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Russian and Japanese Aerospace Literature

During 1995 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 Supersonic Flow from Russia and Computational Fluid Dynamics from Japan.

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Russian Aerospace Literature This month: *Supersonic Flow*

A94-23854 The pattern of supersonic flow past a pair of bodies and flow restructuring between the bodies (Kartina sverkhzvukovogo obtekaniya pary tel i perestrojka techeniya mezhdu nimi). V. S. KHLEBNIKOV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 1, Feb. 1994, pp. 158–165. In Russian. 18 Refs. Documents available from Aeroplus Dispatch.

Flow patterns are analyzed for the case of symmetric and nonsymmetric supersonic flow past two separate bodies and two bodies connected with each other. Based on a large amount of experimental data, semiempirical expressions are obtained which relate the critical parameters of the direct and inverse flow restructuring to the relative dimensions of the body and its shape, body permeability, and Mach and Reynolds numbers.

A94-20925 Numerical calculation of a three-dimensional laminar compressible boundary layer on profiled delta wings with supersonic leading edges (Chislennyj raschet trekhmernogo laminarnogo szhimaemogo pogranichnogo sloya na profilirovannykh treugol'nykh kryl'yakh so sverkhzvukovymi perednimi kromkami). V. N. VETLUTSKIJ and T. V. POPLAVSKAYA, *Prikladnaya Mekhanika i Tekhnicheskaya Fizika* (ISSN 0869-5032), Vol. 34, No. 5, Oct. 1993, pp. 88–94. In Russian. 12 Refs. Documents available from Aeroplus Dispatch.

The problem of a three-dimensional compressible laminary boundary layer on profiled wings with supersonic leading edges is stated, and a computation algorithm is presented. Results of an implementation of the algorithm for the windward side and the leeside of a wing with a sweep angle of 45 deg are presented for Mach 3; results for the windward side of a wing of the same sweep angle are presented for Mach 3 and 6 and various angles of attack. The effect of the Mach number, angle of attack, and relative profile thickness on the friction coefficient and its contribution of the total drag of the wing are investigated.

A94-20919 Changes in the shape and characteristics of a burning body in supersonic flow (Izmenenije formy goriashchego tela i jego kharakteristik pri sverkhzvukovom obtekaniji). S. YU. MENZHINSKIJ and N. N. PILYUGIN, *Prikladnaya Mekhanika i Tekhnicheskaya Fizika* (ISSN 0869-5032), Vol. 34, No. 4, Aug. 1993, pp. 46–55. In Russian. 9 Refs. Documents available from Aeroplus Dispatch.

Changes in the shape of burning spherical and parabolic bodies are determined for the case of hypersonic motion along a ballistic trajectory. Determinations are also made of the drag of the bodies and their mass at the end of the trajectory. Changes of the curvature radius and lateral surface (which determines the luminescence of the surface of burning models) with time are calculated.

A94-20907 Flow past a spherical blunt body in a supersonic turbulent wake (Obtekanie sfericheskogo zatupleniya v sverkhzvukovom turbulentnom slede). YU. P. GOLOVACHEV and V. V. ZEMLYAKOV, *Zhurnal Vychislitel'noj Matematiki i Matematicheskoj Fiziki* (ISSN 0044-4669), Vol. 33, No. 9, Sept. 1993, pp. 1422–1427. In Russian. 9 Refs. Documents available from Aeroplus Dispatch.

Axisymmetric turbulent flow in a shock layer at the surface of a spherical blunt body located in the far wake region is analyzed. The shock layer flow is described by simplified Reynolds equations, and a solution is obtained using an implicit exponential scheme. Results of calculations are presented to illustrate changes in the shock layer flow structure and in the mechanical and thermal loads as a function of distance between the bodies.

A94-19822 Supersonic flow of a viscous ideal gas around a circular cylinder (Obtekanie krugovogo tsilindra sverkhzvukovym potokom vyazkogo sovershennogo gaza). V. A. BASHKIN, I. V. EGOROV, and M. V. EGOROVA, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 6, Dec. 1993, pp. 107–115. In Russian. 10 Refs. Documents available from Aeroplus Dispatch.

Supersonic flow of an ideal gas around a circular cylinder with an isothermal surface is analyzed using full Navier–Stokes equations. The effect of the free-stream Mach number in the range 2.5–10 and Reynolds number in the range 30–10 exp 5 on the flow field structure and heat transfer toward the surface is investigated. Particular attention is given to the analysis of the near wake and local characteristics at the rear of the cylinder.

A94-18436 Nonlinear perturbations inducing a proper pressure gradient in a boundary layer on a plate in transonic flow (Nelinejnye vozmushcheniya, indutsiruyushchie sobstvennyj gradient davleniya v pogranichnom sloe na plastine v transzvukovom potoke). V. I. ZHUK, *Prikladnaya Matematika i Mekhanika* (ISSN 0032-8235), Vol. 57, No. 5, Oct. 1993, pp. 68–78. In Russian. 15 Refs. Documents available from Aeroplus Dispatch.

A study is made of nonstationary nonlinear perturbations in a laminar boundary layer on a plate in the case of external transonic flow. The problem of the two-dimensional velocity field is reduced to that of solving an integro-differential equation for a time-dependent and a spatial function coordinate. The theory developed here implements a continuous transition from subsonic to supersonic flow, since the governing equation contains, as the limiting cases, the Burgers and Benjamin–Ono equations, which describe the evolution of perturbations beyond the transonic region.

A94-18415 Lift-drag ratio at supersonic velocities (Aehrodinamicheskoe kachestvo pri sverkhzvukovykh skorostyakh). G. I. MAJKAPAR, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 5, Oct. 1993, pp. 134–141. In Russian. 13 Refs. Documents available from Aeroplus Dispatch.

The wave lift-drag ratio (disregarding friction resistance) is analyzed using flows behind an oblique shock and a rarefaction wave. It is shown that the lift-drag ratio of an infinite skew plate can be significantly higher than that of triangular plates with subsonic, sonic, and supersonic edges. Possible implementations of a finite skew wing and lifting bodies with a high lift-drag ratio are examined.

A94-13140 Flow near the critical line in a gasdynamic model of stellar wind with heat conduction (Techenie vblizi kriticheskoj linii v gazodinamicheskoj modeli zvezdnogo vetra s teploprovodnost'yu). Z. KH. SALMAN and I. S. SHIKIN, *Prikladnaya Matematika i Mekhanika* (ISSN 0032-8235), Vol. 57, No. 3, June 1993, pp. 156–160. In Russian. 6 Refs. Documents available from Aeroplus Dispatch.

A one-dimensional stationary spherical symmetric model of stellar wind is examined within the framework of gas dynamics assuming that energy transfer in the outer atmosphere of a star is realized through electron heat conduction. The shape of the critical curve corresponding to the subsonic-

supersonic transition is investigated in detail; the types of the singular points on the curve and their relation to the separatrix directions are examined. The stability of the solutions with respect to perturbations in the vicinity of singular points is analyzed using the approach proposed by Kulikovskii and Slobodkina (1967).

A94-12795 A study of chemically nonequilibrium flow past bodies with allowance for vibrational relaxation (Issledovanie khimicheski neravnovesnogo obtekaniya tel s uchetom kolebatel'noj relaksatsii). YU. V. GLAZKOV and V. G. SHCHERBAK, *Moskovskij Universitet, Vestnik, Seriya 1-Matematika, Mekhanika* (ISSN 0579-9368), No. 3, June 1993, pp. 41–47. In Russian. 10 Refs. Documents available from Aeroplus Dispatch.

The problem of supersonic steady flow of a multicomponent nonequilibrium dissociating viscous gas past a blunt body is formulated in terms of parabolized Navier–Stokes equations for the case where the vibrational relaxation times are comparable with the dissociation reaction time and with the time during which a liquid particle remains in the vicinity of the body. The problem is solved numerically using iterations in terms of the pressure gradient, proposed previously for homogeneous gas flows. The effect of thermodynamic nonequilibrium on the profiles of the unknown quantities and heat flow toward the body surface is examined.

A94-11008 Induced vorticity and mixing of supersonic flows (Indutsirovannoe vikhreobrazovanie i peremeshivanie sverkhzvukovykh techenij). V. I. BERGEL'SON, I. V. NEMCHINOV, T. I. ORLOVA, and V. M. KHAZINS (RAN, Inst. Dinamiki Geosfer, Moscow, Russia), *Rossijskaya Akademiya Nauk, Doklady* (ISSN 0869-5652), Vol. 331, No. 4, Aug. 1993, pp. 439–442. In Russian. 15 Refs. Documents available from Aeroplus Dispatch.

A possible mechanism for the generation of intense large-scale vortices in a medium is proposed which is based on the 'warm layer' effect, involving the formation of a large-scale precursor ahead of a shock wave propagating along a heated surface. The possibility of intense mixing in a supersonic layer perturbed by a thin rarefied channel is demonstrated by an example. Numerical results are presented for the problem of a piston sliding at a constant velocity inside a tube filled with an ideal gas with an adiabatic exponent of 1.4.

A94-10957 Supersonic flow of a viscous gas past the front surface of plane blunt bodies (Sverkhzvukovoe obtekanie lobovoj poverkhnosti ploskikh zatuplennykh tel vyazkim gazom). YU. P. GOLOVACHEV and N. V. LEONT'EVA, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 3, June 1993, pp. 169–172. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

The problem of supersonic flow past the windward part of plane wings of infinite span at angles of attack is solved using full Navier–Stokes equations and boundary conditions including slip and a temperature discontinuity. The use of this model makes it possible to significantly expand the range of flow conditions of interest to lower Mach and Reynolds numbers. The solutions obtained are compared with results based on models of a thin and completely viscous shock layer.

A94-10956 A numerical study of steady-state supersonic separated flow past three-dimensional lifting systems (Chislennoe issledovanie statsionarnogo otryvnogo obtekaniya prostranstvennykh nesushchikh sistem sverkhzvukovym potokom). S. S. GRAS'KIN, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 3, June 1993, pp. 142–148. In Russian. 10 Refs. Documents available from Aeroplus Dispatch.

A numerical method is proposed for studying supersonic flow past complex three-dimensional configurations. The method is an extension of well-known approaches that are commonly used for solving similar problems in subsonic aerodynamics. To illustrate the method, calculations of the aerodynamic characteristics of wings and three-dimensional lifting systems are performed.

A94-10951 Gasdynamic structure of the heliosphere—Theory and experiment (Gazodinamicheskaya struktura geliosfery—Teoriya i ehksperiment). V. B. BARANOV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 3, June 1993, pp. 3–24. In Russian. 64 Refs. Documents available from Aeroplus Dispatch.

The development of gasdynamic models of the structure of the heliosphere is reviewed from a historical perspective. A gasdynamic model of supersonic flow of interstellar gas past solar wind is described. Attention is then given to current scientific programs concerned with the study of the circumsolar space at large heliocentric distances. Some new gasdynamic problems associated with these programs are formulated.

A94-10936 The need for an end face in the optimal rear section of a two-dimensional body in the presence of a boundary layer (O neobkhodimosti donnogo tortsa dlya optimal'noj kormovoj chasti dvumernogo tela pri nalichii pogranichnogo sloya). R. K. TAGIROV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 4, July 1993, pp. 199–203. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

The effect of the boundary layer on flow past a body is examined with particular reference to supersonic flow past the rear section of a plane body. In the analysis, no constraints are imposed on the aspect ratio of the body. Results are presented for a rear section with and without an end face. It is shown that, in the presence of a boundary layer, an optimal rear section must always have an end face. Thus, for example, it is not necessary to have a sharp trailing edge between a nozzle and the rear section of the exhaust. It is noted that this conclusion is also valid in the case of subsonic flow.

A94-10935 Nonstationary interaction of a sphere with atmospheric temperature inhomogeneities in supersonic flow past a body (Nestatsionarnoe vzaimodejstvie sfery s atmosfernymi temperaturnymi neodnorodnostyami pri sverkhzvukovom obtekanii). P. YU. GEORGIEVSKIJ and V. A. LEVIN, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 4, July 1993, pp. 174–183. In Russian. 16 Refs. Documents available from Aeroplus Dispatch.

The structure of shock layer flow and the resulting pulsed aerodynamic loads during the nonstationary interaction of a sphere with atmospheric temperature inhomogeneities of various forms and intensities are investigated analytically in the case where Euler equations are applicable. It is shown that such an interaction is accompanied by new qualitative effects that have not been noted to date by any other authors.

A94-10934 Supersonic flow at angle of attack past a star-shaped body with no planes of symmetry (Sverkhzvukovoe obtekanie pod uglom ataki zvezdoobraznogo tela, ne imeyushchego ploskostej simmetrii). M. I. FOLLEH, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 4, July 1993, pp. 164–173. In Russian. 5 Refs. Documents available from Aeroplus Dispatch.

The problem of supersonic flow at angle of attack past star-shaped bodies is investigated here in the general case of a star-shaped body without planes of symmetry. The results of the study indicate that the retention of the resultant forces in the angle of attack plane is a fundamental property of star-shaped bodies which is not related to the presence of planes of symmetry. The conditions for the reversal of the torque are determined; the torque of star- shaped bodies is shown to be independent of the angle of attack.

A93-55014 Steady-state supersonic flow of a vibrationally excited gas past a slender body of revolution at a small angle of attack (Obtekanie tonkogo tela vrashcheniya pod malym uglom ataki statsionarnym sverkhzvukovym potokom kolebatel'no-vozbuzhdennogo gaza). A. N. BOGDANOV and V. A. KULIKOVSKIJ, *Prikladnaya Mekhanika i Tekhnicheskaya Fizika* (ISSN 0869-5032), Vol. 34, No. 3, May–June 1993, pp. 11–20. Documents available from Aeroplus Dispatch.

The problem of supersonic flow of a vibrationally excited gas past a slender body of revolution at a small angle of attack is solved analytically using a linear approximation. The solution makes it possible to calculate the transverse force acting on the body and the moment of this force relative to the body nose. It is found that the relaxation of the vibrational excitation changes the magnitude of the force and, in the case of sufficient initial nonequilibrium, even its sign.

A93-53365 Determination of heat transfer to flow in a duct with a pseudodiscontinuity (Opredelenie teplopodvoda k potoku v kanale s pseudoskachkom). P. K. TRET'YAKOV, *Fizika Goreniya i Vzryva* (ISSN 0430-6228), Vol. 29, No. 3, May–June 1993, pp. 71–77. 8 Refs. Documents available from Aeroplus Dispatch.

Heat transfer due to propellant combustion in a duct with supersonic flow leads to flow deceleration. The resulting gasdynamic structure is characteristic of a pseudodiscontinuity and is essentially inhomogeneous over the duct cross section. In this case, the extent of combustion or the amount of heat transferred to the flow are determined by measuring static pressure on the duct wall. The use of a one-dimensional method may lead to an erroneous result. The method proposed here is based on the characteristics of the change of the inhomogeneity coefficient, which is derived from a one-dimensional representation of the conservation equations. The method uses the pressure differential of isothermal flow with heat transfer; friction and heat transfer to the wall are taken into account. As an example, the method is applied to the combustion of hydrogen and kerosene.

A93-51818 Steady state supersonic flows of a vibrationally excited gas past thin bodies (Statsionarnye sverkhzvukovye techeniya kolebatel'no-vozbuzhdennogo gaza okolo tonkikh tel). A. N. BOGDANOV and V. A. KULIKOVSKIJ, *Prikladnaya Mekhanika i Tekhnicheskaya Fizika* (ISSN 0044-4626), No. 1, Jan.–Feb. 1993, pp. 54–64. 14 Refs. Documents available from Aeroplus Dispatch.

The paper is concerned with the problem of steady state supersonic flow of a vibrationally excited gas past thin plane bodies and bodies of revolution, with the gas relaxing downstream to an equilibrium. In addition to the relative thickness of the body, delta, a second small parameter, the relative nonequilibrium, epsilon, is introduced. The solution is obtained in the form of an asymptotic series expansion in terms of the small parameters.

A93-51815 Shock wave formation at the boundary of a local supersonic region (O formirovanii udarnoj volny na granitse mestnoj sverkhzvukovoj zony). S. A. SHCHERBAKOV, *Prikladnaya Mekhanika i Tekhnicheskaya Fizika* (ISSN 0044-4626), No. 1, Jan.–Feb. 1993, pp. 24–32. 11 Refs. Documents available from Aeroplus Dispatch.

A self-similar solution to an equation of plane potential flow is obtained near the point of formation of a shock wave defining the boundary of a local supersonic region. In accordance with this solution, a shock wave of variable intensity exists at the boundary of the local supersonic region. The characteristic at the point of shock wave formation includes continuous derivatives of the gasdynamic parameters along the coordinates. The solution obtained here is consistent with the theorems of Nikolskii and Taganov (1946).

A93-51786 Experimental studies of supersonic flow past wedges with longitudinal slots on the windward side Ehksperimental'nye issledovaniya sverkhzvukovogo obtekaniya klin'ev s prodol'nymi pazami na

navetrennoj storone V. I. VORONIN, G. S. UL'YANOV, and A. I. SHVETS, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 2, Mar.–Apr. 1993, pp. 173–175. 5 Refs. Documents available from Aeroplus Dispatch.

By using a simple hypersonic lifting shape in the form of a wedge as an example, an experimental study is made of a method of increasing the lift-drag ratio of waverider configurations. The method investigated here involves the use of longitudinal slots on the windward side. It is shown that the wave drag can be reduced without any decrease in the lifting force by appropriately selecting the angle of the slot surface and the relative width of the slots. The aerodynamic characteristics of the models tested are presented as a function of the slot angle and relative width.

A93-51780 Supersonic flow past a cone with heat transfer near its tip (Sverkhzvukovoe obtekanie konusa pri teplopodvode v okrestnosti ego vershiny). V. A. LEVIN and L. V. TERENT'EVA, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 2, Mar.–Apr. 1993, pp. 110–114. 12 Refs. Documents available from Aeroplus Dispatch.

Supersonic flow past a cone in the wake of a spherical heat source is investigated analytically. The problem is reduced to that of solving a system of gas dynamics equations written in nondimensional form. The equations are solved numerically using the McCormack method. It is shown that heat transfer toward the nose of the body effectively reduces its wave resistance.

A93-48989 The large-scale structure of the circumsolar plasma in the zone of transition between subsonic and supersonic flow (Krupnomasshtabnaya struktura okolosolnechnoj plazmy v oblasti perekhoda ot dozvukovogo techeniya k sverkhzvukovomu). N. A. LOTOVA, O. A. KORELOV, and YA. V. PISARENKO (IZMIRAN, Troitsk, Russia), *Kinematika i Fizika Nebesnykh Tel* (ISSN 0233-7665), Vol. 9, No. 1, Jan.–Feb. 1993, pp. 16–23. 15 Refs. Documents available from AIAA Technical Library.

The transition zone between subsonic and supersonic solar wind flow is studied using nine natural radio sounding sources. The observations were carried out in June–August 1989. In the interval of the radial distances 5-40 solar radii, the scattering angle radial dependence theta-R was studied. The two-dimensional mapping of the solar wind transonic region was obtained. The large-scale configuration of the medium was reconstructed from the data on the scattering angle theta-R. The relation between the configuration of the solar wind transonic region and that of the solar supercorona has been investigated. (Author (revised)).

A93-48829 Flow of a thermally nonequilibrium argon plasma in the arc of a plasmatron with expansion into a vacuum chamber (Techenie termicheski neravnovesnoj argonovoj plazmy v duge plazmotrona s vykhodom v vakuumnuyu kameru). I. G. PANEVIN, A. S. VOJNOVSKIJ, A. G. KOSTYLEV, and V. V. NOVOMLINSKIJ (Moskovskij Aviatsionnyj Inst., Moscow, Russia), *Sibirskij Fiziko-Tekhnicheskij Zhurnal* (ISSN 0869-1339), No. 2, Mar.-Apr. 1993, pp. 82–86. 10 Refs. Documents available from Aeroplus Dispatch.

Subsonic and supersonic flows of an argon plasma in a plasmatron and an adjacent vacuum chamber are investigated experimentally and analytically for pressures of 10 exp 2–10 exp 4 Pa and a current of 800 A. The parameters of the electric arc plasma are calculated by using a single-fluid two-temperature model based on a full system of Navier–Stokes equations for electrons and heavy components. The Maxwell equations are reduced to a Laplace equation for determining the two-dimensional electric potential field. Numerical calculations are carried out using a modified version of the control volume method.

A93-46975 Heat transfer on blunt cones in nonuniform supersonic flow in the presence of gas injection from the surface (Teploobmen na zatuplennykh konusakh pri sverkhzvukovom neravnomernom obtekanii i nalichii vduva s poverkhnosti). N. N. PILYUGIN and R. F. TALIPOV (Moskovskij Gosudarstvennyj Univ., Moscow, Russia), *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 31, No. 1, Feb. 1993, pp. 97–104. 18 Refs. Documents available from Aeroplus Dispatch.

The parameters of laminar flow and heat transfer on a blunt cone in a nonuniform supersonic flow are calculated using the equations of the total viscous shock layer (TVSL) model, with particular consideration given to the characteristics of the oncoming wake-type flow and to the effect of gas injection from the surface. The results of TVSL calculations of the flow and heat-transfer parameters are compared with other numerical and asymptotic solutions. It is shown that the efficiency of gas injection at the critical point of the model for the purpose of lowering the heat flow intensity can be significantly increased by using the nonuniformity of the oncoming flow.

A93-43017 Numerical modeling of the interaction of liquid drops and jets with shock waves and gas jets (Chislennoe modelirovanie vzaimodejstviya kapel', struj zhidkosti s udarnymi volnami i gazovymi struyami). V. S. SUROV (Chelyabinskij Gosudarstvennyj Univ., Chelyabinsk, Russia), *Sibirskij Fiziko-Tekhnicheskij Zhurnal* (ISSN 0869-1339), No. 1, Jan.–Feb. 1993, pp. 116–125. 10 Refs. Documents available from Aeroplus Dispatch.

The motion of a liquid drop (jet) and of the ambient gas is described, in the general case, by Navier–Stokes equations. An approximate solution to the interaction of a plane shock wave with a single liquid drop is presented. Based on the analysis, the general system of Navier–Stokes equations is reduced to two groups of equations, Euler equations for gas and Navier–Stokes equations for liquid; solutions to these equations are presented. The discussion also covers the modeling of the interaction of a shock wave with a drop screen, interaction of a liquid jet with a counterpropagating supersonic gas flow, and modeling of processes in a shock layer during the impact of a drop against an obstacle in gas flow.

A93-42405 A numerical study of the flutter of conical shells (Chislennoe issledovanie flattera konicheskikh obolochek). V. V. DITKIN, B. A. ORLOV, and G. I. PSHENICHNOV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 1, Jan.–Feb. 1993, pp. 185–189. 9 Refs. Documents available from Aeroplus Dispatch.

The paper is concerned with the problem of the aerodynamic stability of thin shells in supersonic flow of a compressible gas. An efficient iteration method for solving problems of this kind is proposed. The problem of supersonic flow of a gas past a cantilever conical nozzle is analyzed as an example.

A93-39124 A numerical investigation of supersonic flow of a viscous gas over long blunt cones, taking into account equilibrium physicochemical transformations (Chislennoe issledovanie sverkhzvukogo obtekaniia zatuplennykh konusov bol'shoi dliny potokom viazkogo gaza s uchetom ravnovesnykh fizikokhimicheskikh prevrashchenii). S. V. UTIUZHNIKOV, *Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 1, Jan.–Feb. 1993, pp. 202–205. 10 Refs. Documents available from Aeroplus Dispatch.

A numerical study was made of supersonic axisymmetrical flow of a viscous heat-conducting gas past a spherically blunted elongated cone at high Reynolds numbers, using a high-efficiency method based on global iterations to solve the equations of the viscous shock layer. Results elucidate the overall effect of a second approximation of the boundary layer theory and the effect of equilibrium physicochemical transitions on the thermal load on elongated cones.

A93-39118 Supersonic flow of a gas over a semiinfinite plate with small-scale harmonic spanwise oscillations (Obtekanie sverkhzvukovym potokom gaza polubeskonechnoi plastiny s malymi garmonicheskimi vozmushcheniiami po razmakhu). V. A. BASHKIN and V. N. SHABANOV, *Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 1, Jan.–Feb. 1993, pp. 146–156. 7 Refs. Documents available from Aeroplus Dispatch.

The problem of supersonic flow of an ideal gas over a semiinfinite plate with lengthwise fins is investigated using the method of combined external and internal factorization. The solution is obtained for a problem involving four expansion terms. It is shown that the calculated effect of the crosswise surface perturbations on the local resistance coefficients agrees with experimental data and with calculations based on Navier–Stokes equations.

A93-39116 Aerodynamic resistance of three-dimensional bodies with a starlike cross section at supersonic velocities, and problems of its calculation (Aerodinamicheskoe soprotivlenie prostranstvennykh tel so zvezdoobraznym poperechnym secheniem pri sverkhzvukovykh skorostiakh i problemy ego rascheta). N. A. OSTAPENKO (Moskovskii Gosudarstvennyi Univ., Moscow, Russia) *Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 1, Jan.–Feb. 1993, pp. 57–69. 21 Refs. Documents available from Aeroplus Dispatch.

The effects of the viscosity of the gas mass around to a three-dimensional pyramidal body with a starlike cross section, the width of the displaced boundary layer, and its separation under the effect of internal shock waves on the aerodynamic resistance of the body were investigated. It is shown that resistance models for starlike bodies that do not take into account the width of the displaced layer can be used only in unperturbed flows with freestream-Mach values of 3 or less. A new model for calculating the displacement width of the boundary layer is proposed. The model was validated in experiments with pyramidal bodies of varying parameters, exposed to hypersonic and supersonic gas flows.

A93-35266 Unsteady supersonic flow around a blunt body in thermal inhomogeneities in turbulent shock layer flows (Nestatsionarnoe sverkhzvukovoe obtekanie zatuplennogo tela v teplovykh neodnorodnostiakh pri turbulentnom rezhime techeniia v udarnom sloe). IU. P. GOLOVACHEV and V. V. ZEMLIAKOV, *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 33, No. 1, Jan. 1993, pp. 151–155. In Russian. 15 Refs. Documents available from Aeroplus Dispatch.

Unsteady turbulent supersonic flow around a sphere moving through thermal inhomogeneities is investigated numerically using a viscous shock layer model. It is shown that the flow is characterized by significant changes in the shape of the head shock, occurrence of internal shock waves and high-temperature jets in the shock layer, and substantial changes in the distribution of drag and heat transfer parameters on the body surface. The behavior of the heat flow on the body surface is affected to the greatest extent by the laminar-turbulent transition.

A93-35265 The quasi-characteristic difference scheme and its application to the calculation of supersonic gas flows (Raznostnaia skhema kvazikharakteristik i ee primenenie dlia rascheta sverkhzvukovykh techenii gaza). M. P. LEVIN, *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 33, No. 1, Jan. 1993, pp. 131–141. In Russian. 10 Refs. Documents available from Aeroplus Dispatch.

A second-order quasi-characteristic difference scheme is proposed for solving mixed problems for systems of hyperbolic equations. The scheme is based on the representation of equations in expanded characteristic form. The approximation and the stability of the scheme proposed here are analyzed using the Cauchy problem as an example.