the appropriate sequence of engineering solutions by changing the software.

**A87-32723 A thin wing in compressible flow (2nd revised and enlarged edition) (Russian book) (Tonkoe krylo v szhimaemom potoke).** ELENA ALEKSANDROVNA KRASILSHCHIKOVA, *Moscow, Izdatel'stvo Nauka*, 1986, 288 pp. 109 Refs.

A mathematical theory is presented for small perturbations of a gas due to the motion of a thin wing and acoustic waves interacting with the wing. An efficient method based on the use of integral equations in characteristic coordinates is proposed and applied to the aerodynamic problem of supersonic flow of a gas past a finite wing of arbitrary planform; both the case of stationary flow and the case of steady-state harmonic vibration of a wing are considered. A method is also presented for solving three-dimensional nonstationary problems in gas dynamics by representing the velocity potential in the form of a surface integral in space-time variables. Solutions in quadratures are presented for a series of aerodynamic problems.

**A87-31725 Parameters for the evaluation of combined engine thrust vector control systems (Parametry dlia otsenki kombinirovannykh sistem upravleniia vektorom tiagi dvigatelei).** B. S. VINOGRADOV, V. I. PANCHENKO, and A. A. TURTANOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 4, 1986, pp. 28-33, 5 Refs.

A system of parameters and dimensionless factors is proposed for evaluating the efficiency of a combined thrust vector control system including gas injection into the supersonic section of the nozzle and ejection onto the external surface of the flight vehicle. The operation of the gas injection system is evaluated using such parameters as the flow rate of the injected gas, the lateral control force, the drop in axial thrust due to injection, the control moment, and flow rate through the main nozzle. The ejection system is evaluated on the basis of the normal force, the change in drag due to ejection, the control moment associated with ejection, and the flow rate of the ejected gas.

**A87-24468 Unsteady motion of a wing due to a vertical gust (Neustanovivsheesia dvizhenie kryla pri deistvii vertikal'nogo poryva).** B. A. ERSHOV, *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia* (ISSN 0024-0850), July 1986, pp. 100-102.

The paper is concerned with the vibration of an elastic wing of infinite span moving in an ideal compressible fluid. In particular, an analysis is made of the coupled vibrations of the wing induced by a vertical gust. A perturbation velocity potential is obtained for unsteady vibrations of the wing.

**A87-20404 A method for suppressing the flutter of a tail unit with a nonbalanced control surface (O sposobe podavleniia flattera opereniia s nesbalansirovannym rulem).** A. V. STARIKOV and S. K. CHERNIKOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 3, 1986, pp. 91, 92.

A method for suppressing flexural-rudder flutter is proposed which consists in shifting the hinge of the control surface of the tail unit relative to the stabilizer. Equations are presented which make it possible to evaluate the nature of tail unit oscillations for different values of the hinge displacement. For given stiffness values of a tail unit, it is always possible to select the shift of the control surface in such a way as to stabilize the structure against flexural-rudder flutter.

**A87-42140 Effect of the longitudinal static stability margin on the take-off mass of aircraft (Vliianie zapasa prodol'noi staticheskoi ustoiichivosti na vzletnuuiu massu samoleta).** V. P. SURIN, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 1, 1987, pp. 74-78.

Changes in the take-off mass of aircraft with the static stability margin are analyzed using the gradient method. Expressions are obtained for determining the coefficient of the increase in the take-off mass for two versions of initial data specification. It is noted that, by reducing the margin of longitudinal static stability and adopting a statically unstable scheme, it is possible to significantly improve the flight performance characteristics of maneuverable aircraft.

**A87-39218 Motion of a high-lift wing in supersonic flow (Dvizhenie mekhanizirovannogo kryla v sverkhzvukovom potoke).** B. A. ERSHOV, *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia* (ISSN 0024-0850), Oct. 1986, pp. 14-16.

For a high-lift wing of infinite span moving with a constant supersonic velocity, calculations are made of the lifting force, pitching moment, and hinge moments. The approach used here is based on a linear model of a thin wing and on a model of a high-lift wing whose median line consists of  $n$  hinged stiff links. Calculation results are presented for arbitrary motions of the wing elements.

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