AIAA JOURNAL
Vol. 33, No. 12, December 1995

# 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 Artificial Intelligence from Russia and Mathematical Models from Japan.**

**Support for assembling and publishing the selected abstracts has been provided by the Innovative Science and Technology Directorate of the Strategic Defense Initiative Organization (SDIO), with the sponsorship and technical management of the abstract service by the Office of Naval Research (ONR) under ONR Grant N00014-93-I-1074.**

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## Russian Aerospace Literature This month: *Artificial Intelligence*

**A95-22423 Cartographic modeling and geographic information systems (Kartograficheskoe modelirovanie i geoinformatsionnye sistemy).** A. I. MARTYNENKO, *Geodeziya i Kartografiya* (ISSN 0016-7126), No. 9, Aug. 1994, pp. 43–45. In Russian. Documents available from Aeroplus Dispatch.

The main principles of the development of geographic information systems (GIS) are briefly examined. In particular, attention is given to the systems approach as the conceptual basis of GIS development and application; mathematical and cartographic modeling of the recognition and generalization of mapping images, raster input/output of cartographic information and its processing and storage in vector form; and development of artificial intelligence systems on the basis of algorithms and programs using cartographic principles.

**A95-19209 Aerospace objects intelligent control systems—Conceptions, tools, applications.** M. B. IGNAT'EV, A. V. NIKITIN, M. G. ZELENSKIJ, A. V. PANKOV, B. V. TUPIKOV, and D. G. YUSHKOV (State Aerospace Instruments Academy, St. Petersburg, Russia), In *SIMTEC '93—1993 International Simulation Technology Conference*, San Francisco, CA, Nov. 7–10, 1993, Proceedings (A95-19201 04-66), San Diego, CA, Society for Computer Simulation, 1993, pp. 51–53. 9 Refs. Documents available from Aeroplus Dispatch.

The principal requirements for the control systems of future aerospace vehicles using elements of artificial intelligence are formulated, and the methods and tools required to meet these requirements are discussed. In particular, attention is given to solving control and diagnostic problems using methods based on Petri net analysis. The methods discussed are used to automatically generate knowledge bases for the diagnosed objects, optimize research systems, and build hybrid expert/simulation systems.

**A94-28452 Introduction of elements of artificial intelligence into heat power engineering (thermodynamic efficiency of aircraft engines) (O vvedenii ehlementov iskusstvennogo intellekta v teploehnergetiku).** A. F. DREGALIN, and R. R. NAZYROVA (Kazanskij Gosudarstvennyj Tekhnicheskij Univ., Kazan, Russia), *Aviatsionnaya Tekhnika* (ISSN 0579-2975), No. 4, 1993, pp. 90–94. In Russian. 10 Refs. Documents available from Aeroplus Dispatch.

The use of personal computers with elements of artificial intelligence for solving problems associated with the design and operation of aircraft and rocket engines is discussed. In particular, attention is given to the concept of thermodynamic artificial intelligence, or the capability to derive formal relationships between thermodynamic functions. It is noted that sufficient knowledge is now available for creating a knowledge base for the analysis of thermodynamic processes in aircraft and rocket engines.

**A94-31795 The reality of perspectives of equipment intellectuality—The peculiarities of system dynamics development of N-level in the process of interaction between (N-1)-level systems.** P. B. BAUM (Moscow Aviation Inst., Russia), In *ICAS, Congress*, 19th, Anaheim, CA, Sept. 18–23, 1994, Proceedings, Vol. 3 (A94-31534 10-01), Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1994, pp. 2619–2624. Documents available from Aeroplus Dispatch.

Analytical and synthetic system typologies are discussed which offer to separate in a definite way inanimate, artificial, and living systems. The memory structure of a self-developing living system should be understood as 'intellect'. Modern complex artificial systems are shown to come close in their structure to living systems. By considering the interactions between (N-1)-level systems, two evolutionary curves of living and inanimate N-level systems are demonstrated. The opportunity of equipment intellectualization by giving it the properties of the self-developing living systems is considered. The latter is possible when imitating in mathematical media the interacting memory structures analogous to living structures. (Author)

**N94-22068 The distributed CAD system for LSI/VLSI design.** V. G. ZACHAROV and V. A. KONYAVSKY, In *Technical Research Centre of Finland, Information Technology and Economic Modelling*, pp. 94–100 (SEE N94-22056 05-83). Documents available from Aeroplus Dispatch.

Peculiarities of microelectronic CAD (Computer Aided Design) are conditioned by a wide assortment of design objects. Computer capacities necessary to carry on design processes vary with the class of the object (PLD's, Gate-Arrays, submicron technology custom VLSI (Very Large Scale Integration), etc.) as well as with design stages. For example, while performance of a PC (Personal Computer) is quite sufficient for circuit input or logical synthesis of nodes etc., a supercomputer's performance might not provide capacity for some technology simulation or circuitry modeling. This variety of requirements to be satisfied constrains the design of a distributed mode system. The structure of a distributed, multiple user CAD system for LSI/VLSI design is envisaged, while considering the demands to provide necessary peak capacities to perform variable information flow processing. Setting up a number of centers integrated into a regional computer net is envisaged by the USSR state informatization program to provide the structure implementation. Problems of hardware choice as well as those of choice of basic and application software are examined.

**N94-19208** Central Eurasia: Aviation and cosmonautics, Joint Publications Research Service, No. 11, November 1992. Documents available from Aeroplus Dispatch.

Papers on the following topics are included: continued discussion of artificial intelligence to aid pilots; and importance, ways of maintaining personnel physiological reserves.

**N94-19149** Central Eurasia. Aviation and cosmonautics, No. 10, October 1992. Joint Publications Research Service, Arlington, VA. Documents available from Aeroplus Dispatch.

Papers on the following topics are included: launch-complex designer Barmin on past, future of space science; varied nature of satellite ground control operations viewed; and case made for artificial intelligence systems on combat aircraft.

**N94-19148** Central Eurasia. Aviation and cosmonautics, Joint Publications Research Service, No. 12, December 1992. Documents available from Aeroplus Dispatch.

Papers on the following topics are included: combat pilots helped by 'artificial intelligence'; safety problems in instrument landing explored; theory of more efficient propulsion method explored; and Tu-160, U.S. B-1B features, performance compared.

**A94-11335 Comparative analysis of intermediary languages of various types.** O. A. ZARETSKAYA-TSCHUKREEVA (Ukrainian Academy of

Sciences, Inst. of Cybernetics, Kiev, Ukraine), *IAF, International Astronautical Congress*, 44th, Graz, Austria, Oct. 16–22, 1993, p. 7. 26 Refs. Documents available from Aeroplus Dispatch.

A procedure for a comparative analysis of intermediary languages (ILs) for the contact of intelligent or highly organized systems of various types is suggested. The model represents the IL as a hierarchy of the following levels: the theoretical level — the level of theoretical solutions of the problem of establishing contact of the given systems; the level of semiotics — the level of the selection of the semiotic means for the solutions proposed at the first level; and the level of realization — the elaboration of a coding system for the abstract semantics constructed at the second level. The concrete ILs (Lincos, the experimental ILs for the contact with higher animals (apes) and dolphins, the ILs for interaction of human intelligence with artificial intelligence (programming languages etc.) are interpreted by the model. The classification of various heterogeneous objects and phenomena functioning as ILs is discussed. The theoretical possibility of establishing contact with the help of some ILs is examined. (Author (revised))

**A93-53348 Fuzzy electronic components and devices (Ehlementy i ustrojstva nechetkoj ehlektroniki).** M. S. KUPRIYANOV, V. A. TEREKHOV, and S. M. CHUEV (Sankt-Peterburgskij Inst. Aviatsionnogo Priborostroeniya, St. Petersburg, Russia), *Priborostroenie* (ISSN 0021-3454), Vol. 35, No. 3, 4, 1992, pp. 43–49. 19 Refs. Documents available from Aeroplus Dispatch.

The use of the analog approach to the representation and processing of fuzzy data is examined. In particular, attention is given to the organization and functioning of analog cells for the execution of fuzzy logic operations. The use of analog cells for implementing the components of a high-speed artificial intelligence system employing an heuristic control strategy is proposed.

**A93-50960 Control problem for a plant with artificial intelligence (O zadache upravleniya ob"ektom s iskusstvennym intellektom).** L. G. RAJKOV, In *Intelligent Systems of Flight-Vehicle Control* (A93-50951 21-63). Moscow, Moskovskij Aviatsionnyj Institut, 1991, pp. 50–58. 2 Refs. Documents available from Aeroplus Dispatch.

The control problem for a plant with artificial intelligence is formulated using J calculus techniques. An approach to the solution of such a problem is proposed which is based on the method of formal descriptions. Possible applications of the approach proposed here are briefly discussed.

**A93-50958 Architecture of multiprocessor data processing machines and dispatching of the knowledge acquisition process in flight control (Arkhitektura mnogoprotsessornykh mashin obrabotki informatsii i dispetcherizatsii protsessa priobreteniya znanij pri upravlenii poletom).** A. EH. METLOVA, In *Intelligent Systems of Flight-Vehicle Control* (A93-50951 21-63). Moscow, Moskovskij Aviatsionnyj Institut, 1991, pp. 42–46. 2 Refs. Documents available from Aeroplus Dispatch.

The use of multiprocessor architectures for evaluating a current situation, including the current technical condition of a controlled plant, is examined, with emphasis on parallel processing. The problem of dispatching the computational procedures in such systems is analyzed. Possible implementations of a multiprocessor architecture are briefly reviewed, with attention given to the DIRECT system and neural nets.

**A93-50957 An information-search system in cybernetics (Informatsionno- poiskovaya sistema v oblasti kibernetiki).** A. Y. LASHCHEV and M. P. POPOV, In *Intelligent Systems of Flight-Vehicle Control* (A93-50951 21-63). Moscow, Moskovskij Aviatsionnyj Institut, 1991, pp. 35–42. 4 Refs. Documents available from Aeroplus Dispatch.

An information-search system is described which makes it possible to solve a variety of problems in the design of on-board control systems with elements of artificial intelligence. In particular, the tasks handled by the information-search system include the selection of an optimal functional scheme based on a set of parameters characterizing the on-board control system, search for the closest engineering solution based on elements of the functional scheme, and automatic generation of a patent application. Methods by which these tasks are implemented are discussed.

**A93-50956 Generation of a plant description dictionary based on expert survey data (Formirovanie slovarya opisaniya ob"ekta po dannym ehkspertnogo oprosa).** P. S. KUDRYAVTSEV, In *Intelligent Systems of Flight-Vehicle Control* (A93-50951 21-63). Moscow, Moskovskij Aviatsionnyj Institut, 1991, pp. 31–35. 6 Refs. Documents available from Aeroplus Dispatch.

The objective of the study is to develop methods for interviewing a group of experts and formalizing the expertise results within a structured format. The problem of compiling a description dictionary for complex systems is examined as an example of a problem where such methods are applicable. The methods proposed here can be implemented on a computer in the form of a dialog system.

**A93-50955 Multilevel intelligent control systems for flight vehicles (Mnogourovnevye intellektual'nye sistemy upravleniya letatel'nymi apparatami).** V. E. KRAJZMAN, In *Intelligent Systems of Flight-Vehicle Control* (A93-50951 21-63). Moscow, Moskovskij Aviatsionnyj Institut, 1991, pp. 25–30. 3 Refs. Documents available from Aeroplus Dispatch.

The implementation of complex adaptive optimal control systems with elements of artificial intelligence is made difficult by the limited capabilities of the existing computer systems. The solution of this problem is possible in a class of systems with a multilevel hierarchical structure. Here, a multilevel hierarchical system, which can be used as a 'pilot's assistant', is described. The development of algorithms for the synthesis of a terminal guidance system for flight vehicles is discussed.

**A93-50952 Behavior of the particular quality characteristics of an intelligent flight vehicle control system in a multicriterial formulation (Povedenie chastnykh pokazatelej kachestva intellektual'noj sistemy upravleniya letatel'nym apparatom v mnogokriterial'noj postanovke).** N. N. ANDRONOV, L. A. KOVZAN, G. N. LEBEDEV, and V. V. PODAFEJ, In *Intelligent Systems of Flight-Vehicle Control* (A93-50951 21-63). Moscow, Moskovskij Aviatsionnyj Institut, 1991, pp. 4–12. 3 Refs. Documents available from Aeroplus Dispatch.

The objective of the study was to develop a method for determining the dynamics of change of the weight coefficients of particular quality criteria using a multicriterial formulation. An approach is proposed whereby the Bellman equation, written for the case of alternative control, is replaced by a power-law polynomial in terms of phase coordinates. In addition to determining a general quality criterion, the development of a second feedback level in an artificial intelligence control system involves definition of the safe motion region and the development of an expert system which makes decisions on the basis of the acquired data using logic inference procedures.

**A93-50951 Intelligent systems of flight-vehicle control (Intellektual'nye sistemy upravleniya letatel'nykh apparatov).** V. V. MALYSHEV, ED., Moscow, Moskovskij Aviatsionnyj Institut, 1991, p. 67 (For individual items see A93-50952 to A93-50961). Documents available from Aeroplus Dispatch.

The papers presented in this volume focus on the use of artificial intelligence in flight vehicle control, including the use of on-board expert systems to control flight safety in real time and accumulation of knowledge in the process of learning using pilot's experience. Papers are included on multilevel control systems and optimization of their structures, a target search system, prediction and planning of the flight vehicle route in the presence of motion inhibiting factors, and generation of a plant description dictionary based on expert survey data.

**A93-48917 Simulation modeling in problems of the design of the central cybernetic system of a control circuit (Imitatsionnoe modelirovanie v zadachakh sozdaniya tsentral'noj kiberneticheskoj sistemy kontura upravleniya).** L. G. RAJKOV, In *Computational-Simulation Modeling in Information Systems* (A93-48916 20-32). Moscow, Moskovskij Aviatsionnyj Institut, 1990, pp. 4–12. 2 Refs. Documents available from Aeroplus Dispatch.

The paper is concerned with the development of artificial intelligence (AI) for aircraft and spacecraft systems on the basis of an AI deduction theory. The mathematical formalism of the deduction theory includes logics, mathematical fundamentals, direct calculus, and applications to the solution of various AI problems. The task of developing artificial intelligence for an aircraft control system is examined as an example.

**N93-29520 The axiomatic definition of a linguistic scale fuzziness degree, its major properties, and applications.** A. P. RYJOV, In *NASA. Johnson Space Center, North American Fuzzy Logic Processing Society* (NAFIPS 1992), Vol. 1 pp. 21–28 (SEE N93-29516 11-59). Documents available from Aeroplus Dispatch.

A model that makes use of fuzzy linguistic scales (FLS) is considered in this report. The definition of FLS fuzziness and its major properties are given in the report. Definitions that are concerned with information loss and noise are also presented. (Author (revised))

**A93-42373 Structure of a knowledge base used in the computerized synthesis of aircraft layout (Struktura bazy znanij, ispol'zuemoj v protsesse avtomatizirovannogo sinteza skhemy samoleta).** V. V. MAL'CHEVSKIJ, In *Current Methods of Selecting the Configurations and Parameters of Flight Vehicles* (A93-42369 17-05). Moscow, Moskovskij Aviatsionnyj Institut, 1990, pp. 21–28. 5 Refs. Documents available from Aeroplus Dispatch.

The integration of a knowledge base into the CAD system for aircraft design is examined. One of possible knowledge base structures is considered, with attention given only to the procedural part of the knowledge base, containing the rules, methods, and heuristics for the generation of novel design decisions. The principal components of the knowledge base deal with the design of the powerplant, aerodynamic design, and structural design. Some specific techniques for generating new design solutions are discussed.

**A93-35686 Adaptive automatic control systems, No. 18 (Adaptivnye sistemy avtomaticheskogo upravleniia, No. 18).** V. I. KOSTIUK, ED., *Kiev, Izdatel'stvo Tekhnika* (ISSN 0320-720X), 1990, 145 p. (No individual items are abstracted in this volume). In Russian. Documents available from Aeroplus Dispatch.

The papers presented in this volume focus on the theoretical and application aspects of automatic control systems capable of adapting to the operating conditions. Topics discussed include a model of indeterminacy in process control problems, control of distributed mechanical system of stochastic nature, optimal control of intense heat transfer in a disperse layer, and the use of Krotov functions in the problem of branching trajectory optimization. Papers are also included on a recursion algorithm for the parametric identification of a class of elastic dynamic plants based on the spline approximation, artificial intelligence control of flexible systems, and entropy estimation of flexible production systems.