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Russian and Japanese Aerospace Literature

Throughout 1992 the *AIAA Journal* will carry selected abstracts on leading research topics from Russian 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 Aircraft Design from Russia and Japan.

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Russian Aerospace Literature This month: *Aircraft Design*

A91-55694 Kamov Ka-62—The new Soviet helicopter for the 1990's. VENIAMIN A. KAS'IANIKOV, *Vertiflite* (ISSN 0042-4455), Vol. 37, Sept.–Oct. 1991, pp. 54–58.

A review is presented of a new multipurpose civil helicopter, seating 14 to 16 passengers, incorporating the very latest technology and design features. The Ka-62 is a single-rotor craft with a fan-in-fin tailrotor to counteract torque and provide directional control. The tail boom is constructed of composite material by filament winding technique and has a fairing accommodating the tail rotor transmission shaft, the directional control linkage, and the hydraulic system tubing. Attention is given to performance specifications, general dimension specifications, avionics, and mission configurations.

A91-28116 Consideration of the local singularities of a vortex lifting surface in the discrete vortex method (Uchet lokal'nykh osobennostei nesushchei vikhrevoi poverkhnosti v metode diskretnykh vikhrei). D. N. GORELOV and O. V. CHERNOV, *PMTF—Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Nov.–Dec. 1990, pp. 38–46. 9 Refs.

In the discrete vortex method, the problem of determining the control points can be solved separately for each wing area with allowance for local singularities of the vortex lifting surface prescribed in accordance with the selected class of solution for the initial singular integral equation. Here, control points are determined for a rectangular wing of finite span in the case where the wing is modeled by U-shaped vortices and closed vortex frames. Examples of calculations of aerodynamic characteristics and attached masses are presented to demonstrate the high efficiency of the computational schemes proposed here.

A91-28093 Effect of flow past the sting on the errors in determining the aerodynamic characteristics of a model in supersonic wind tunnels (Vliianie obduva derzhavki na pogreshnosti opredeleniia aerodinamicheskikh kharakteristik modeli v sverkhzvukovykh aerodinamicheskikh trubakh). A. V. LOKOTKO, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskie Nauki* (ISSN 0002-3434), Oct. 1990, pp. 38–43.

Flow past the sting may generate additional forces, leading to distortions in the measured aerodynamic loads on the model. The current method of allowing for the resulting errors is briefly described and shown to be insufficiently accurate, with the error sometimes reaching 7–10 percent for low-drag models. A more accurate method is proposed which allows for the pressure ratio and other significant factors associated with flow past the sting. The validity of the method is verified experimentally.

A91-39230 Sensitivity analysis, optimization, and data support in finite element systems (Analiz chuvstvitel'nosti, optimizatsiia i ikh informatsionnoe obespechenie v MKE-sistemakh). V. A. ZARUBIN, *Raschety na Prochnost'* (ISSN 0234-1905), No. 32, 1990, pp. 151–168. 16 Refs.

Methods of sensitivity analysis and structural optimization are examined with particular reference to a finite element system for the design of aircraft structures, RIPAK. The discussion focuses on the use of data bases and expert systems for increasing the efficiency of software implementations of the above methods. Particular attention is given to the use of optimality criteria and mathematical programming methods.

A91-28097 Methods for the comprehensive study of stresses acting on the tail section of flight vehicles in piston-type wind tunnels with powerplant jet modeling (Metody kompleksnogo issledovaniia nagruzok na kormovye chasti letatel'nykh apparatov v porshnevykh gazodinamicheskikh ustanovkakh s modelirovaniem strui dvigatel'nykh ustanovok). V. V. KISLYKH and I. A. RESHETIN, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskie Nauki* (ISSN 0002-3434), Oct. 1990, pp. 141–144.

The currently used methods for studying a wide class of jet flows under realistic conditions are examined with particular reference to the use of piston-type gasdynamic testing facilities. The high efficiency of such wind tunnels is due to the possibility of generating high-energy flows of short duration at pressures up to 2000 atm. A method for the comprehensive study of loading of the tail section of flight vehicles is described which uses a two-chamber adiabatic compression system with a pressure regulator as a jet generator. Results obtained for a 1:100 scale model are presented.

A91-23903 Effect of the initial flow conditions on the aerodynamic and acoustic characteristics of turbulent jets (Vliianie nachal'nykh uslovii istecheniia na aerodinamicheskie i akusticheskie kharakteristiki turbulentnykh strui). E. V. VLASOV, A. S. GINEVSKII, and R. K. KARAVOSOV, *Mechanics of nonuniform and turbulent flows* (A91-23901 08-34). Moscow, Izdatel'stvo Nauka, 1989, pp. 26–34. 19 Refs.

The effect of acoustic and vibrational perturbations on the aerodynamic characteristics of jets is investigated theoretically and experimentally for laminar and turbulent boundary layers of varying initial thickness. It is shown that, depending on the excitation frequency and amplitude, the acoustic and vibrational excitation of turbulent jets may either intensify or weaken mixing. The introduction of artificially generated acoustic or vibrational perturbations can thus be used as an efficient control method for turbulent jets.

A91-24311 Application of methods and tools for computer-aided design in investigation of prospects for civil aircraft progress. V. E. DENISOV, Proceedings of the 17th ICAS, Congress, Stockholm (Vol. 1), Sweden, Sept. 9–14, 1990, (A91-24301 09-01). Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1990, pp. 45–50.

An interactive computer workstation system has been developed for the preliminary design of prospective passenger aircraft. This user-friendly system is specifically tailored to (1) the selection of rational aircraft parameters, (2) the analysis of alternative design concepts for a given set of performance specifications, (3) the initial identification of those performance requirements, and (4) the selection of requirements with regard to the unification of engines for two distinct aircraft designs.

A91-18860 Theory of a deep dynamic stall on a wing (K teorii glubokogo dinamicheskogo sryva na kryle). G. I. TAGANOV, *PMTF—Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), May–June 1990, pp. 72–78. 9 Refs.

An attempt is made to develop a theory for the hysteresis of the aerodynamic characteristics of an airfoil under conditions of deep dynamic stall which could explain experimental data reported in the literature. The starting point of the analysis is the theory of quasi-stationary flow past a wing or supercritical angles of attack. It is found that the dynamic hysteresis of the periodic airfoil oscillations under conditions of deep dynamic stall is largely due to a change in the geometry (displacement thickness) of the vortex wake.

A91-17115 Development of computer-oriented means of nomogram processing for solving aerodynamics problems during preflight aircraft preparation (Razrabotka mashinno-orientirovannykh sredstv obrabotki nomogramm dlia resheniia zadach aerodinamiki pri podgotovke samoleta k poletu). O. V. ZHUK, N. A. LEVCHENKO, V. P. ZINCHENKO, and A. A. ERMOLENKO, *Samoletostroenie—Tekhnika Vozdushnogo Flota* (ISSN 0581-4634), No. 56, 1989, pp. 64–68.

The paper is concerned with some theoretical and practical aspects of the development of a complex of computer-oriented tools for the processing of nomograms required for the efficient determination of the take-off and landing characteristics of aircraft. In particular, attention is given to the development of a mathematical model for nomogram processing and efficient methods for determining its optimal parameters. The relative error of the computational algorithms based on the model described here does not exceed 2 percent.

A91-17101 Modeling of the combined operation of the helicopter rotor and fuselage (Modelirovanie sovmestnoi raboty nesushchego vinta i fiuzeliazha vertoleta). E. D. KOVALEV and V. I. MIRGOROD, *Samoletostroenie—Tekhnika Vozdushnogo Flota* (ISSN 0581-4634), No. 56, 1989, pp. 3–10.

The aerodynamic characteristics of a helicopter rotor are investigated analytically with allowance for the effects of rotor-fuselage interference. A mathematical model based on the discrete vortex method is proposed which makes it possible to determine the integral and distributed aerodynamic characteristics of a helicopter at stationary and transient regimes and to investigate flow fields in the vicinity of the rotor and the fuselage. The nonlinear nonstationary aerodynamic characteristics of a two-blade rotor are calculated as an example.

A91-13594 Aerodynamic shape optimization by the method of inverse boundary value problems (Optimizatsiia aerodinamicheskikh form metodom obratnykh kraevykh zadach). A. M. ELIZAROV and E. V. FEDOROV, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 54, July–Aug. 1990, pp. 571–580. 17 Refs.

Solutions are presented for variational problems concerning the shape of wing profiles with maximum lifting force, minimum drag, and maximum aerodynamic quality. Functionals are obtained whose minimization is equivalent to the optimization of the above parameters. The existence and uniqueness of the extreme points are analyzed, and examples of optimzed profiles are presented.

A90-46577 Analytical studies of the transonic flutter of aircraft (Raschetnye issledovaniia transzvukovogo flattera samoleta). S. I. KUZ'MINA, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 6, 1989, pp. 110–115.

The pressure coefficient and aerodynamic derivative of oscillating swept-back and swept-forward wings are calculated as a function of the Mach number using a program based on a numerical method for solving stationary Euler equations. By using this program and adopting the 'one-dimensional stationarity' hypothesis, a solution is obtained for the problem of determining the critical dynamic head of transonic flutter. The results are compared with those obtained by the panel method for subsonic flight velocities.

A90-44909 Ergonomic support of aircraft development processes (Ergonomicheskoe obespechenie protsessov razrabotki letatel'nykh apparatov). V. B. TARASOV and A. P. CHERNYSHEV, *Kibernetika i Vychislitel'naia Tekhnika* (ISSN 0454-9910), No. 84, 1989, pp. 96–102. 7 Refs.

Theoretical and methodological aspects of the ergonomic (human factors) support of aircraft development processes are examined. The necessity of taking the human factor into account in the computer-aided design of aircraft is established, and ways to do this are suggested.

A90-50817 Effect of incoming flow turbulence on the aerodynamic characteristics of a smooth symmetric body at large angles of attack (Vliianie stepeni turbulentnosti nabegaiushchego potoka na aerodinamicheskie kharakteristiki gladkogo osesimmetrichnogo tela pri bol'shikh uglakh ataki). S. A. FESHCHENKO and G. E. KHUDIAKOV, *Moskovskii Universitet, Vestnik, Seriia 1—Matematika, Mekhanika* (ISSN 0579-9368), July–Aug. 1990, pp. 95–98. 5 Refs.

The effect of the incoming flow turbulence on the aerodynamic characteristics of bodies at large angles of attack was investigated in a systematic manner in a subsonic wind tunnel using acylinder (0.15 m in diameter) with conical nose with a half-angle of taper of 12 degrees. The incoming flow velocity was 10-45 m/s; the turbulence of the incoming flow, determined thermoanemometrically from the longitudinal pulsed velocity component, was 0.2, 0.8, 3.5, and 5.8 percent; the angle of attack varied from 50 to 90 degrees. It is shown, in particular, that an increase in turbulence significantly affects the dependence of the lateral force coefficient, Czb, on the angle of attack.

A90-46564 Some possibilities of the vortex layer method for calculating the aerodynamic characteristics of an augmented airfoil interacting with the engine jet (Nekotorye vozmozhnosti metoda vikhrevogo sloia dlia rascheta aerodinamicheskikh kharakteristik mekhanizirovannogo profilia pri nalichii dopolnitel'nogo obduva struei dvigatelia). N. B. VORONTSOVA, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 6, 1989, pp. 1–7. 12 Refs.

The problem of interaction between an augmented profile and the engine jet is examined, with power supply modeled by discontinuous changes of the full and static pressures in the active section. Examples of calculations of various configurations are presented. Based on calculations of boundary layer characteristics, the optimal position of the slat and the change in the critical angle of attack of a slat-equipped augmented airfoil are determined for the case of airfoil-jet interaction.

A90-46561 Using the smoking-wire visualization method in the study of wing models at large angles of attack in subsonic wind tunnels (Ispol'zovanie vizualizatsii metodom dymiashchei provolochki pri issledovaniiakh modelei kryl'ev na bol'shikh uglakh ataki v dozvukovykh aerodinamicheskikh trubakh). V. I. BOGOMAZOV, S. I. INSHAKOV, and V. P. IANKOV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 5, 1989, pp. 113–117. 9 Refs.

Results of a smoking-wire visualization study are presented for wing models equipped with plane jet injection systems at supercritical angles of attack. The visualization data are compared with the results of weighing studies for the same wings. It is noted that the smoking wire method makes it possible to visualize both separated and nonseparated flows past models of different shapes with injection in subsonic wind tunnels at incoming flow velocities up to 15 m/s.

A90-46559 A generalized relation for the aerodynamic efficiency of plane bodies (Obobshchennaia zavisimost' dlia aerodinamicheskogo kachestva ploskikh tel). V. IA. ZAVERTAILO, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 5, 1989, pp. 104–109.

Generalized expressions for the aerodynamic efficiency of plane bodies are obtained which are applicable to a wide class of flight vehicles. The values of the aerodynamic efficiency and relative aerodynamic efficiency of plane bodies calculated using the expressions proposed here are found to be in satisfactory agreement with experimental data. Derivations of the formulas are presented.

A90-46554 Wing design optimization under stress-strain constraints using full-strength and minimum mass criteria (Optimizatsiia konstruktsii kryla pri ogranicheniiakh na velichinu napriazhenii i deformatsii s ispol'zovaniem kriteriev ravnoprochnosti i minimuma massy). E. I. KRIUCHKOV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 5, 1989, pp. 60–66. 5 Refs.

A method is proposed for optimizing the distribution of the load-bearing wing material using the minimum mass criterion in the presence of constraints with respect to stresses and strains. At the initial stage of the optimization procedure, a full-strength algorithm is used first and then a gradient method. The approach proposed here allows the use of simplified versions whereby gradients are calculated for the strain constraints only. The full-strength algorithm, the gradient projection method, and the combined method proposed here are compared using the optimization of a wing of small aspect ratio as an example.

A90-29005 Effect of the leading edge bluntness of a moderately swept wing on the aerodynamic characteristics of an aircraft model at subsonic and transonic velocities (Vliianie zatupleniia nosovoi chasti kryla umerennoi strelovidnosti na aerodinamicheskie kharakteristiki modeli samoleta pri dozvukovykh i okolozvukovykh skorostiakh). A. E. GONCHAR, V. A. ZHURAVLEV, V. P. KAZNEVSKII, and D. P. KROTKOV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 2, 1989, pp. 72–75.

Aerodynamic characteristics of an aircraft model with a moderately swept (40 deg) wing are presented for various degrees of leading edge bluntness. Experimental studies were conducted on the model at subsonic and transonic velocities (M 0.6–0.9) over the angle of attack range -2 to -28 deg. It is shown that the bluntness of the wing leading edge makes it possible to increase the maximum aerodynamic quality of the model at subsonic velocities (M 0.6, 0.7) and the aerodynamicquality at large angles of attack at subsonic and transonic velocities (M 0.6–0.9).

A90-44935 Aerodynamic drag of a pair of bodies in transonic and supersonic flow (Ob aerodinamicheskom soprotivlenii pary tel pri trans- i sverkhzvukovom obtekanii). V. S. KHLEBNIKOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), May–June 1990, pp. 152–156. 10 Refs.

The paper presents an experimental study of the aerodynamic characteristics of models of pairs of rod-linked bodies in the acceleration and deceleration sections in transonic and supersonic flows. Experiments were carried out in an open wind tunnel in the Mach range of 0.5-1.7 and in the Re range of 10 to the 5th to 1.5 × 10 to the 6th. The dependence of the drag coefficient of the model on the relative drag of the leading body is determined for the supersonic-flow case.

A90-42995 Calculation of nonseparated flow past a wing profile at large Reynolds numbers (O raschete bezotryvnogo obtekaniia krylovogo profilia pri bol'shikh chislakh Reinol'dsa). S. A. VELICHKO and IU. B. LIFSHITS, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 54, May–June 1990, pp. 435–442. 18 Refs.

A mathematical model describing nonseparated flow of an incompressible fluid past a wing profile at large Reynolds numbers is proposed which provides a way to determine the effect of viscosity on the aerodynamic characteristics. An analysis of the solution in the vicinity of the trailing edge makes it possible to formulate a refined analog of the Chaplygin-Zhukovskii condition. The accuracy of the results obtained is found to be comparable with that of experimental data.

A90-36031 Some aspects of the control system and power unit lead tests using in-flight simulator systems and flying test-beds. I. I. ZAITSEV, B. B. KOROVIN, and L. G. KHARAZIAN, 5th AIAA, SFTE, DGLR, and SETP, Biannual Flight Test Conference, Ontario, CA, May 22–24, 1990. 5 pp. (AIAA Paper 90-1323).

Methods for improving flight test effectiveness as part of the state-of-the-art aviation design process are presented. It is shown that flying test beds are an effective instrument for solving difficult problems of helicopter flight control system research tests, as well as for engine climatic tests. It is also demonstrated that in some cases engine climatic tests may be successfully carried out without transporting the flying test bed to remote climatic zones due to the use of physical simulation methods.

A90-30342 Aerodynamic characteristics of wave riders based on flows behind axisymmetric shock waves (Aerodinamicheskie kharakteristiki volnoletov, postroennykh na techeniiakh za osesimmetrichnymi skachkami uplotneniia). V. I. VORONIN and A. I. SHVETS, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), Jan.–Feb. 1990, pp. 183–185.

A method for the numerical calculation of the parameters of flow behind axisymmetric shock waves is briefly described. Aerodynamic characteristics are presented for wave riders whose compression surfaces are based on flows behind axisymmetric power-law shock waves. These characteristics are then compared with the aerodynamic characteristics of wave riders with plane compression surfaces.

A90-29191 The use of automated parametric analysis for selecting efficient structural schemes for wings (Primenenie avtomatizirovannogo parametricheskogo analiza dlia vybora ratsional'nykh konstruktivno-silovykh skhem kryla). A. K. KOVALEVSKII and E. K. LIPIN, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 3, 1989, pp. 91–100. 6 Refs.

A method and a set of parametric analysis software have been developed for selecting efficient wing structures with allowance for strength and stability constraints. Stress-strain analysis is carried out by the finite element method. As an example, structural optimization of a low-aspect-ratio wing is conducted for three loading cases. It is shown that the lowest mass is obtained with a multiple-spar wing.

A90-29188 Efficiency of using a multiple-wall torsion box in the load-bearing structures of lifting surfaces (Ob effektivnosti primeneniia mnogostenochnogo kessona v konstruktivno-silovoi skheme nesushchei poverkhnosti). E. K. LIPIN, V. E. TENIAEVA, and V. M. FROLOV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 3, 1989, pp. 61–71.

The stiffness and mass characteristics of the multiple-wall and multiple-rib versions of the torsion box of the central lifting surface of aircraft were studied for the case of concentrated and distributed loading. The advantages of using a multiple-wall torsion box, rather than the multiple-rib box, for highly loaded lifting surface are demonstrated.

A90-29184 Combined effect of viscosity and bluntness on the aerodynamic efficiency of a delta wing in flow with a high supersonic velocity (Sovmestnoe vliianie viazkosti i zatupleniia na aerodinamicheskoe kachestvo treugol'nogo kryla v potoke s bol'shoi sverkhzvukovoi skorost'iu). P. I. GORENBUKH and V. V. NOSOV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 3, 1989, pp. 30–36. 7 Refs.

Supersonic flow past plane delta wings was investigated experimentally in the Reynolds number range 120,000-3,000. In the case of nonviscous flow, the maximum aerodynamic efficiency is shown to correlate with the sigma parameter. For sigma greater than 1/3, the effect of the bluntness of the leading edges of a highly swept wing is negligible, and its aerodynamic characteristics in the region of maximum aerodynamic efficiency are close to those of a wing with a sharp leading edge.

A90-35686 Role of human factors widening in new aircraft design. L. M. BERESTOV, S. IU. BORIS, V. V. GORIN, and V. V. ROGOZIN, *ICAO Bulletin* (ISSN 0018-8778), Vol. 44, Dec. 1989, pp. 21–24.

The use of an airborne laboratory to study the relationship between flight crews and flight equipment is discussed. The laboratory is based on a medium size, trunk-route aircraft, the TU-154 M, and is used in the USSR. The laboratory's instrumentation, data processing system, and simulation equipment are described. Results are presented from a study on various types of side-stick controllers (SSCs), focusing on the influence of the type and location of the SSC on the control process, the optimum force-displacement characteristics of the SSC, the optimum aircraft controllability characteristics using the SSC, pilot load, and the degree of adaptation by pilots to the SSC. Consideration is given to the importance of taking human factors into account during the process of aircraft design.

A90-29187 A study of approximately optimal cruising flight regimes of variable-mass aircraft (Issledovanie priblizhenno optimal'nykh kreiserskikh rezhimov poleta samoleta peremennoi massy). O. V. BALABANOV and V. T. PASHINTSEV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 3, 1989, pp. 52–60. 5 Refs.

An energy model of the controlled motion of variable-mass aircraft is used for the approximate synthesis of the optimal thrust and flight height control. A family of approximately optimal flight trajectories is obtained, with minimum fuel consumption for a given flight distance. Modified versions of the approximate synthesis are presented which allow for changes in the wind velocity component with height and for an additional constraint on the finite flight time.

A90-29182 Calculation of the drag of fuselage tail sections of different shapes in supersonic flow of a nonviscous gas (Raschet soprotivleniia khvostovykh chastei fiuzeliazhei razlichnykh form pri obtekanii sverkhzvukovym potokom neviazkogo gaza). S. A. SHCHENNIKOV and S. V. IAGUDIN, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 3, 1989, pp. 10–19. 9 Refs.

Calculation of supersonic flow past fuselage tail sections and engine nacelles of different shapes are presented. The three-dimensional flow of a nonviscous gas was calculated using McCormack's scheme; axisymmetric flow was calculated by the characteristic method. The drag coefficients of axisymmetric and plane tail sections of different cross-sectional width/height ratios are compared assuming equal cross-sectional areas.

A90-29004 Using the lifting line theory for calculating straight wings of arbitrary profile (Primenenie teorii nesushchei linii dlia rascheta priamykh kryl'ev s proizvol'nymi profiliami). N. A. CHICHEROV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 2, 1989, pp. 66–71. 11 Refs.

A wing of large aspect ratio is examined in the context of the lifting line theory, and a lifting line equation is written in a form different from the Prandtl equation. Based on this equation, a modified version of the discrete vortex method is proposed for calculating the aerodynamic characteristics of straight wings with allowance for the real profile characteristics. The results obtained using the approach proposed here are in good agreement with experimental results from different wind tunnels.

A90-28994 A method for recalculating the temperature fields of aircraft structures for different experimental conditions (Metodika perescheta temperaturnykh polei aviakonstruktsii pri razlichnykh usloviiakh provedeniia eksperimenta). A. T. USOV and L. A. SHEVCHUK, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 1, 1989, pp. 126–130.

Algorithms and a program are presented by means of which the temperatures of structural elements, measured under one set of conditions, can be recalculated for a different set of conditions. The recalculation algorithm involves solving, by an iteration method, a system of equations based on the approximation of the measured temperature by integral sums of the convolution integral type and then determining, in discrete form, the function of the system responseto a single pulse of thermal loading.

A90-28993 A study of the strength characteristics of a twin-fuselage aircraft with a trapezoid wing system (Issledovanie prochnostnykh kharakteristik dvukhfiuzeliazhnogo samoleta s zamknutoi sistemoi kryl'ev). V. N. SEMENOV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 1, 1989, pp. 120–125. 7 Refs.

The advantages of a twin-fuselage aircraft scheme with a trapezoid wing system are examined in terms of the weight coefficient and stiffness. A comparison of the strength characteristics is made with reference to data for a 250-passenger twin-fuselage aircraft with a take-off mass of about 112 tons. It is shown, in particular, that the use of a trapezoid wing with a twin-fuselage scheme provides an additional 20-27-percent weight reduction of the wing system, with almost a factor of 5 reduction in the maximum wing deflection.

A90-23401 Selection of the blended wing configuration for light aircraft (Vybor formy sostavnogo kryla dlia legkogo samoleta). A. A. BADIAGIN, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 4, 1989, pp. 3–5.

The paper is concerned with the problem of selecting the optimum planform of a blended wing/fuselage for. In particular, an optimization procedure is presented for the ratio of the cantilever and lifting body areas. The efficiency of a lifting body of tapered planform is demonstrated with reference to the results of calculations for a specific case.

A90-28991 Aerodynamic quality of a plane delta wing with blunted edges at large supersonic flow velocities (Aerodinamicheskoe kachestvo ploskogo treugol'nogo kryla s zatuplennymi kromkami pri bol'shikh sverkhzvukovykh skorostiakh obtekaniia). P. I. GORENBUKH, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 1, 1989, pp. 108–112.

Experimental data on the aerodynamic quality of plane delta wings with blunted edges are reported for free-stream Mach 9 and Reynolds numbers of 1.2 x 10 to the 6th - 4 x 10 to the 5th. The data are compared with results calculated by the method proposed by Nikolaev (1987). A unified analytical-experimental dependence is obtained for the relative aerodynamic quality near the maximum-aerodynamic-quality regime.

A90-28989 Some characteristics of changes in the nonstationary aerodynamic characteristics of a wing profile with an aileron in transonic flow (Nekotorye zakonomernosti izmeneniia nestatsionarnykh aerodinamicheskikh kharakteristik profilia kryla s eleronom v transzvukovom potoke). IU. P. NUSHTAEV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 1, 1989, pp. 97–102.

Changes in the nonstationary aerodynamic characteristics of a wing profile with an aileron in flow of an ideal gas are investigated numerically under conditions of harmonic oscillations in relation to the relative profile thickness, oscillation frequency, and rotation axis position. Vortex-free isentropic flow of an ideal gas is analyzed assuming that perturbations introduced by an oscillating airfoil and the frequencies of the oscillatory motions are small. The problem is reduced to that of solving the well-known Lin-Reissner-Jsien equation for the small perturbation potential.

A90-14560 Dynamic analysis of lifting surfaces of small relative thickness in the case of finite displacements (O dinamicheskom raschete nesushchikh poverkhnostei maloi otnositel'noi tolshchiny pri konechnykh peremeshcheniiakh). V. G. GAINUTDINOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 3, 1989, pp. 19–23. 5 Refs.

An algorithm is presented for the dynamic analysis of flexible lifting surfaces modeled by thin and thin-walled rods as well as lifting surfaces described by more complex models. Attention is given to lifting surfaces of large and moderate aspect ratios and lifting surfaces whose cross sections move like rigid disks under deformation. Equations of motion are obtained for the case of finite displacements, and an example of calculations is presented.

A90-18305 Application of the finite element method to the problem of rotational flow around wings. A. L. KUDRIAVTSEV and N. B. PLISSOV, Finite element analysis in fluids; Proceedings of the Seventh International Conference on Finite Element Methods in Flow Problems, Huntsville, AL, Apr. 3–7, 1989 (A90-18233 06-34). Huntsville, AL, University of Alabama in Huntsville Press, 1989, pp. 851–856.

A numerical method based on the solution of a boundary value problem for a nonlinear differential equation is used to determine the characteristics of an airfoil in a nonuniform flow. In addition, the characteristics of a finite-span wing are obtained through a numerical treatment of lifting-line theory suggested by Karman and Tsien (1945). The finite element method is used to solve these two problems. Numerical examples are presented which show the significant effect of vorticity on the aerodynamic characteristics of wings.

A90-14556 Structural analysis of the horizontal tail surfaces of subsonic transport aircraft (Strukturnyi analiz ploshchadi gorizontal'nogo operenija dozvukovogo transportnogo samoleta). V. P. GOGOLIN, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 3, 1989, pp. 6–10.

The structure of the horizontal tail surfaces of subsonic transport aircraft is analyzed with allowance for alignment tolerances, static stability margin, and zero-lift balancing. The analysis has made it possible to develop an algorithm for solving problems involving the determination of maximum weight requirements for the implementation of novel design solutions. The discussion is illustrated by an example for a hypothetical aircraft.

A90-28979 Using the method of symmetric singularities for calculating flow past subsonic flight vehicles (Primenenie metoda simmetrichnykh osobennostei dlia rascheta obtekaniia dozvukovykh letatel'nykh apparatov). N. N. GLUSHKOV, IU. L. INESHIN, and IU. N. SVIRIDENKO, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 20, No. 1, 1989, pp. 23–28. 8 Refs.

A panel method is presented for calculating flow past aircraft in the context of the potential theory of an incompressible fluid. The method makes it possible to calculate the complete aircraft configuration, including engine nacelles, suspended loads, and pylons. A characteristic feature of the present method is the principle of symmetric distribution of sources (sinks) and vortices on the opposite surfaces of the lifting elements. Comparisons are made with other analytical methods and experimental data. Isobar calculations over the surface of a transport aircraft are conducted as an example.

A89-54619 Separated flow past a concave conical wing of large transverse curvature at small angles of attack (Otryvnoe obtekanie vognutogo konicheskogo kryla s bol'shoi poperechnoi kriviznoi pod nebol'shimi uglami ataki). V. L. BORSHCH and V. V. KRAVETS, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), July–Aug. 1989, pp. 130–136. 10 Refs.

Laminar flow past a wing model in the form of a circular half-cone with an angle of taper of 34 deg was modeled numerically in the context of a quasi-conical approximation for three-dimensional Navier-Stokes equations. Under such an assumption, the displacement of external nonviscous flow due to intense flow separation beyond the leading edges leads to flow patterns similar to those observed in the case of V-shaped wings with a bend in the transverse profile. A weak secondary separation is shown to occur under primary separation regions at nonzero angles of attack.

A89-52852 A second-order finite-difference scheme for calculating three-dimensional supersonic flows of an ideal gas (Konechno-raznostnaia skhema vtorogo poriadka dlia rascheta trekhmernykh sverkhzvukovykh techenii ideal'nogo gaza). M. K. AUKIN and R. K. TAGIROV, *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 29, July 1989, pp. 1057–1066. 13 Refs.

An explicit second-order finite-difference scheme for calculating three-dimensional stationary supersonic flows of an inviscid gas is proposed, and some methodological features of the scheme are discussed. Results of calculations for conical flows and a submerged jet are found to be in good agreement with the results obtained by using some well-known second-order schemes. Examples of calculations for complex three-dimensional supersonic flows are presented.

Japanese Aerospace Literature This month: *Aircraft Design*

A91-49178 Quick automatic evaluation of propeller performance combined to an engine. SHIGENORI ANDO and MICHIYO KATO, *Japan Society for Aeronautical and Space Sciences Journal* (ISSN 0021-4663), Vol. 39, No. 449, 1991, pp. 294–302. 8 Refs.

A quick automatic method is presented for evaluating a propeller performance combined to an engine. The formulation is obtained through drastic simplification by retaining the essential parts only. A scheme—'thrust-consistent scheme'—is constructed for the part of propeller analysis. Accuracy examination has been made both for the static and the forward-moving conditions, and confirmed to be within 10 percent errors. One example of application to an engine-propeller combination is presented, which shows that the present method can be used to select the best set of several parameters such as diameter, solidity, and pitch.

A91-46819 Fundamental philosophy of PAR-WIG design at USA-DTNSRDC. SHIGENORI ANDO, *Japan Society for Aeronautical and Space Sciences Journal* (ISSN 0021-4663), Vol. 39, No. 448, 1991, pp. 218–226. 6 Refs.

Problems with the first-generation WIG (wing-in-ground) are discussed. The PAR (power augmented ram) technology is classified into three types: (1) wing PAR cushion; (2) fuselage PAR cushion; and (3) LEX/TEX PAR cushion. IGE (in-ground-effect) and OGE (off-ground-effect) improvements are addressed. Three types PAR-WIG designs are presented, and a PAR-WIG water impact design methodology is described.

A91-46820 Practical application of the wing-in-ground (WIG) effect vehicle. SYOZO KUBO, TETUYA KAWAMURA, TAKENORI MATSUBARA, and TOSHIO MATSUOKA, *Japan Society for Aeronautical and Space Sciences Journal* (ISSN 0021-4663), Vol. 39, No. 448, 1991, pp. 236–242. 31 Refs.

Possible future applications of the WIG-effect vehicle are considered. The IGE (in-ground-effect) and OGE (off-ground-effect) techniques are examined, and the aerodynamic problems of the WIG are discussed. Aspects of WIG technology development are examined, including wing efficiency, off-water and on-water problems, and the use of new materials. Environmental pollution concerns, including noise and exhaust emissions, are addressed.

A91-42817 Parametric study of airframe-integrated scramjet cooling requirement. TAKESHI KANDA, GORO MASUYA, YOSHIO WAKAMATSU, NOBUO CHINZEI, and AKIO KANMURI, *Journal of Propulsion and Power* (ISSN 0748-4658), Vol. 7, May–June 1991, pp. 431–436. 17 Refs.

The cooling requirement of a hydrogen-fueled airframe-integrated scramjet engine as well as an airframe is examined, and effects of various parameters including flight Mach number, flight dynamic pressure, engine wall temperature, and engine scale, on the engine characteristics are analyzed. The coolant required for the airframe is about 20 percent of the total coolant. Simple equations that correlate coolant flow rate with those parameters are derived.