

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 Flow Visualization from Russia and Spacecraft/Satellite Design from Japan.

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Russian Aerospace Literature This month: *Flow Visualization*

A92-12418 Investigation of thermoconvective motion of liquid in enclosure by photochromic flow visualization. IU. S. RIAZANTSEV and V. N. IURECHKO, *Acta Astronautica* (ISSN 0094-5765), Vol. 25, Oct. 1991, pp. 659-664. 4 Refs.

Thermal convection in liquids including thermogravitational and thermocapillary motions can be studied by means of photochromic flow visualization (PFV). Colored tracers are activated by UV radiation pulses of increased duration and energy in liquids in systems with density stratification, and the system can be combined with the shadow or LDV technique. Experimental results are given for a flow field in a rectangular cavity with side heating in the case of a homogeneous liquid and a liquid with step-like density stratifications.

A92-12169 Evolution of three-dimensional flows during the interaction between conical shock waves and a turbulent boundary layer (*Razvitie prostranstvennykh techenii pri vzaimodeistvii konicheskikh skachkov uplotneniia s turbulentnym pogranichnym sloem*). A. A. ZHELTOVODOV and A. I. MAKSIMOV, *Sibirskii Fiziko-Tekhnicheskii Zhurnal* (ISSN 0002-3434), Mar.-Apr. 1991, pp. 88-98. 18 Refs.

Supersonic flow past half-cones located on a plate was investigated experimentally in a systematic manner in order to gain a better understanding of the evolution of three-dimensional turbulent flows and to compare some of the flow characteristics for different geometrical configurations. The experiments were carried out in a wind tunnel for an adiabatic model surface at free-stream Mach 2.27, 3, and 4. It is found, in particular, that, for moderate intensities of sliding shock waves, flow in the mixing region is characterized by predominantly horizontal deviations of the flow lines. A significant restructuring of the flow observed for high shock wave intensities suggests the formation of a three-dimensional separation.

A91-55740 Ballistic range optical equipment. I. M. DEMENT'EV, I. A. KAMALOV, V. A. KOMISSARUK, A. N. MIKHALEV, and S. G. TOMSON, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 549-555. 6 Refs.

The optical equipment and electronic system are described which is required and developed for high-speed photography at an experimental short-duration ballistic range. Emphasis is given to the requirements of the light-source synchronization required for employing the shadowgraph technique, and the use of the Schlieren device, grating interferometer, and scale-time transformation are considered. The photographic results of different optical devices are presented, and a synchronization technique is described in a functional block scheme.

A92-12862 On the applicability of photochromic flow visualization in space fluid dynamics experiments. IU. S. RIAZANTSEV and V. N. IURECHKO, *Proceedings of the 1st AIAA/IKI Microgravity Science Symposium*, Moscow, USSR, May 13-17, 1991, (A92-12851 02-29). Washington, DC, American Institute of Aeronautics and Astronautics, 1991, pp. 76-78. 9 Refs.

The possible application of a photochromic flow visualization method to study velocity field structures in a space fluid dynamic experiment is discussed. It is suggested that this method can be used as an alternative to the tracer particle method.

A91-55758 Liquid crystal thermography for aerodynamic heating study. G. ZHARKOVA and V. KHACHATURIAN, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 892-897. 7 Refs.

Aerodynamic investigations are reported in which the properties of liquid crystal (LC) thermoindicators are examined in terms of their applicability to heating experiments. The use of encapsulated LC thermoindicators is discussed when they are employed to locate the transition from laminar to turbulent flow. LC thermoindicators are useful devices for measuring inhomogeneous supersonic heat flows on experimental models and for visualizing flow characteristics.

A91-55704 The flow visualization by Schlieren methods with Fuco knife and scanning light beam. I. V. GUMENNIK, and B. S. RINKEVICHUS, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 113-118. 4 Refs.

The use of a narrow laser beam is examined in conjunction with Schlieren visualization methods to permit automated real-time data collection regarding the object subjected to flow-visualization studies. The technique incorporates the electrical recording of refractive angles by means of a narrow scanned laser beam and is called the laser-scanning refractometer (LSR). The theory and an experimental apparatus described; the latter combines the LSR and an industrial-interference Schlieren device based on the slit-and-knife principle. Schlieren images and the corresponding LSR-signal recordings are given for both the primary and the later stages of turbulence evolution in stratified liquids. The distribution of the object-phase inhomogeneities can be obtained as an electric signal that is not influenced by adjacent parts and can be used to supplement laser-Doppler anemometry.

A91-55741 Two-direction visualization of vortex rings emerging in the course of formation of the supersonic jet. V. V. GOLUB, A. I. KHARITONOV, I. U. L. SHAROV, and A. M. SHULMEISTER, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 556-561. 3 Refs.

Formation of the gaseous jet behind a sonic nozzle is investigated. The nozzle was located at the end wall of a shock tube joined with the vacuum chamber. A diffraction interferometer and a two-direction shadow system for recording the flow images across and along the axis of the jet were used. An analysis of the results was carried out, and the spatial distribution in the head part of a forming jet is obtained.

A91-55711 Holographic diagnostics of capillary fluid flow. O. G. LYSENKO, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 167-170. 4 Refs.

Holographic microinterferometry is discussed with respect to the measurement and characterization of surface dynamics in capillary flows. The holographic technique visualizes and measures the inner and outer boundaries and the meniscus shape of a capillary placed vertically into a microobjective focal plane. Results of the diagnostics are listed with parameter measurements such as surface tension, wetting angles in liquid/gas systems, and liquid/liquid surface tension. The technique can be applied to aerospace engineering studies of capillary pumps and condensers in temperature-control devices.

A91-55705 Optoelectronic technique for measuring phase object speed by displacing visualization field images. A. I. KHARITONOV, and I. V. ERSHOV, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 119-124. 6 Refs.

A revised technique is presented for measuring the speed of an object by means of photoelectric recordings of the optical signals in the region where visualization-field images overlap. The modification is employed in the measurement of both pendulum and shock-wave speeds with a Schlieren device and by selecting the suitable space-time characteristics of the receiving/recording unit. The method is found to be effective and can be applied to the study of model aircraft moving through transparent media at subsonic and supersonic speeds.

A91-55268 A cone in supersonic flow near a surface with a turbulent boundary layer (Konus v sverkhzvukovom potoke vblizi poverkhnosti s turbulentnym pogranichnym sloem). A. I. ZUBKOV, B. E. LIAGUSHIN, and I. U. A. PANOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), July-Aug. 1991, pp. 177-180. 9 Refs.

Results of an experimental study of supersonic flow (Mach 3, stagnation pressure 1.2 MPa) past cones located near a surface with a thick turbulent layer are reported. Depending on the intensity of the incident shock wave, four characteristic shock wave configurations are formed on the reflection of the shock. Some quantitative data are presented which characterize changes in the size of the separated flow region and characteristic pressures in this region.

A91-40632 The quick-acting laser visualization of processes arising by interaction of shock and detonation waves and small particles. V. M. BOIKO, and A. N. PAPYRIN, *Proceedings of the 17th International Symposium on Shock Waves and Shock Tubes Current topics in shock waves*, Bethlehem, PA, July 17-21, 1989 (A91-40576 17-34). New York, American Institute of Physics, 1990, pp. 512-518. 12 Refs.

Results of studies on the development and application of a set of quick-acting methods of laser visualization for studying interaction processes of gas and particles in high-speed two-phase flows generated by shock and detonation waves are reviewed. The present methods make possible the study of acceleration dynamics of separate particles and the measurement of their motion velocity within the range of 1 to 100 m/sec; the recording of the 'instantaneous' value of the concentration and velocity fields of a dispersed phase in a given flow region; the observation of the particles' motion trajectories; and the study of the dynamics of local gas disturbances as well as the measurement of the dispersed composition of particles within the range of 10 to 300 microns and the functions of particle distribution in velocities.

A91-35795 Linear evolution of perturbations in boundary layers with an inflectional velocity profile (O lineinoi evoliutsii vozmushchenii v pogranichnykh sloiakh s perebnyim profilom skorosti). M. B. ZEL'MAN and B. V. SMORODSKII, *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Jan.-Feb. 1991, pp. 50-55. 15 Refs.

The evolution of the spectrum and structure of unstable perturbations in a boundary layer is examined as a function of the position and magnitude of extrema on the velocity curve. The Reynolds number and wave spectra considered correspond to those typically observed in laminar-turbulent transition experiments. The evolution of the waves and wave packets of discrete and continuous spectrum fluctuations is analyzed within the framework of a linear local-parallel stability problem for varying curve inflection parameters. The universal nature of flow characteristics is established through a comparison with other kinds of profiles.

A91-55710 Modern holographic methods of flow visualization. N. SPORNIK, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 161-166. 12 Refs.

The review of holographic techniques addresses applications to the visualization of heterogeneous transparent media, discusses the reconstruction and recording optical systems, and presents interferograms from recent studies. Laser interferometers are employed for the recording the hologram with a Schlieren system, and examples are given from aerodynamic studies of shock waves, air intake, and a jump-border layer. The techniques facilitate the investigation of heat, plasma, as well as optical elements by providing quantitative visual data of nonstationary processes.

A91-55709 Speckle-interferometry in researching transparent phase objects. N. VLASOV, I. MAL'TSEVA, and I. U. PRESNIAKOV, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 155-160. 17 Refs.

Techniques of holographic speckle-interferometry with laser radiation as the source of illumination are reviewed with mention given to applications to the study of flows. The principle optical schemes are illustrated with comment on the relative merits of each and a diagram of measured refraction angles. The techniques discussed are useful for the study of diffusely reflecting objects and transparent objects, and the reduction of thickness is proposed for optimizing the illuminated object area.

A91-55706 Direct interferometry for multiple shock flows. E. F. ZHIGALKO, and L. L. KOLYSHKINA, *Proceedings of the 5th International Symposium Flow visualization V*, Prague, Czechoslovakia, Aug. 21-25, 1989 (A91-55701 24-35). New York, Hemisphere Publishing Corp., 1990, pp. 125-129. 4 Refs.

A new method is discussed for a direct interferometry of two-dimensional plane flows with surfaces of density discontinuity. The method alternates many-channel interferometry and can be applied to complex nonuniform flows. The theory and a device utilizing the method are considered together with examples of applications for shock tube experiments on complex unsteady gas flows about polyhedral profiles.

A91-55646 Influence of an acoustic field of the flow structure behind a LEBU in a turbulent boundary layer. S. P. BARDAKHANOV, V. V. KOZLOV, and V. V. LARICHKIN, *Proceedings of the IUTAM Symposium Structure of turbulence and drag reduction*, Zurich, Switzerland, July 25-28, 1989 (A91-55626 24-34). Berlin and New York, Springer-Verlag, 1990, pp. 503-506. 5 Refs.

Results of a wind tunnel study of the effect of acoustic disturbances on the structure of flow behind large eddy breakup devices (LEBU) are reported. The LEBU models consisted of steel plates 1 mm thick with a rounded front and sharpened edges; the signals were processed by a hot-wire anemometer and a frequency analyzer. It is shown that, at high sound intensities, coherent structures in the wake can interact with boundary layer coherent structures and thus change the efficiency of the LEBU.

A91-55259 Vortex systems in stratified wake flow behind a sphere (Vikhrevye sistemy sputnogo stratifitsirovannogo techeniia za sferoi). E. I. A. SYSOEVA and I. U. D. CHASHECHKIN, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), July-Aug. 1991, pp. 82-90. 15 Refs.

The fine flow structure and the characteristics of the principal types of vortex structures in the wake of a sphere moving uniformly in the horizontal direction in an exponentially stratified fluid are investigated experimentally. It is found that the wake flow of a continuously stratified fluid behind a horizontally moving sphere is characterized by several types of fast and slow vortex systems whose structure and dynamics are related to the distortion of the initial uniform stratification in the vicinity of the body and far from it.

A91-49512 Aerodynamics of a vortex cavern (Aerodinamika vikhrevoi kaverny). E. P. VOLCHKOV, V. D. GORIACHEV, L. V. SERIKOV, and V. I. TEREKHOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), May-June 1991, pp. 158-164. 10 Refs.

The flow structure in a vortex cavern is investigated experimentally. It is found that the complexity of the experiment precludes a detailed study of the formation and evolution of recirculation zones in the axial region of the vortex cavern, and an attempt is made to investigate the flow by numerical modeling, with the experimental data used for the initial validation of the model. The statement of the problem and the solution method are discussed, and results of calculations of velocity components and turbulence intensity are presented.

A90-34686 Flow past toroidal bodies (Obtekanie toroobraznykh tel). O. N. IVANOV and A. I. SHVETS, *Moskovskii Universitet, Vestnik, Seriya 1 - Matematika, Mekhanika* (ISSN 0579-9368), Mar.-Apr. 1990, pp. 29-32.

Results of a wind-tunnel study of flow past two toroidal bodies at Mach numbers of 0.4-1.2 and 3 are presented. The characteristic properties of these types of flows are determined using schlieren photography and surface pressure measurements.

A91-49402 Longitudinal vortex structures and heat transfer in the reattachment region of a supersonic turbulent boundary layer (Prodl'nye vikhrevye struktury i teploobmen v oblasti prisoedineniia sverkhzvukovogo turbulentnogo pogranichnogo sloia). E. G. ZALICHNYI and V. M. TROFIMOV, *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Mar.-Apr. 1991, pp. 66-72. 16 Refs.

Results of an experimental study of the three-dimensional features of flow and heat transfer associated with Taylor-Goertler vortices are reported. A new second wall layer of longitudinal structures is discovered whose generation mechanism is not related to the Taylor-Goertler vortices. Details of the experimental procedure are described.

A91-44544 Thermogasdynamic effects of the engine turbines with the contra-rotating rotors. IU. V. SOTSENKO, ASME, Presented as Paper 90-GT-63 at the 35th International Gas Turbine and Aeroengine Congress and Exposition, Brussels, Belgium, June 11-14, 1990. 9 pp. 11 Refs.

There were carried out experimental investigations of the gas dynamic features and the analysis of the thermodynamic characteristics of the advanced engine turbines, designed with allowance for effects of the contra-rotating rotors. The investigations were performed on 12 rectilinear cascades with the different fluid deflection and meridional opening. The comparison of the obtained characteristics and the analysis of the flow pattern show the cascades for contra-rotating rotors have specific features which are necessary to take account while its designing.

A91-41295 Possibility of describing the turbulent flows of a viscous fluid by a finite-dimensional attractor (O vozmozhnosti opisaniia turbulentnykh techenii viazkoi zhidkosti attraktorom konechnoi razmernosti). G. G. MALINETSKII, A. B. POTAPOV, and V. G. PRIIMAK, *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 316, No. 5, 1991, pp. 1101-1106. 15 Refs.

Theoretical results are presented on the feasibility of using a finite-dimensional attractor to describe the turbulent flows of a viscous fluid. Specifically, the results Priimak and Rozhdestvenskii's (1987) direct simulation of the steady turbulent flows of a viscous incompressible fluid in an infinite circular tube are used to evaluate the fractal dimension of the attractor of the Navier-Stokes equation and to examine its geometrical properties.

A91-29943 An experimental study of an unsteady boundary layer (Eksperimental'noe issledovanie nestatsionarnogo pogranichnogo sloia). V. A. GUDKOV, *Molecular gas dynamics and the mechanics of inhomogeneous media* (A91-29927 11-34). Moscow, Izdatel'stvo Nauka, 1990, pp. 242-250. 5 Refs.

The unsteady boundary layer in the vicinity of bodies accelerating in flow of a liquid is investigated theoretically and experimentally using two bodies: a sphere and an ogival (streamlined) body. In the experiments, flow visualization was achieved by using fluorescent dyes. It is found that the positive relative acceleration of the bodies contributes to nonseparated flow of the liquid within the boundary layer, with the separation point shifting toward the rear stagnation point. This effect is more pronounced in the case of the streamlined body.

A91-25240 Development of the functional capabilities of coherent optical methods of velocity measurement (Razvitie funktsional'nykh vozmozhnostei kogerentno-opticheskikh metodov izmereniia skorsti). IU. N. DUBNISHCHEV, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriya Tekhnicheskikh Nauk* (ISSN 0002-3434), Aug. 1990, pp. 3-15. 40 Refs.

Coherent optical methods of velocity measurement are briefly reviewed with emphasis on laser Doppler anemometry (LDA). In particular, attention is given to the principles of coherent LDA; ways of increasing the accuracy of LDA measurements; types of laser sources used in LDA; and LDA measurements of particle size and concentration. The discussion also covers optical discrimination of the Doppler frequency shift; real-time measurement and visualization of the velocity field over the flow cross section; and performance characteristics of some commercial LDA systems.

A90-44538 Fluid flow in free flow electrophoresis chamber in microgravity. MICHAEL S. BELLO and V. I. POLEZHAIEV, *Microgravity Science and Technology* (ISSN 0938-0108), Vol. 3, May 1990, pp. 3-7. 11 Refs.

The paper is devoted to the approximate analysis and computer simulations of the viscous incompressible fluid flow in the free-flow electrophoresis chamber, parameters of which are similar to those of the Hele-Shaw cell. The buoyancy effects are assumed to be negligible and do not affect the fluid flow. Such a case corresponds to either electrophoretic separation in microgravity environment or to the electrophoresis in a rather thin chamber. The investigation is based on the Navier-Stokes equations averaged over the transverse coordinate. The streamlines of the steady flow were calculated for various values of the parameter α and the relative size of the inlet opening s . The parameter α characterizes the ratio of the fluid friction forces against chamber walls to the inertia forces. Three different regimes of the steady flow in the chamber could occur: irrotational flow and jetlike flow with and without secondary flows. The dependence of the entrance region length on the parameters α and s was obtained.

A91-33920 Effect of a single three-dimensional surface roughness on the transition in a supersonic boundary layer (Vliianie edinichnoi trekhmernoi sherokhovatosti na perekhod v sverkhzvukovom pogranichnom sloe). O. I. ZININ, A. A. MASLOV, V. E. NOVIKOV, and S. G. SHEVEL'KOV, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriya Tekhnicheskii Nauki* (ISSN 0002-3434), June 1990, pp. 47-53. 9 Refs.

The effect of a single surface roughness in the form of a projecting cylinder (0.3 mm in diameter) on the laminar-turbulent transition in a boundary layer on a flat plate was investigated experimentally at $M = 2.0$ for various wind tunnel regimes. The transition was observed by means of flow visualization techniques and measured by using pressure transducers and hot-wire anemometry. The results are in agreement with the results of Van Driest and Blumer (1962) obtained for a cone with surface roughness in the form of spheres. The evolution of turbulence in the wake of the roughness is examined.

A91-18856 Flow of a plane shock wave past a thermal adjacent to a rigid wall (Ob obtekanii termika, primykaiushchego k zhestkoi stenke, ploskoi udarnoi volnoi). B. I. ZASLAVSKII, S. IU. MOROZKIN, A. A. PROKOF'EV, and V. R. SHLEGEL', *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), May-June 1990, pp. 15-23. 16 Refs.

The interaction of a plane shock wave with a wall layer of a low-density gas (a wall thermal) was investigated experimentally over a wide range of the shock wave front incidence angles, wall layer densities, and shock wave intensities. Results of a theoretical analysis of the wave structure produced during such an interaction are also presented. Details of the experimental procedure and experimental equipment are described.

A91-16998 Laboratory study of resonant motion regimes of a homogeneous fluid with a free surface in inclined rotating containers (Laboratornoe issledovanie rezonansnykh rezhimov dvizhenii odnorodnoi zhidkosti so svobodnoi poverkhnost'iu v naklonno vrashchaisushchikhsia sosudakh). S. N. DIKAREV, *Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana* (ISSN 0002-3515), Vol. 26, Sept. 1990, pp. 982-992. 9 Refs.

Inertial vortex regimes generated in tilted rotating containers filled with a homogeneous fluid which has a free surface are investigated experimentally. It is shown that, although the fluid under a small vertical tilt oscillates only slightly, intense vortex currents will be generated in a fluid under conditions of certain resonant ratios between the depth of the fluid and the horizontal dimension of the container. An experimental study of three well-ordered regimes and one irregular regime of inertial flow is described.

A91-13546 Possibility of modeling thermal and force loading of the lateral surface of a body in the path of a high-velocity gas flow (K vozmozhnosti modelirovaniia teplosilovogo vozdeistviia na bokovuiu poverkhnost' tela, obtekaemogo vysokoskorostnym potokom gaza). N. M. GAVRILOVA, N. V. MEDVETSKAIA, IU. V. POLEZHAIEV, *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 28, July-Aug. 1990, pp. 728-735. 11 Refs.

A new modeling-channel testing scheme is proposed which makes it possible to reproduce flow past the lateral surface of a body at supersonic Mach and high Reynolds numbers, corresponding to turbulent flow in a boundary layer. Supersonic channel profiles are calculated in such a way as to produce a specified flow parameter distribution on the body surface. Results of calculations are presented.

A91-13501 Experimental studies of flow microstructure in the blading of axial-flow turbomachines (Review) (Eksperimental'nye issledovaniia mikrostruktury potoka v protochnoi chasti osevykh turbomashin /Obzor/). E. P. DYBAN, and E. IA. EPIK, *Promyshlennaiia Teploekhnika* (ISSN 0204-3602), Vol. 12, No. 4, 1990, pp. 3-25. 25 Refs.

Experimental data on flow microstructure in the blading of axial-flow turbines are presented to show that such flows are characterized by the presence of various types of perturbations, such as increased turbulence, periodic velocity fluctuations, secondary flows, and separations. The importance of laboratory studies modeling individual factors, such as turbulence superposed on velocity fluctuations of specified form, is emphasized. It is also noted that such research is important for the refinement of methods for calculating transfer processes in the flow path of turbines.

A91-29924 Aerodynamic characteristics of cones for small angles of attack under conditions of the boundary layer transition (Aerodinamicheskie kharakteristiki konusov pri mal'nykh uglakh ataki v usloviakh perekhoda pogranichnogo sloia). V. N. ANDREEV, V. A. KOZLOVSKII, and K. A. STEKENIUS, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), Jan.-Feb. 1991, pp. 168-174. 8 Refs.

The configuration of the transition region on the surface of acute cones with half-angles of taper of 0.122 and 0.174 was investigated as a function of the angle of attack. The experiments were carried out in a wind tunnel at Mach 4, 4.4, 6, and 6.2; the Re_1 number, determined from the incoming flow parameters, varied in the range $(0.51-4.1) \times 10$ to the 7th. The boundary layer was visualized by the schlieren photometric method. In addition to boundary layer visualization, the integral aerodynamic characteristics of the models were determined by means of three-component tensometric scales inside the models. The results are presented in graphic form.

A91-29831 Effect of local surface heating on the transition to turbulence in a three-dimensional boundary layer of a gas (Vozdeistvie lokal'nogo nagrevaniia poverkhnosti na perekhod k turbulentnosti v trekhmernom pogranichnom sloe gaza). A. V. DOVGAL', V. I. A. LEVCHENKO, and V. A. TIMOFEEV, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seria Tekhnicheskii Nauki* (ISSN 0002-3434), Dec. 1990, pp. 43-48. 18 Refs.

In earlier studies, the possibility of using local heating to increase the stability of a laminar boundary layer of a gas has been demonstrated theoretically and experimentally for two-dimensional boundary layers. In the study reported here, experiments were carried out to determine the effect of local heating on the laminar-turbulent transition in a three-dimensional boundary layer. It is shown that local heating can be used to delay the laminar-turbulent transition in three-dimensional boundary layer flows. In particular, local heating lowers the requirements for the acceptable surface roughness for laminar boundary layers.

A91-29829 Evolution of an incompressible turbulent wall flow in the region of curvilinear surface conjugation (Osobennosti razvitiia neszhimaemogo pristenogo turbulentnogo techeniia v oblasti sopriazheniia krivoliniinykh poverkhnostei). V. I. KORNILOV, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seria Tekhnicheskii Nauki* (ISSN 0002-3434), Dec. 1990, pp. 22-30. 25 Refs.

Flow structure in the region of conjugation of curvilinear intersecting surfaces forming an open corner configuration was investigated experimentally with a view to finding configurations which would result in flow with no gradients in the longitudinal direction and free from boundary effects. The experiments were carried out on several different models in a subsonic low-turbulence wind tunnel at freestream velocity of 30 m/s, corresponding to $Re_1 = 2 \times 10$ to the 6th/m. The experimental data are analyzed using power-law relations to approximate the velocity profiles. The effect of surface curvature on flow characteristics is discussed.

A91-25280 Visualization of water streams in high-resolution radar imagery of the mouth of Neva River (Vizualizatsiia struinykh techenii v Nevskoi gube na radiolokatsionnykh izobrazheniakh vysokogo razresheniia). S. V. VIKTOROV, L. L. SUKHACHEVA, V. V. VITER, I. I. POSTNIKOV, and P. A. SHIROKOV, *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 315, No. 2, 1990, pp. 337-340.

High-resolution SAR imagery obtained with the Cosmos-1870 satellite on June 26, 1989 confirm the streamwise movement at the mouth of the Neva River. The imagery analysis made it possible to obtain the instantaneous pattern of streams in the river mouth, to determine the stream extent and width, and to identify the presence of intense stream zones.

A91-25244 A polarization method for visualizing quasi-one-dimensional turbulent flows (Polarizatsionno-opticheskii metod vizualizatsii kvaziodnomernykh turbulentnykh techenii). I. M. BYCHKOV, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seria Tekhnicheskii Nauki* (ISSN 0002-3434), Aug. 1990, pp. 61-64.

A polarization method for visualizing quasi-one-dimensional turbulent flows is described whereby an optically active fluid (e.g., a colloidal vanadium pentoxide solution) is illuminated, through the thickness, by polarized light. The method makes it possible to detect processes with a duration of 0.01-0.001 s by using normal photodetection; processes with durations of 0.0001-0.00001 s and 10 to the -6th s can be detected using high-speed and pulsed photodetection techniques, respectively. Results of visualization studies of flows out of rectangular capillaries are sented.

A91-25263 A study of unsteady supersonic flow of air heated by a longitudinal electric discharge past bodies (Issledovanie nestatsionarnogo obtekaniia tel sverkhzvukovym potokom vozdukh, podogretym prodol'nym elektricheskim razriadom). V. V. VITKOVSKI, L. P. GRACHEV, N. N. GRITSOV, I. U. E. KUZNETSOV, V. V. LEBEDENKO et al., *Teplotfizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 28, Nov.-Dec. 1990, pp. 1156-1163. 10 Refs.

Supersonic flow of air heated by a longitudinal electric discharge past hemispheres and cones was investigated experimentally using high-velocity visualization techniques. It is found that, in the presence of an electric discharge, flow past bodies is essentially unsteady, with characteristic time scales of the order of several microseconds, despite the low level of discharge current pulsations. The experimental data are compared with gas density distributions based on a one-dimensional model assuming the presence of thermal inhomogeneities in the flow.

A91-25246 Visualization of unsteady supersonic jets (Vizualizatsiia nestatsionarnykh sverkhzvukovykh strui). M. E. CHURBANOV and B. E. SINIL'SHCHIKOV, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seria Tekhnicheskii Nauki* (ISSN 0002-3434), Aug. 1990, pp. 84-87. 5 Refs.

A new system for the visualization of unsteady supersonic jets has been developed which makes it possible to study jets issuing from nozzles of large critical diameters. The system uses schlieren photography to study jets of any scale, the jet size being limited only by the size of the facility and by the power of the flashlamp. Results of visualization studies of unsteady gun-powder jets (critical nozzle diameter up to 15 mm) in a field of 50 x 70 critical nozzle diameters are examined.

A90-49341 Visual investigation of vapour-gas zone in heat pipe condenser. M. D. PARFENTLEY, Presented as Paper 901274 at the 20th SAE Intersociety Conference on Environmental Systems, Williamsburg, VA, July 9-12, 1990. 6 pp.

The paper presents the results of the visual investigations of the working fluid vapor and noncondensable gaseous impurities interacting in low-temperature heat pipe condensation zone. The effect of the transferred heat flow amount on the vapor and noncondensable gaseous impurity (NGC) separation is established. The obtained dependence makes it possible to determine the minimal amount of the transferred heat flow from which the vapor and NGC will be dynamic mixed and the temperature profile will be symmetric in the heat pipe condensation zone. Water, ethanol, acetone, and Freon-11 were used as the working fluid, while air, argon, and helium as NGC.

A90-30331 Flow instability in the separation zone of a laminar boundary layer on a small surface irregularity (Neustoiichivost' techeniia v zone otryva laminarnogo pogranichnogo sloia na maloi nerovnosti poverkhnosti). A. V. BOIKO, A. V. DOVGAL', V. V. KOZLOV, and V. A. SHCHERBAKOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), Jan.-Feb. 1990, pp. 16-22. 16 Refs.

The development of laminar flow perturbations in the separation zone behind a surface projection in the boundary layer of a flat plate is investigated experimentally. The linear instability characteristics of the separated flow are determined, and the interaction of oscillations generated in the separation zone with the mean flow is examined. It is shown that the frequencies and increments of perturbations arising in the separation zone are close to the values characteristic of inviscidly stable free shear flows.

Japanese Aerospace Literature This month: *Spacecraft/Satellite Design*

A92-12562 A conceptual study on a new style logistic service vehicle. MITSUSHIGE ODA, KATSUMI KITOH, and TAKAHIRO ITOH, Presented as Paper 91-188 at the 42nd IAF International Astronautical Congress, Montreal, Canada, Oct. 5-11, 1991. 8 pp.

A conceptual study of an in-orbit deployable reentry vehicle which can be used for logistic support and space experiments is reported. The vehicle has a deployable capsule shell which can be extended in orbit to deploy solar paddles, radiator, and manipulator arm. The subelements of these systems are described and the systems' major characteristics are listed. The concepts are also graphically depicted.

A91-13768 The design and orbital operation of Space Flyer Unit. K. KURIKI, N. NINOMIYA, M. NAGATOMO, N. TSUYA, M. KAWACHI et al., Presented as Paper 90-055 at the 41st IAF International Astronautical Congress, Dresden, Federal Republic of Germany, Oct. 6-12, 1990. 12 pp.

The Space Flyer Unit (SFU) is an unmanned, reusable multipurpose platform to be launched by the Japanese H-II rocket and retrieved by the U.S. Space Shuttle. The SFU core system and payloads are described, and the SFU target mission and performance are summarized. SFU operation is examined, including the launch phase, early orbit phase, mission operation phase, preretrieval phase, retrieval phase, proximity operation phase, and return phase.

A90-45696 Japan's space program—Building for the 21st century. CRAIG COVAULT, *Aviation Week and Space Technology* (ISSN 0005-2175), Vol. 133, Aug. 13, 1990, pp. 36-43, 62-67, 70-72.

Japan is gearing its space program toward space station operations, development of an infrastructure for manned flight, and the launch of spacecraft to the moon, Venus, and Mars. The National Space Development Agency (NASDA) is responsible for handling large boosters and applications satellites. The Institute of Space and Astronautical Science (ISAS) develops medium boosters and science spacecraft. Japan's Ministry of Trade and Industry along with ISAS and NASDA is developing the 3.8-ton Space Flyer, the nation's first large retrievable satellite. The new H-2 launch facilities rival the largest U.S. or European sites. In addition, a large new rocket engine test stand has been constructed to test fire the oxygen/hydrogen LE-7 main engine that powers the first stage of the H-2 heavy booster. Initial space flight missions include the OREX orbiting reentry experiment, which is part of the HOPE spaceplane development. Launching of the ETS-6 is planned to demonstrate advanced geosynchronous satellite technologies. The Japanese Space Flyer, a 3.8-ton reusable spacecraft to carry various payloads, is scheduled for launch into a low earth orbit in late 1994. Additional details are provided for the HOPE unmanned spaceplane, the Marine Observation Satellites, the Earth Resources Satellite, and the Advanced Earth Observing Satellite.