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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 Structural and Fluid Dynamics from Russia and Japanese Spacecraft from Japan.

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Russian Aerospace Literature
This month: *Structural and Fluid Dynamics*

A94-18975 Russian-Sino Symposium on Astronautical Science and Technique. Samara, Russia, Samara Aviation Institute, 1992, p. 264 (No individual items are abstracted in this volume).

The present volume on astronautical science and technology discusses adaptive reentry vehicles, simulation of the effect of meteoric matter on spacecraft, the use of metal construction materials in space, a space complex for meteoric and man-made orbital debris, and the design of optimum metallic fuel tank dividers. Attention is given to the use of orbital tethered facilities for ensuring transport operations in space, spacecraft materials and covers, optimal design of composite material structures, and factors affecting ablation rates of defective insulation. Topics addressed include optimum parameters of a space vehicle landing system, a family of scientific and technological microspacecraft, an evaluation of the revivability of the fuel systems of spacecraft, and methods and equipment for detecting hypervelocity particles. Also discussed are ways of improving the energy-mass characteristics of engines, computation of convection heat transfer in a nozzle using a turbulent boundary layer equation, and a 2D temperature field in the case of porous cooling.

A94-12818 Dynamics of swirled gas flow between disks in the case of a rotating bladeless diffuser (Dinamika predvaritel'no zakruchennogo gazovogo potoka v mezhdiskovom zazore v sluchae bezlopatochnogo vrashchayushchegosya diffuzora). A. A. KHALATOV, M. M. GOJKHENBERG, and T. V. MENDELEEVA (ANU, Inst. Tekhnicheskoj Teplofiziki, Kiev, Ukraine) *Promyshlennaya Teplotekhnika* (ISSN 0204-3602), Vol. 14, No. 4–6, Dec. 1992, pp. 43–48. In Russian. 6 Refs. Documents available from Aeroplus Dispatch.

A mathematical model is developed which describes swirled gas flow between disks in a rotating bladeless diffuser. The model is used to develop an algorithm and a computer program for calculating pressure increase in the disk zone. Results of the computational experiments are generalized in terms of similarity theory, and universal relations are obtained for the correction of the input parameters.

A93-51910 Calculation of supersonic flow past a body of revolution with a piecewise linear distribution of singularities at its axis (Raschet sverkhzvukovogo obtekaniya tela vrashcheniya s kusochno-linejnym raspredeleniem intensivnosti osobennostej na ego osi). YU. S. SOROKIN, In: Problems in the aerodynamics of flight vehicles and their components (A93-51901 22-02), Moscow, Russia, Moskovskij Aviatsionnyj Institut, 1992, pp. 53–61. 6 Refs. Documents available from Aeroplus Dispatch.

A method for calculating supersonic flow past bodies of revolution is proposed whereby the body of revolution is modeled by sources and dipoles along the body axis with a piecewise linear law of intensity variation along the axis. This approach makes it possible to obtain finite analytical expressions for velocities and significantly reduce the computational effort. Examples of calculations are presented to demonstrate the validity of the approach.

A93-51901 Problems in the aerodynamics of flight vehicles and their components (Voprosy aehrodinamiki letatel'nykh apparatov i ikh chastej). YU. A. RYZHOV, ED., Moscow, Russia, Moskovskij Aviatsionnyj Institut, 1992, p. 91 (For individual items see A93-51902 to A93-51914).

The papers presented in this volume provide an overview of recent theoretical and experimental work in the field of flight vehicle aerodynamics and general aeromechanics. In particular, attention is given to the calculation of compressed gas flows on optimal difference grids, spline-collocation solution of a Fredholm equation of the second kind in the problem of flow past an airfoil, a study of the aerodynamics of a wing with end slots, and aerodynamic characteristics of airship models of different shapes. Other topics discussed include determination of the aerodynamic characteristics of a thin body of revolution with a piecewise linear distribution of singularities at its axis, calculation of a plane supersonic jet simulating the exhaust jet of a hypersonic flight vehicle engine, and a stability condition for the motion of a continuous incompressible medium.

A94-23855 Kinetic derivation of gas dynamic equations for multicomponent mixtures of light and heavy particles (O kineticheskom vyvode uravnenij gazodinamiki mnogokomponentnykh smesej legkikh i tyazhelykh chastits). V. S. GALKIN and N. K. MAKASHEV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 1, Feb. 1994, pp. 180–200. In Russian. 43 Refs. Documents available from Aeroplus Dispatch.

Gas dynamic equations for multicomponent mixtures of particles with largely different masses and frozen internal degrees of freedom are derived in the context of kinetic theory. The possibility of a one-velocity and two- temperature microscopic description is demonstrated. It is shown that a multiple-velocity solution of the Boltzmann equation must be used for the heavy components; a method of introducing the effective temperature is discussed. A modification of the generalized Chapman-Enskog method is presented.

A94-23847 Nonlinear equations of motion for flexible rod systems (Nelinejnye uravneniya dvizheniya gibkikh sterzhnevykh sistem). A. N. DANILIN, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 1, Feb. 1994, pp. 177–188. In Russian. 11 Refs. Documents available from Aeroplus Dispatch.

A mathematical model is developed for the analysis of the nonlinear nonstationary dynamics of structures consisting of rigid bodies and flexible rod elements. The approach used is based on finite element discretization using exact static solutions. The approach provides a unified framework for modeling such nonstationary processes as the deployment and extension of structures in space, maneuvering, and various technological processes involving finite relative displacements and rotations of elastic rod elements.

A94-21688 Hyperbolic modification of Navier-Stokes equations (Giperbolicheskaya modifikatsiya uravnenij Nav'e-Stoksa). B. G. KUZNETSOV, *PMFT—Prikladnaya Mekhanika i Tekhnicheskaya Fizika* (ISSN 0869- 5032), Vol. 34, No. 6, Dec. 1993, pp. 133–141. In Russian. 4 Refs. Documents available from Aeroplus Dispatch.

A comparison of the propagation velocities of perturbations determined from Euler and Navier-Stokes models leads to a paradox in the case of a viscous gas, where an infinite velocity is obtained. A hyperbolic modification of Navier-Stokes equations is proposed which makes it possible to resolve this paradox.

A94-21668 Determination of plane flow parameters for an incompressible fluid in the case of small variations of the profile shape (Opredelenie parametrov ploskogo techeniya neszhimaemoj zhidkosti pri maloj variatsii kontura profilya). A. L. GONOR, *Prikladnaya Matematika i Mekhanika* (ISSN 0032-8235), Vol. 57, No. 6, Dec. 1993, pp. 167–169. In Russian. 4 Refs. Documents available from Aeroplus Dispatch.

A corrected version of a formula for calculating flow of an incompressible fluid over a profile close to the specified shape is obtained. The validity of the formula is demonstrated using a test example.

A94-21665 Bifurcation of the upper arm of the neutral curve for a boundary layer on a plate in compressible flow (Bifurkatsiya verkhnej vetvi nejtral'noj krivoj dlya pogranichnogo sloya na plastine v szhimaemom potoke). V. I. ZHUK, *Zhurnal Vychislitel'noj Matematiki i Matematicheskoj Fiziki* (ISSN 0044-4669), Vol. 34, No. 1, Jan. 1994, pp. 130–147. In Russian. 14 Refs. Documents available from Aeroplus Dispatch.

A Mach number limit is estimated above which the properties of the unstable mode of natural oscillations of the boundary layer become qualitatively different from those known in the incompressible case. An example is presented, in which the function describing the upper arm of the neutral curve becomes three-valued. For given conditions, four neutral values of the wave number correspond to a fixed Reynolds number, and the instability region is divided in two.

A94-19440 Nearly conservative difference schemes for gas dynamics equations (Pochti konservativnye raznostnye skhemy dlya uravnenij gazovoj dinamiki). A. A. CHARAKHCH'YAN, *Zhurnal Vychislitel'noj Matematiki i Matematicheskoj Fiziki* (ISSN 0044-4669), Vol. 33, No. 11, Nov. 1993, pp. 1681–1692. In Russian. 17 Refs. Documents available from Aeroplus Dispatch.

A method for modifying a wide class of schemes using arbitrary grids is proposed which makes it possible to obtain nearly conservative schemes that guarantee no loss of accuracy in internal energy calculations. The efficiency of the schemes proposed here in comparison with conservative schemes is demonstrated for the case of cumulative effect calculation using moving grids.

A94-18437 New approximate analytical solutions for gas dynamics equations (Novye priblizhennye analiticheskie resheniya uravnenij gazovoj dinamiki). G. I. NAZAROV, *Prikladnaya Matematika i Mekhanika* (ISSN 0032-8235), Vol. 57, No. 5, Oct. 1993, pp. 79–86. In Russian. 8 Refs. Documents available from Aeroplus Dispatch.

Approximate binomial solutions for gas dynamics equations in velocity hodograph variables are obtained without resorting to the method of approximations. The solutions are obtained for both subsonic flow, containing an arbitrary analytical function of a complex variable and a sonic (critical) point, and supersonic motion, which includes two arbitrary functions of characteristic variables and a sonic point. The matching of these solutions at the sonic line during transonic motion is demonstrated by an example.

N94-16583 Determination of the effect of the walls of a wind-tunnel from the parameters of flow near them (Opredelenie vliyaniya stenok aerodinamicheskoi truby po parametram potoka vblizi nikh). S. A. GLASKOV, Royal Aircraft Establishment, Farnborough (England). Documents available from Aeroplus Dispatch.

This paper describes a method based on the use of two flow variables measured at a boundary close to the tunnel wall to calculate wall interference. It is similar to earlier work in the West although the author was probably unaware of this work. (Derived from text)

A94-13138 Calculation of flow induced by gas injection through the walls of a duct of finite length (Raschet techeniya, indutsiruemogo vduvom gaza cherez stenki kanala konechnoj dliny). A. P. KURYACHIJ, *Prikladnaya Matematika i Mekhanika* (ISSN 0032-8235), Vol. 57, No. 3, June 1993, pp. 50–56. In Russian. 6 Refs. Documents available from Aeroplus Dispatch.

A method is proposed for calculating gas flow in a narrow plane duct of finite length, with gas injected through the duct walls and outflowing from the duct at a specified pressure. The calculations are carried out in the Prandtl approximation. The method allows the determination of flow characteristics for different characteristic Mach number values based on the results of a single calculation for a fixed Reynolds number. The procedure for considering the ellipticity of the problem is substantially simplified.

A94-12885 Dynamics of a nonideal shell and control of its vibrations (Dinamika neideal'noj obolochki i upravlenie ee kolebaniyami). N. E. EGARMIN, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 4, Aug. 1993, pp. 49–59. In Russian. 11 Refs. Documents available from Aeroplus Dispatch.

The vibrations of a thin nearly axisymmetrical shell are analyzed in the case of loading by external surface and bulk forces, including forces due to the motion of the shell base. A model of a thin elastic homogeneous axisymmetrical shell placed on a stationary base and free of external forces is adopted as the basic model. Control laws leading to the generation of vibrations of the desired type are formulated. The problem examined here is relevant to the analysis of the operation and design of solid state wave gyroscopes.

A94-12883 Modeling the dynamics of a high-velocity rotating elastic flight vehicle (Modelirovanie dinamiki vysokoskorostnogo vrashchayushchegosya uprugogo letatel'nogo apparata). V. A. ZORIN, V. I. MOROZOV, and A. T. PONOMAREV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 4, Aug. 1993, pp. 28–38. In Russian. 11 Refs. Documents available from Aeroplus Dispatch.

A method is proposed for constructing a model of the three-dimensional motion of a high-velocity rotating elastic flight vehicle. The model is implemented in the form of nonlinear integro-differential equations linearized with respect to aerodynamics and elasticity and complemented by terms allowing for the vehicle rotation and mass variability in time. The approach is based on the synthesis of data obtained by means of computer-aided aerodynamics and structural mechanics methods.

A94-12800 Variational inverse boundary value problems in aerohydrodynamics for subsonic gas flow (Variatsionnye obratnye kraevye zadachi aehrogidrodinamiki dlya dozvukovogo techeniya gaza). A. M. ELIZAROV, E. V. FEDOROV, and D. A. FOKIN, *Zhurnal Vychislitel'noj Matematiki i Matematicheskoj Fiziki* (ISSN 0044-4669), Vol. 33, No. 6, June 1993, pp. 958–968. In Russian. 10 Refs. Documents available from Aeroplus Dispatch.

Variational problems of determining the shape of nonporous wing profiles with a maximum lift-drag ratio in steady state subsonic flow of a viscous gas with large Reynolds numbers are solved numerically. The viscosity is considered in the boundary layer approximation, while gas compressibility is accounted for in the framework of Chaplygin's gas model. Examples of optimized profiles are presented, as are numerical calculations.

A94-12799 A finite element method for calculating the nonsteady state aerodynamic characteristics of a subsonic cascade of vibrating airfoils (Metod konechnykh ehlementov dlya rascheta nestatsionarnykh aehrodinamicheskikh kharakteristik dozvukovoj reshetki vibriruyushchikh profilej). A. A. OSIPOV, *Zhurnal Vychislitel'noj Matematiki i Matematicheskoj Fiziki* (ISSN 0044-4669), Vol. 33, No. 6, June 1993, pp. 919–935. In Russian. 29 Refs. Documents available from Aeroplus Dispatch.

A numerical method is developed for calculating the linear oscillations of subsonic flow of an ideal gas near a vibrating plane cascade of airfoils. Attention is given to harmonic vibrations of airfoils with a constant phase shift between any two adjacent airfoils in a cascade. The computational scheme is based on the finite element method used in conjunction with the variational principle. A modified formulation of the boundary value problem is used in order to reduce the errors associated with the large inhomogeneities of the main steady state flow near the leading and trailing edges of the airfoils.

A94-11042 A kinetic model of a gas-particle mixture and its validation. III—Validation (Kineticheskaya model' vzvesi i ee obosnovanie. III—Obosnovanie). V. A. TSIBAROV, *Sankt-Peterburgskij Universitet, Vestnik, Seriya 1—Matematika, Mekhanika, Astronomiya* (ISSN 0024-0850), No. 1, Jan. 1993, pp. 92–97. In Russian. 6 Refs. Documents available from Aeroplus Dispatch.

Kinetic equations of the gas and particle phases are derived using a version of a Liouville equation analog written for an ensemble consisting of gas molecules and solid particles. The particles move in a nonconservative field. The approach used here makes it possible to validate the kinetic equations obtained previously (Tsibarov, 1992).

A94-11040 Optimal aerodynamic shapes in rarefied gas (Ob optimal'nykh aehrodinamicheskikh formakh v razrezhennom gaze). R. N. MIROSHIN, *Sankt-Peterburgskij Universitet, Vestnik, Seriya 1—Matematika, Mekhanika, Astronomiya* (ISSN 0024-0850), No. 1, Jan. 1993, pp. 77–82. In Russian. 13 Refs. Documents available from Aeroplus Dispatch.

An isoperimetric problem concerned with the optimization of a convex body shape in rarefied gas is formulated. A two-stage procedure for solving the problem is presented. The solution is based on the theory of local interaction and employs the Chebyshev-Markov theorem.

A94-10958 Possibility of the existence of weak contact discontinuities in a circular shock tube (Vozmozhnost' sushchestvovaniya slabykh kontaktnykh razryvov v krugloj udarnoj trube). V. D. SEROVA, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 3, June 1993, pp. 173–175. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

For the case of the interaction of a strong shock wave with a small obstacle at the axis of a round shock tube, the shock wave velocity and the Mach number in its wake are determined for which weak contact discontinuities cannot exist. Parameter ranges are determined for which weak contact discontinuities attenuate with time and for which they are transformed to strong contact discontinuities.

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.

A94-10955 Asymptotic theory of vortex breakdown (Asimptoticheskaya teoriya razrusheniya vikhrya). VIK. V. SYCHEV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 3, June 1993, pp. 78–90. In Russian. 31 Refs. Documents available from Aeroplus Dispatch.

The phenomenon of vortex breakdown is investigated by using an asymptotic analysis of a system of Navier-Stokes equations at large Reynolds numbers. A criterion for vortex breakdown is formulated; the flow structure is described as a whole and in the direct vicinity of the breakdown point. It is shown that vortex breakdown is a two stage process, and a description of each stage is provided.

A94-10954 A numerical study of the mixed three-dimensional boundary layers of flow past an ellipsoid at angles of attack (Chislennoe issledovanie techenij v smeshannykh prostranstvennykh pogranichnykh sloyakh ehllipsoida obtekaemogo s uglami ataki). YU. N. KARPEEV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 3, June 1993, pp. 69–77. In Russian. 9 Refs. Documents available from Aeroplus Dispatch.

Two cases of mixed flow in three-dimensional boundary layers on an ellipsoid of revolution are investigated numerically, for angles of attack of 10 and 5 deg, using a finite difference method. The closure equation for flows in the transition and turbulent regions is obtained by using the principle of superposition of viscous and turbulent stresses and the 'mixing path' model, extended to three dimensions. It is found that turbulent mixing significantly weakens three-dimensional effects, leading to the shifting of three-dimensional separation zones further downstream and to the reduction of their size.

A94-10952 A study of the subharmonic transition in a plane channel by direct numerical modeling (Issledovanie subgarmonicheskogo perekhoda v ploskom kanale metodom pryamogo chislennogo modelirovaniya). M. V. USTINOV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 3, June 1993, pp. 46–53. In Russian. 11 Refs. Documents available from Aeroplus Dispatch.

The existing models of the subharmonic regime of the laminar-turbulent transition in a plane channel are briefly reviewed. In order to clarify the mechanism of the subharmonic transition in a plane channel, the transition is investigated by direct numerical modeling. The results obtained indicate that the development of perturbations at the stage of their parametric amplification in the case of 'natural' initial conditions is adequately described by Herbert's (1983) model.

A94-10928 Development of a universal one-parameter model for turbulent viscosity (K sozdaniyu universal'noj odnoparametricheskoj modeli dlya turbulentnoj vyazkosti). A. N. GULYAEV, V. E. KOZLOV, and A. N. SEKUNDOV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 4, July 1993, pp. 69–81. In Russian. 25 Refs. Documents available from Aeroplus Dispatch.

An improved version of the universal one-parameter model for turbulent viscosity, originally proposed by Kovasznay (1967), is described. The model uses a different criterion which describes the distinguishing features of axisymmetric flows in terms of the inhomogeneity of turbulent viscosity distribution. The manner in which the model deals with the effects of compressibility is discussed. The model proposed here is simpler and more computationally efficient than the previous versions. A method for the quantitative evaluation of the accuracy and universality of turbulent viscosity models is also presented.

A93-54996 Motion of a rigid body in a flow of particles (O dvizhenii tverdogo tela v potoke chastits). A. A. BUROV and A. V. KARAPETYAN, *Prikladnaya Matematika i Mekhanika* (ISSN 0032-8235), Vol. 57, No. 2, Mar.–Apr. 1993, pp. 77–81. 4 Refs. Documents available from Aeroplus Dispatch.

An analysis is made of the problem of the motion of a rigid body in a flow of particles around a stationary point. Although this problem is known to be essentially nonconservative, it turns out that, under certain assumptions, the dynamics of the body in this problem can be described by a system of Hamiltonian equations. The conditions under which this is possible are examined. The stationary motions of the system considered here are determined, and their stability analyzed.

A93-53364 Recent advances in computational analysis of hypersonic vehicles R. F. WALTER (W. J. Schafer Associates, Inc., Albuquerque, NM) *Fizika Goreniya i Vzryva* (ISSN 0430-6228), Vol. 29, No. 3, May–June 1993, pp. 66–71. 12 Refs. Documents available from Aeroplus Dispatch.

The nonequilibrium gasdynamics processes of importance to hypersonic aerobraking vehicles are reviewed. Recent improvements in understanding these phenomena and in the detailed numerical modeling of these processes will be discussed. The paper concludes by describing the extent to which these models have been incorporated into multidimensional computational fluid dynamics (CFD) computer codes.

A93-53306 Intermediate asymptotics in nonlinear shell dynamics (Promezhutochnye asimptotiki v nelinejnoj dinamike obolochek). I. V. ANDRIANOV and E. G. KHOLOD, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 2, 1993, pp. 172–177. 12 Refs. Documents available from Aeroplus Dispatch.

It is shown that Bolotin's (1979) dynamic boundary effect can be treated as a case of intermediate asymptotics. As an example, the problem of nonlinear oscillations of a shallow spherical shell is considered, for which an efficient analytical solution is presented.

A93-51823 Analytical solution of the one-dimensional problem of moderately strong evaporation (and condensation) in a half-space (Analiticheskoe reshenie odnomernoj zadachi ob umerenno sil'nom isparenii /i kondensatsii/ v poluprostranstve). A. V. LATYSHEV and A. A. YUSHKANOV, *PMTF—Prikladnaya Mekhanika i Tekhnicheskaya Fizika* (ISSN 0044- 4626), No. 1, Jan.–Feb. 1993, pp. 102–108. 9 Refs. Documents available from Aeroplus Dispatch.

An exact solution is presented for the problem of evaporation (and condensation) in a vacuum of a fluid occupying a half-space. The solution is obtained by using a one-dimensional model of the Boltzmann equation with a collision operator in the BGK form, linearized with respect to an equilibrium distribution function at a large distance from the interface. The mathematical aspects of the method are briefly discussed.

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.

A93-46699 A numerical solution of the asymptotic problem of boundary layer separation in an incompressible liquid upstream of the corner point of a body (Chislennoe reshenie asimptoticheskoj zadachi ob otryve pogranichnogo sloya neszhimaemoj zhidkosti pered uglovoj tochkoj kontura tela). M. A. KRAVTSOVA, *Zhurnal Vychislitel'noj Matematiki i Matematicheskoj Fiziki* (ISSN 0044-4669), Vol. 33, No. 3, March 1993, pp. 439–449. 14 Refs. Documents available from Aeroplus Dispatch.

A solution is obtained for the flow separation problem for an incompressible liquid, upstream of the corner point of a body. The problem is analyzed in the framework of the asymptotic theory of interaction between the laminar boundary layer and the inviscid outer flow layer, using Veldman's (1981) quasi-simultaneous method to calculate the interaction of the flow layers.

A93-43092 Representation of general solutions to the dynamics equations for a moving compressible viscous fluid in spherical coordinates (O predstavlenii obshchikh reshenij uravnenij dinamiki dvizhushchejsya szhimaemoj vyazkoj zhidkosti v sfericheskikh koordinatakh). A. N. GUZ' (ANU, Inst. Mekhaniki, Kiev, Ukraine) *Rossijskaya Akademiya Nauk*, Doklady (ISSN 0869-5652), Vol. 329, No. 5, April 1993, pp. 559–561. 9 Refs. Documents available from Aeroplus Dispatch.

The formulations and the solution methods proposed by Guz (1980, 1981) for problems of uniform flow of viscous fluids past solid bodies are valid only for rectangular and cylindrical body coordinates. This paper presents general solutions for a body within a moving compressible fluid in spherical coordinates, making it possible to solve problems of a solid sphere oscillating due to the surrounding flow of a compressible viscous fluid.

A93-43012 Modeling of flow and convective energy separation in vortex tubes (Modelirovanie techeniya i konvektivnogo ehnergorazdeleniya v vikhrevykh trubakh). A. A. BORISOV, P. A. KUJBIN, and V. L. OKULOV (RAN, Inst. Teplofiziki, Novosibirsk, Russia) *Sibirskij Fiziko-Tekhnicheskij Zhurnal* (ISSN 0869-1339), No. 1, Jan.–Feb. 1993, pp. 30–38. 3 Refs. Documents available from Aeroplus Dispatch.

A comprehensive analysis of flow induced in a tube by helical vortex filaments is presented. The velocity field induced by helical vortex flow in a cylindrical tube is described analytically, and the effect of energy separation in a vortex tube is examined. The effect of convective transfer on the energy separation process is estimated.