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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 Aeroacoustics from Russia and Fracture Mechanics from Japan.

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Russian Aerospace Literature This month: *Aeroacoustics*

A95-27128 Coherent structure role in forming the near sound field of turbulent jet. E. V. VLASOV and T. M. MAKARENKO (TsAGI, Zhukovski, Russia), *In International Congress on Air- and Structure-borne Sound and Vibration*, 3rd, Montreal, Canada, June 13–15, 1994, Proceedings, Vol. 2 (A95-27086 06-71), Auburn, AL, International Scientific Publications, 1994, pp. 1185–1190. 5 Refs. Documents available from Aeroplus Dispatch.

The role of the large-scale coherent structures produced in the initial jet part in the near sound field generation is considered. Coefficient measurements of the space-time correlation of pressure pulsations in the jet core and pressure pulsations in the near field showed a close connection between the pressure pulsations and the coherent structures. Amplification or attenuation of the large-scale structures under external excitation (acoustic or vibrational jet disturbances) leads to the corresponding variation of the jet near field acoustics. To explain the physics of the examined phenomena, visualization of the jet flow is performed. Possible ways of controlling the jet acoustic characteristics by excitation of the coherent structures are investigated. A jet noise suppressor is proposed and investigated on a model and on a full-scale engine. It is based on the concept of aeroacoustic interaction. (Author)

A95-24689 Possibility of operative forecasting of the propagation of acoustic noise in the ground atmospheric layer with meteorological conditions taken into account (Vozmozhnosti operativnogo prognoza prizemnogo rasprostraneniya akusticheskikh shumov v atmosfere s uchetom meteorologicheskikh uslovij). N. G. ABRAMOV, A. Ya. BOGUSHEVICH, V. I. KARPOV, N. P. KRASNENKO, and A. A. FOMICHEV (RAN, Inst. Optiki Atmosfery, Tomsk, Russia), *Optika Atmosfery i Okeana* (ISSN 0869-5695), Vol. 7, No. 3, March 1994, pp. 403–413. In Russian. 8 Refs. Documents available from Aeroplus Dispatch.

A description of a program package called 'Acoustics of Open Spaces' designed for operative assessments of the mean field of sound pressures from a remote sound source in the ground atmospheric layer is presented. The program complex allows for the characteristics of the acoustic noise source, vertical profiles of the main meteorological parameters, characteristics of an underlying surface, and parameters of the atmospheric turbulence. Results obtained with this complex in field tests for distances from an acoustic noise source up to 6 km are also presented.

A95-20005 Sound radiation and scattering by localized vortices. A. T. SKVORTSOV (Russian Academy of Sciences, Acoustics Inst., Moscow, Russia), *In NOISE-CON 94; Proceedings of the 13th National Conference on Noise Control Engineering*, Fort Lauderdale, FL, May 1–4, 1994 (A95-20001 04-71), New York, Noise Control Foundation, 1994, pp. 203–208. 32 Refs. Documents available from Aeroplus Dispatch.

The processes of sound scattering and sound radiation by localized vortices are important for a number of problems in aeroacoustics (turbulent flow noise abatement), in atmospheric and ocean acoustics (as a model of sound interaction with large-scale turbulence), nonlinear acoustics (these processes could produce harmonics from synchronism), in the theory of superfluidity (scattering of vortices determines the mutual friction force between the superfluid and normal components of the medium), and astrophysics (as possible mechanism of energy transfer in solar corona). This paper reviews fundamental laws governing the processes of sound radiation and sound scattering by vortices in a slightly compressible medium (i.e., in the case when characteristic vortex velocity is considerably less than speed of sound).

A94-29339 Direct shadow method application to aero-acoustic interaction investigation. V. G. PIMSHTEIN (TsAGI, Moscow, Russia), *In Flow visualization VI; Proceedings of the 6th International Symposium*, Yokohama, Japan, Oct. 5–9, 1992 (A94-29328 09-35), Berlin and New York, Springer–Verlag, 1992, pp. 183–187. Documents available from Aeroplus Dispatch.

Some investigation results for interaction process of sawlike sound waves of high intensity (160–170 dB) with axisymmetrical subsonic and supersonic jets are presented. Flow and sound waves visualization was performed by the direct shadowgraph method using an impulse source with exposure duration 2 x 10 exp –7 sec. Peculiarities of disturbance emergence and development in a subsonic air jet and in a helium jet under acoustic excitation are considered. It is shown that large-scale disturbances arise on the acoustically excited side of a supersonic jet and the jet radiates directional sound at the frequency of the external excitation (Mach waves). (Author)

A94-29281 Refining a method for calculating jet noise in a free acoustic field (Utochnenie metodiki rascheta shuma reaktivnoj strui v svobodnom zvukovom pole). A. V. GENERALOV, I. S. ZAGUZOV, and V. N. KALABUKHOV, *In Design and Adjustment of Aircraft Gas-turbine Engines* (A94-29278 09-07), Kuibyshev, Russia, Kujbyshevskij Aviatsionnyj Institut, 1988, pp. 28–33. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

In the present study, experimental testbed data on jet noise were corrected to allow for the effect of a free nonturbulent atmosphere without temperature and wind velocity gradients. The corrected dimensionless noise spectra were then used to obtained refined empirical expressions for calculating the noise of a reaction jet in a free acoustic field.

A94-16752 Acoustic characteristics of propfans. V. M. KUZNETSOV, V. I. GANABOV, L. S. KRYMOVA, and S. Yu. MAKASHOV (TsAGI, Moscow, Russia), *AIAA, Aeroacoustics Conference*, 15th, Long Beach, CA, Oct. 25–27, 1993, p. 7. 16 Refs. Documents available from Aeroplus Dispatch.

Results are presented from an experimental investigation of propfan acoustics that encompasses acoustic loading distributions on a hard surface, taking into acount the sources that determine the forcing action of the blades on their environment. Attention is given to the influence of aerodynamic and geometric parameters of propfans, and their working conditions, on the radiated acoustic field. Passenger transport-related propfan noise problems are discussed.

A94-16704 Vibration and acoustic radiation of thin-walled structures under aerodynamic excitation. B. M. EFMITSOV (TsAGI, Moscow, Russia), *AIAA, Aeroacoustics Conference*, 15th, Long Beach,

CA, Oct. 25–27, 1993, p. 5. 11 Refs. Documents available from Aeroplus Dispatch.

An analysis is conducted of the phenomena defining thin-wall structure vibrations and acoustic radiation, under excitation by either uniform or largely nonuniform fields of aerodynamic pressure fluctuation. Attention is given to unique, latent resonances which are activated at determinable points in the relationship between nonuniformity, pressure fluctuation field phase velocity, structural elastic wavelength, and propagation velocity.

A94-16690 Sound radiation by high frequency oscillations of the vortex ring. V. F. KOPIEV and S. A. CHERNYSHEV (TsAGI, Moscow, Russia), *AIAA, Aeroacoustics Conference*, 15th, Long Beach, CA, Oct. 25–27, 1993, p. 10. 17 Refs. Documents available from Aeroplus Dispatch.

The present extension of a conventional description of vortex ring eigenoscillatory behavior, based on disturbances that occur in response to a vortex boundary oscillations, yields a family of high frequency oscillations. The shape of the oscillation is defined by two approximations. A novel expression is obtained for the quadrupole moment of the sound field, where the volume integral is reduced to that of the surface.

A93-51762 An aeroacoustic stand for evaluating the efficiency of sound-absorbing structures under conditions of acoustic wave propagation in a moving medium (Aehroakusticheskij stend dlya issledovaniya ehffektivnosti zvukopogloshchayushchikh konstruktsij pri uslovii rasprostraneniya zvukovykh voln v dvizhushchejsya srede). A. G. MUNIN, A. A. ANDREEV, Z. N. NAUMENKO, and O. A. SHEVCHENKO, TsAGI, Trudy, No. 2355, 1988, pp. 83–91. 6 Refs. Documents available from Aeroplus Dispatch.

An aeroacoustic test stand is described which is designed for evaluating the acoustic efficiency of sound-absorbing structures in a channel of 150 × 150 sq mm cross section in which the flow velocity varies from 0 to 150 ms and the sound pressure level in the incident wave varies from 90 to 154 dB. The discussion covers the general design of the test stand, its technical characteristics, and details of the measuring procedure. Sample experimental results are presented.

A93-47510 An acoustic suppressor for the jet noise of a turbojet engine (Akusticheskij glushitel' shuma reaktivnoj strui TRD). E. V. VLASOV, A. S. GINEVSKIJ, I. S. ZAGUZOV, and R. K. KARAVOSOV, *In Turbulent Flow Problems* (A93-47505 19-34), Moscow, Tsentral'nyj Institut Aviatsionnogo Motorostroeniya, 1991, pp. 76–85. 4 Refs. Documents available from Aeroplus Dispatch.

A novel technique for reducing the jet noise of turbojet engines is proposed which is based on the aeroacoustic interaction effect. The noise is reduced using a multitube nozzle consisting of a central nozzle and several peripheral ones, which have an order-of-magnitude-smaller diameter. The high-frequency noise effect of the peripheral streamlets leads to a reduction of the total noise in both the near and the far acoustic fields. Experiments were conducted on models as well as on a full-scale turbojet engine.

A93-39040 Identification of noise sources based on experimental amplitude-frequency noise characteristics of aircraft (Identifikatsiia istochnikov shumoobrazovaniia na osnove eksperimental'nykh amplitudno-chastotnykh kharakteristik shuma samoleta). I. S. ZAGUZOV, *In Dynamic Processes in the Powerplants and Power-Generating Equipment of Flight Vehicles* (A93-39027 15-31), Kuibyshev, Russia, Kuibyshevskii Aviatsionnyi Institut, 1990, pp. 108–122. 7 Refs. Documents available from Aeroplus Dispatch.

Problems involved in the identification of the principal sources of noise generation from experimentally obtained amplitude-frequency noise characteristics of aircraft on the ground and under flight conditions are examined. Particular attention is given to the analysis of sound interference and edge diffraction phenomena, which introduce noticeable distortions in the amplitude-frequency aircraft noise characteristics and make the task of identifying the true noise sources more difficult.

A93-19196 Control of coherent structures and aero-acoustic characteristics of subsonic and supersonic turbulent jets. E. V. VLASOV, A. S. GINEVSKII, and V. G. PIMSHTEIN (TsAGI, Moscow, Russia), *In DGLR/AIAA Aeroacoustics Conference*, 14th, Aachen, Germany, May 11–14, 1992, Proceedings, Vol. 2 (A93-19126 05-71), Bonn, Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1992, pp. 672–678. 12 Refs. Documents available from Aeroplus Dispatch.

Three important problems associated with the role of large-scale coherent structures of jet flows in turbulent mixing processes and in aerodynamic noise generation are investigated in the present work. Firstly, new data illustrating the relation between coherent subsonic jet structures and their sensitivity to the periodic excitation and the jet noise in its far and near field are received. Secondly, from visual investigations of subsonic turbulent jets under high-intensity sound wave excitation there was investigated the interaction of sound waves and large-scale vortex structures generated by them. Thirdly, noise reduction methods for subsonic and supersonic non-isobaric turbulent jets are studied. Those methods are based on the aeroacoustic interaction effect. (Author)

A93-19167 On the acoustic radiation nature of a turbulent vortex ring V. F. KOP'EV (TsAGI, Moscow, Russia), *In DGLR/AIAA Aeroacoustics Conference*, 14th, Aachen, Germany, May 11–14, 1992, Proceedings, Vol. 1 (A93-19126 05-71), Bonn, Deutsche Gesellschaft fuer Luft-und Raumfahrt, 1992, pp. 361–366. 23 Refs. Documents available from Aeroplus Dispatch.

A wide range of fundamental questions associated with dynamic model formulation for 3D aerodynamic sound sources are considered. The possibility of combined experimental and theoretical investigation of aeroacoustic features of a separate vortex ring is presented. The reference theoretical model is examined, an acoustic test is performed and visualization techniques of fast proceeding processes in the vortex ring core are developed. (R.E.P.)

A93-18203 An experimental investigation of the atmospheric propagation of acoustic pulses emitted by a detonation generator (Eksperimental'noe issledovanie rasprostraneniia v atmosfere akusticheskikh impul'sov, izluchaemykh detonatsionnym generatorom). IU. I. KRASNOSHCHEKOV, V. N. TOVCHIGRECHKO, V. E. FRIDMAN, and I. P. CHUNCHUZOV (RAN, Inst. Fiziki Atmosfery, Moscow, Russia), *Rossiiskaia Akademiia Nauk, Izvestiia, Fizika Atmosfery i Okeana* (ISSN 0002-3515), Vol. 28, Nos. 10, 11, Oct.–Nov. 1992, pp. 1037–1043. In Russian. 5 Refs. Documents available from Aeroplus Dispatch.

Results of an experimental investigation of the effects of wind velocity stratification and nonlinearity on the form and duration of sound pulses emitted by a detonation generator are presented. The shape of a pulse at small distances from the generator (less than 150 m) is distorted mainly due to nonlinear effects and dissipation caused by the ground impedance. At great distances (up to 5 km) the shape and duration of the pulse are mainly determined by the wind stratification. The pulse splitting is studied for various types of boundary layer stratification and propagation azimuth. (P.D.)

A93-16707 Flow past a finite-span wing in the presence of external acoustic loading (Obtekanie kryla konechnogo razmakha pri vneshnem zvukovom vozdeistvii). V. N. LUSHIN (Gosudarstvennyi Sibirskii NII Aviatsii, Novosibirsk, Russia), *Sibirskii Fiziko-Tekhnicheskii Zhurnal* (ISSN 0869-1339), No. 4, July–Aug. 1992, pp. 64–68. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

Flow past a finite-span wing in the presence of acoustic loading was investigated experimentally in a wind tunnel using a rectangular wing model with an aspect ratio of 5 and a span of 2.5 m. The tests were carried out for sideslip angles of 0, 15, and 30 deg and flow velocities ranging from 0 to 30 m/s. It is shown that acoustic loading has a substantial effect on the overall aerodynamic characteristics of the wing model and that the acoustic method can be used to control three-dimensional separation vortices generated on finite-span wings. (V.L.)

A93-15256 Acoustic control of flow separation on a straight and a yawed wing (Upravlenie otryvom potoka na priamom i skol'ziashchem kryle pri pomoshchi zvukovogo vozdeistviia). B. IU. ZANIN, V. V. KOZLOV, and V. N. LUSHIN (RAN, Inst. Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, Russia), *Sibirskii Fiziko-Tekhnicheskii Zhurnal* (ISSN 0869-1339), No. 3, May–June 1992, pp. 32–36. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

The effect of the irreversible reattachment of global separation under the effect of sound on a straight infinite-span wing model has been reported in an earlier study (Zanin et al., 1990). Here, results of a further study of this effect, including the case of three-dimensional flow over a yawed wing, are reported. The results of the study indicate that acoustic control of flow separation is applicable to a wide range of flows past wings, including swept wings. (V.L.)

A93-12981 Some problems in theoretical aeroacoustics (Nekotorye voprosy teoreticheskoi aeroakustiki). E. A. LEONT'EV, TsAGI, Trudy, No. 2499, 1991, pp. 3–31. In Russian. 20 Refs. Documents available from Aeroplus Dispatch.

The papers presented here provide a brief overview of some important problems in aeroacoustic theory. The problems discussed include the effect of the earth surface on sound propagation, simultaneous determination of the acoustic field and lifting force pulsations for an airfoil in unsteady gas flow, and sound propagation in a moving medium. A paper is also presented on an equation for ideal gas velocity, Galilean invariance of the Howe equation, and Lighthill's theory. (V.L.)

A93-12810 An experimental study of a method for reducing the jet noise of bypass engines using mechanical flow mixers (Eksperimental'noe issledovanie metoda snizheniia shuma strui TRDD spomoshch'iu mekhanicheskikh smesitelei potokov). I. S. ZAGUZOV and K. V. KAKHOVSKII, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 1, 1992, pp. 46–49. In Russian. 2 Refs. Documents available from Aeroplus Dispatch.

Results of an experimental study of the effect of lobe mixers on the noise level of bypass turbofan engines are examined. It is shown that the principal parameter responsible for the effective reduction of the jet noise is the radial clearance between the mixer lobes and the discharge nozzle. A diagram of an experimental 18-lobe mixer is presented. (V.L.)