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7 July 1981

USSR Report

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

(FOUO 17/81)

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USSR REPORT

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

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HARDWARE

UDC 681.32(075)

SOME RESULTS OF SIMULATION OF THE PLANNED PS-3000 COMPUTER SYSTEM

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 101, No 1, Jan 81 pp 101-104

[Article by I. N. Agladze, T. A. Kuprava, I. D. Rodonaya, and N. D. Chikovani, Georgian SSR Polytechnical Institute imeni V. I. Lenin]

[Text] Simulation is broadly employed when creating new computer systems; moreover in different design stages, simulation is performed at different levels: at the level of electric circuits, logical elements, register transmissions, and the systemic level.

This article presents some results of simulating the planned PS-3000 computer system at the systemic level.

In the program we wrote, the model of the PS-3000 system is represented as a set of main memory modules (MMM's), instruction processing modules (IPM's), and arithmetic-logical modules (ALM's).

A basic diagram of this part of the system is shown in Figure 1.

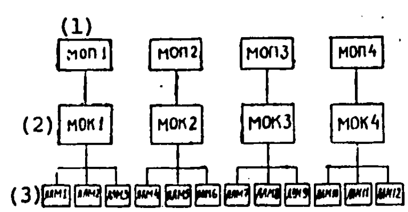

Figure 1

Key:
1. MMM
2. IPM
3. ALM

The following algorithm of the system's operation was reflected in the program model. Each IPM forms an address for a request to read a portion of the instructions in an MMM, it receives that portion of the instructions from the latter, and it processes the instructions; the code of the operation and the time of decoding of an instruction by a given IPM are selected randomly. Next requests to read the operands of the instruction are transmitted to one of the MMM's, selected at random. An instruction that has been decoded and prepared for execution is transmitted into one of the three ALM's, also selected at random. The results of instruction execution are transmitted into one of the MMM's for recording. The model simulates fulfillment only of scalar operations by the system.

The program model of this system's operation is written in IMSS--stochastic system simulation language. In this case the model is represented as a set of mutually associated queueing systems simulating the operation of the computer system's hardware and software, while the structure of the system under analysis is successively expressed in the structure of its network simulation model (1). The latter property of a model written in IMSS permits visual confirmation of its adequacy to the structure under analysis.

A simulation network for the minimum composition of the PS-3000 is shown in Figure 2.

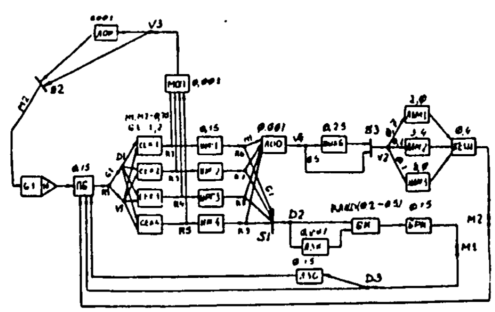

Figure 2

Symbols in the simulation network are: ПБ--copy buffer, СЕК1-СЕК4--sections of an MMM, БК--an IPM's instruction buffer, БРК--buffer storing decoded instructions from the IPM, ВЫХБ--IPM's output buffer, КЕШ--IPM results buffer, ИРГ1-ИРГ4--MMM's information registers, G1--group request source. The ЛВО, ЛВК, ЛОО, and ЛОР devices [not further identified] are added to the network for auxiliary purposes. Type R, M, D, S, and V units are intended correspondingly for routing, for change in names and priorities, for duplication, for synchronization, and for distribution of request flows among the different devices on the basis of a given probability. Numbers above the devices indicate the time required by the device to service requests, in μsec.

The IMSS description of the network's devices and units and of the links between them makes up the program simulation model of the PS-3000 system, intended to be run in a computer.

Simulation was performed with a YeS-1020 computer. The program model was run in the computer for different intervals of simulation time. As the simulation time increased, the results became more stable. The system's productivity, stated in operations per second, was the simulation results.

A graph showing changes in productivity in response to change in simulation time is shown in Figure 3. We can use it to evaluate the statistical sufficiency of the simulation results.

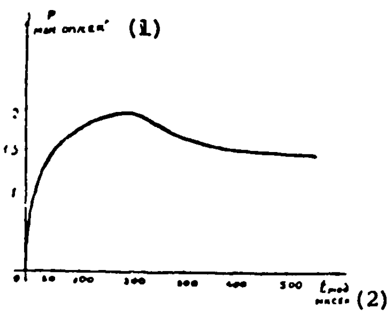

Figure 3

Key:

1. Operations per second
2. t_{sim}, μsec

Table 1

(1) Устройство	(2) Загрузка (простои)	(3) Тип заявки	(4) Макс. число заявок на устройстве	(5) Число поступивших заявок	(6) Число обслуженных заявок
ПС	0.197136 0.802864	G1 M1 M2	16 4 1	74 296 139	74 296 139
	(7) по потоку в целом:		16	509	509
СЕК1	0.429155 0.570745	G1 M1 M2	15 18 2	74 76 33	74 76 33
	по потоку в целом:		18	183	183
СЕК2	0.421704 0.578296	G1 M1 M2	15 12 2	74 72 33	74 72 33
	по потоку в целом:		16	179	179
СЕК3	0.421704 0.578296	G1 M1 M2	15 16 2	74 69 36	74 69 36
	по потоку в целом:		20	179	179
СЕК4	0.442469 0.575531	G1 M1 M2	15 16 2	74 79 37	74 79 37
	по потоку в целом:		17	190	190
(8) АЛМ1	0.428211 0.571789	M1	12	95	95
АЛМ2	0.239607 0.760393	M1	3	28	28
АЛМ3	0.322163 0.677837	M1	5	17	16
КЕШ	0.139931 0.860069	M1	2	139	139
БК	0.129853 0.870147	G1	2	148	148
БРК	0.055867 0.944133	G1	1	148	148
(9) МОП	0.000345 0.999654	M2	2	139	139
ВЫХБ	0.035641 0.964358	M1	4	152	152

Key:

1. Device
2. Load (simple)
3. Type request
4. Maximum number of requests per device
5. Number of incoming requests
6. Number of serviced requests
7. Total flow
8. ALM
9. MMM

The jump in productivity at $t_{sim} = 200$ μsec to 2 million operations per second may be explained by unsteady loading of all of the system's buffers at the same time in the initial period of work. This corresponds to the logic of the real system's operation. Subsequently the system's productivity approaches an asymptote of 1.4 million operations per second.

By studying the model of the PS-3000 system's operation, as represented by the stochastic network, in addition to determining the productivity of the system as a whole, we are able to determine some other characteristics of the devices, which are summarized in the table.

Analysis of the simulation results permits the conclusion that work with just scalar operations results in substantial underloading of the system's potential productivity. This conclusion agrees well with the point of view of the system's designers (Institute of Control Problems), who planned the system for tasks involving a larger proportion of vector operations.

Simulation of the PS-3000 system with the help of a stochastic network was an ancillary task for the authors, and it was performed with the goal of comparing these results with those obtained through functional simulation of the system. The system's functional model consists of a more-detailed description, in PL/I language, of all processes occurring in the system at the level of individual instructions. The results of these two entirely different simulation methods--structural and functional--exhibited a discrepancy not exceeding 10-15 percent, which permits the authors to assert the adequacy of the models of the real system they developed, and to use the obtained results to make decisions associated with the system's design.

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11004
CSO: 1863/170

UDC 621.3.049.77(03)

HANDBOOK ON INTEGRATED MICROCIRCUITS

Moscow SPRAVOCHNIK PO INTEGRAL'NYM MIKROSKHEMAM in Russian 1980 (signed to press 22 Feb 80) pp 2-8, 10-11, 23

[Annotation, table of contents, foreword to second edition, and excerpts from part one from book "Handbook on Integrated Microcircuits", edited by B. V. Tarabrin, Izdatel'stvo "Energiya", second edition revised and enlarged, 100,000 copies, 816 pages]

[Text] This handbook presents information on digital and analog integrated microcircuits. Domestically produced integrated microcircuits are classified. Types of housings and their general characteristics and parameters are described. Detailed information is provided on each series of integrated microcircuits: the basic purpose of each series, the basic electric circuits, base design, and electric parameters. The first edition was published in 1977.

This handbook is intended for engineers and technicians involved in the development, use, and repair of electronic apparatus.

Contents Page

Part Two
Reference Information on Digital Integrated Microcircuits

Part Three
Reference Information on Analog Integrated Microcircuits

Part Four
Methods for Measuring the Electric Parameters of Integrated Microcircuits

Foreword to Second Edition

The period since the time of preparation and publication of the first edition of the "Handbook of Integrated Microcircuits" has been typified by swift introduction of integrated microcircuits into general-purpose and control computer complexes; into peripheral equipment; into the data recording and transmission devices of automatic production process control systems; into instruments and equipment intended for scientific research and mechanization of engineering and control; into medical and household instruments; into apparatus for agricultural needs and for environmental control, and so on.

Broad introduction of integrated microcircuits into the national economy is promoted by decisions of the 25th CPSU Congress, which determined that: "The main task of the 10th Five-Year Plan is to successively implement the Communist Party's policy of raising the material and cultural standard of living of the people on the basis of dynamic and proportionate development of social production, enhancement of its effectiveness, acceleration of scientific-technical progress, growth of labor productivity, and all-out improvement of the quality of work done in all units of the national economy."

Use of integrated microcircuits has made it possible to improve and to create new methods for planning, designing, and producing electronic apparatus of various purposes, to upgrade its technical and operating characteristics, and to introduce electronics into a number of devices traditionally designed on the basis of mechanical or electromechanical principles of operation.

But at the same time, the practical experience of the handbook's authors provides the grounds for asserting that mistakes are sometimes made in selecting the nomenclature of integrated microcircuits when designing and producing electronic apparatus: The conditions of their application are violated; a number of requirements concerning links between integrated microcircuits are not accounted for, resulting in unstable operation of the electronic apparatus.

One of the causes behind these mistakes is an insufficient knowledge of the parameters and operating features of integrated microcircuits on the part of electronic apparatus developers and manufacturers.

As with the first, the second edition has the goal of acquainting the reader with integrated microcircuits that have enjoyed the greatest application in different types and classes of electronic apparatus (rather than the entire nomenclature of industrially produced microcircuits), and to provide the reader with the minimum volume of information on parameter measurements, assembly, design of electronic apparatus units, and so on.

This handbook does not override official documents (operational certificates, specifications, instructions for use), but it does allow the user to review the great assortment of integrated microcircuits being produced by domestic industry, their parameters, and their operating conditions, to compare them with the requirements imposed on the apparatus, and to correctly select both series-produced and custom-made microcircuits.

The microcircuit nomenclature of this edition of the handbook is significantly different from that of the first edition (1977). In particular the composition of series TTL and KMOP microcircuits, series-produced operational amplifiers, and back-up electric power sources have been significantly supplemented as offering major promise today; microcircuits exhibiting high resistance to interference and series-produced superhigh-speed microcircuits employing emitter-linked logical circuits have been included. Concurrently a number of series-produced microcircuits enjoying limited use today were dropped from the handbook.

The part describing the applications of different classes of microcircuits (TTL, KMOP, ESL, VPL) was expanded, and a reference table of compatible old and new identification codes is provided.

The authors feel that separate editions would have to be published in order to provide fuller information on this subject, to include the behavior of integrated circuits in response to changes in temperature and load.

The materials presented in this handbook are based on a generalization of experience in using microcircuits, and on a study of their properties and parameters.

The authors hope that this handbook will be useful to engineers and technicians developing and using electronic apparatus based on integrated microcircuits.

The authors request all remarks and wishes for the handbook's improvement should be sent to the following address: 113114, Moscow, M-114, Shlyuzovaya nab., 10, izdatel'stvo "Energiya".

1-2. Structural-Technological Types of Integrated Microcircuits

Technology

Modern microelectronics is developing predominantly in two basic structural-technological directions--creation of semiconductor integrated microcircuits, and creation of hybrid integrated microcircuits.

Semiconductor Microcircuits

The technology of their creation is based on a planar process permitting simultaneous manufacture of a large quantity of microcircuits on a single plate of semiconductor material. This process involves:

Planar technology making use of semiconductor material, with components isolated by *p-n* spacing junctions;

planar technology making use of semiconductor materials, with components isolated by a layer of silicon dioxide;

planar-epitaxic technology, with components isolated by *p-n* spacing junctions;

technology of combined circuits, where active components (transistors, diodes) are created in semiconductor material on the basis of planar technology, and passive components (capacitors, resistors) are created on the surface of the semiconductor material by the methods of thin-film technology.

Each of these technological methods has its advantages in relation to concrete semiconductor microcircuits, but planar-epitaxic technology has enjoyed the greatest successes today.

Hybrid Integrated Microcircuits

These microcircuits are manufactured mainly with the use of two basic technological processes:

Acquisition of thick films by a silk screen method;

acquisition of thin films by thermal vacuum plating, etc.

Integrated microcircuits manufactured by the silk screen printing method have come to be called thick-film circuits, while those manufactured by the methods of vacuum spray-coating, ion-plasma spray coating, reactive spraying, and so on are referred to as thin-film integrated microcircuits.

The applications of semiconductor and hybrid integrated microcircuits have shown that they do not compete with one another, mutually supplementing one another instead.

Housings

Integrated microcircuits are made with and without housings.

Types of Housings

According to GOST [All-Union State Standard] 17467-72, integrated microciruit housings are divided into four types (Table 1-1).

Table 1-1

Type	Housing Base Shape	Location of Housing Terminals Relative to Base
1	Rectangular	On base and perpendicular to it
2	Rectangular	Away from base and perpendicular to it
3	Round	On base and perpendicular to it
4	Rectangular	Parallel to plane of base but away from it

Housings are subdivided into type-sizes on the basis of their overall dimensions and connection dimensions; a code is assigned to each type-size, consisting of a digit designating the type housing (1, 2, 3, or 4) and a double-digit number (from 01 to 99) designating the number of the type-size.

The identification code for the structure of a housing consists of the housing type-size code, a number indicating the quantity of terminals, and the modification number.

For example the housing identification code 201.14-2 would mean a type-2 rectangular housing of type-size 01, with 14 terminals, modification 2.

The overall and connection dimensions are indicated on drawings (in specifications, handbooks, and microcircuit certificates) without regard to special components or devices used for additional removal of heat from the microcircuit housings, if these devices are not inseparable parts of the housings. Special components or devices (heat transfer devices) and the means of their attachment are indicated in the technical documents accompanying concrete types of microcircuits.

The following terminal spacings have been established for microcircuit housings: For type 1 and 2 housings--2.5 mm; type 3--a 30 or 45° angle; type 4--1.25 mm.

Housing terminals may be round or rectangular in shape. As a rule the diameter of round terminals is within 0.3-0.5 mm, while the dimensions of terminals having rectangular cross section lie within the limits of a circle 0.4-0.6 mm in diameter.

Integrated microcircuits of some series developed prior to introduction of the GOST mentioned above are contained in nonstandard housings.

The structure of some types of housings for industrially produced microcircuits and their overall and connection dimensions are shown on pp 12-22.

Unhoused Microcircuits

An unhoused microcircuit is a semiconductor crystal with components created within its volume and on its surface. The crystal is protected by a film of varnish or by a thin layer of sealing compound. Unhoused microcircuits are connected to assembly boards by flexible wire leads with a diameter of 40-50 μ, or by rigid terminals having the form of balls or pillars 0.3-0.4 mm in diameter. The structure of unhoused microcircuits is shown on p 22.

1-3. Classification of Integrated Microcircuits on the Basis of Functional Purpose, and Type Designation

A GOST effective in the USSR since July 1974 applies to newly developed and modernized integrated microcircuits, and it establishes their classification and provides a system of identification codes.

In accordance with this GOST, microcircuits are subdivided into three groups on the basis of their structural-technological execution; these three groups are designated as follows:

1; 5; 7--semiconductor;

2; 4; 6; 8--hybrid;

3--other (film, vacuum, ceramic, and so on).

The identification code for the type of integrated microcircuit consists of four elements.

The first element--a digit indicating the structural-technological execution of the microcircuit (semiconductor, hybrid);

the second element--two digits designating the serial number of the microcircuit series (from 00 to 99);

the third element--two letters designating the functional purpose of the microcircuit, in accordance with Table 1-2 [table not reproduced];

the fourth element--the serial number of the microcircuit, based on the functional characteristic of the given series.

The first two elements designate the number of the microcircuit series. The first of three digits in the identification codes of microcircuits developed prior to July 1974 is positioned at the beginning of the type designation, while the second and third digits are placed after the alphabetic index. Alphabetic designations of microcircuit function are shown in Table 1-2. Alphabetic designations following the conventions in effect prior to introduction of the GOST are shown in the far right column of Table 1-2.

Many microcircuits described in this handbook were developed prior to the GOST's introduction, and their functional designations are presented in accordance with the former conventions.

Old and new identification codes representing the same types of microcircuits can be encountered in the literature and in technical documents today. This causes some difficulty for engineers and technicians developing and operating electronic apparatus employing microcircuits.

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NEW BOOK DISCUSSES PARALLEL COMPUTER SYSTEMS

Moscow PARALLEL'NYYE VYCHISLITEL'NYYE SISTEMY in Russian 1980 (signed to press 16 Sep 80) pp 2-8

[Annotation, table of contents, and preface of book "Parallel Computer Systems" by B. A. Golovkin, Izdatel'stvo "Nauka", 10,000 copies, 520 pages]

[Text] Annotation

This book considers parallel computer systems (computer systems that perform parallel data processing): multimachine, multiprocessor, mainline (conveyor), matrix, associative, combined and variable structure types, and a few other systems. Systems of these types are distinguished by greater flexibility and have high productivity and reliability.

The book is a systematic description of the organization of the structure and functioning of parallel computer systems. This description presents structural diagrams and basic characteristics of several dozen domestic and foreign parallel computer systems.

The book is intended for engineers and scientific workers in the fields of computer technology, programming, and data processing as well as advanced undergraduate and graduate students in the corresponding fields.

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Preface

This book considers multimachine, multiprocessor, mainline (conveyor), associative, and matrix systems, systems with vector flow of data and ensembles of processors, as well as systems with combined and variable structure. The substantial interest in the systems and their importance are a result of the fact that they have great flexibility and provide high and record levels of productivity, reliability, readiness, and survivability. The ratio of the productivity of these systems to their cost has increased significantly in recent years, which is especially important for broadening their area of application.

In the near future we expect a significant expansion of the development of the types of computer systems under consideration, an increase in their production, improvement in performance, and an expansion of the sphere of application, particularly in connection with the development of microprocessor technology and the technology of large integrated circuits.

The rapid development of diverse and complex computer systems is bringing about change and greater precision in terminology and the appearance of new concepts. This is particularly typical of the area of computer technology under consideration here. Under such conditions terminology causes substantial problems. In writing this book I have used the terminology that is most widespread, even though in many cases it is not generally accepted and established.

The title "Parallel Computer Systems" (computer systems for parallel data processing) was selected to describe the computer systems in the book. A distinctive feature of the system reviewed here is that they have at least two control units or central processing units which work simultaneously. As a result, the central part of these systems has at least two parallel flows of commands or data. Additionally, the programming methods and computer mathematics techniques for these systems in most cases are called "parallel." Therefore, by selecting the word "parallel" as a basis, it is possible to speak with adequate clarity about the means and methods of parallel data processing — parallel computer systems, parallel programming, and parallel computer methods. Nonetheless, we will not have complete clarity because, for example, there are also elements of parallel data processing in single-processor computers: parallelism in processing word bits in the arithmetic-logical unit; merging the work of computer units in time; advanced scanning of commands and data, and others.

The first chapter of this book describes the evolution of computer machines and systems from sequential data processing to parallel processing. The second chapter offers a systematic presentation of the organization of the structure and functioning of various types of parallel computer systems. The last chapter considers the numerical characteristics of the structures of computer systems, evaluation and prediction of increase in the productivity of parallel computer systems, and the ratio of their productivity to their cost. The other chapters contain concise descriptions of several dozen typical parallel computer systems of different types. Primary attention here is devoted to standard operating and very recent systems. A number of typical early systems and conceptions of parallel computer systems are also described. The description is oriented to the organization of the structure and functioning of computer systems and illustrated with structural diagrams of the systems. Figure 0.1 [not reproduced] diagrams the logical connections among chapters of the book.

Several thousand works have been published in the subject area of parallel computer systems. In a book of limited scope it is impossible to review such a number of books or even to list their titles. To make it easier for readers to familiarize themselves with the literature on parallel computer systems and study them more thoroughly, the book includes a brief survey and bibliographic references on parallel systems which are found in the corresponding sections.

The book assumes that readers will be familiar with the fundamentals of the organization of computer structures and is intended for engineers and scientists in the fields of computer technology, programming, and data processing as well as for advanced undergraduate and graduate students in the corresponding special areas.

11,176
CSO: 1863/147

BASIC CONFIGURATIONS OF MULTIPLE MACHINE YeS SYSTEMS

Moscow PARALLEL'NYYE VYCHISLITEL'NYYE SISTEMY in Russian 1980 (signed to press 16 Sep 80) pp 118-135

[Section of Chapter 3 of book "Parallel Computer Systems" by B. A. Golovkin, Izdatel'stvo "Nauka", 10,000 copies, 520 pages]

[Text] 3.3. Systems Based on the YeS Family of Computers

3.3.1. Structure of the YeS Family of Computers [218, 244, 246, 429] The YeS [Unified System] of electronic computers is a family of program-compatible stationary third-generation computers* which have a broad range of productivity levels and are designed to perform various scientific-technical, economic, management, and other jobs. Collectives at scientific research institutions and enterprises of the CEMA countries of Bulgaria, Hungary, East Germany, Cuba, Poland, Romania, the USSR, and Czechoslovakia are working on building the Unified System of computers. Industrial production of the first machines was begun in 1972. At the present time YeS computers comprise the bulk of the computers used in the socialist countries.

The program compatibility of the family of computers is achieved by uniform formats and form of data notation, addressing systems, and set of commands and an identical structure in all the models of computers included in the Unified System. The computers of the family are compatible from the bottom up, that is, programs written for machines with lower productivity can be run on machines with higher productivity.

The center of the Unified System is its processors, which cover the range of computation speed between a few thousand operations a second and several million. The processor performs operations with fixed and floating points and operations on decimal numbers. Several formats are adopted for data and commands based on the byte and four-byte word. Operations can be performed on half, whole, and double words as well as fields of variable length to a maximum of 256 bytes. The Unified System has adopted byte addressing with a 24-bit address. This makes it possible to form a direct address for access to memory with a maximum capacity of 16,777,216 bytes. Commands may

* The YeS-1010 and YeS-1021 machines differ in structure and command systems from the other computers of the Unified System.

have 0, 1, 2, or 3 addresses depending on the format (2, 4, and 6 bytes). The full standard set of commands contains 144 commands. The main memory volume varies greatly in the different models. Some models use alternation of addresses in memory blocks operating in parallel.

The processor has 16 general-purpose registers with a capacity of one word apiece. Four registers with a capacity of two words apiece are included in the processor to perform operations of greater precision with a floating point. The processors have an elaborate interrupt system. In addition, a timer and means of aggregating are included in the processor.

The Unified System also uses the parallel-sequential principle of performance of operations, for example single-byte data processing with two-byte retrieval from the main memory of the YeS-1020 machine.

Selector and multiplex channels are connected to the processor. Their number and carrying capacity, as well as the set of external units connected to the channels, will depend on the particular model. Among the external units are magnetic tape, disc, and drum stores, punched card and punched tape input-output equipment, line printers, typewriters, screen consoles, and graph plotters of various types. Equipment is also envisioned to transmit data at different speeds by telephone and telegraph communications lines.

The structure of a YeS computer is shown in Figure 3.8 below [245].

The software of the Unified System is based on the YeS DOS [disc operating system] and the YeS OS [operating system], which can be used on all program compatible models. The operating systems provide multiprogram work.

The YeS-1010 and YeS-1021 (YeS-1020A) models differ from the other models in structure and system of commands. They also differ from one another, so they have their own software. The YeS OS-10 operating system has been developed for the YeS-1010 model, while the YeS MOS small operating system has been worked out for the model YeS-1021.

Let us go back to the YeS DOS and OS operating systems. There are several versions of the operating systems. The DOS is oriented to junior models of YeS computers with limited main memory volume (64-128 kilobytes) and affords maximum efficiency when used with these models. The YeS OS system is more general in application and powerful in its functions, significantly surpassing the YeS DOS. It is used on models which have main memory volume of more than 128 kilobytes, and demonstrates its full capabilities with computers that have medium and large main memory and adequate external memory.

The YeS OS system has a clearcut modular structure which makes it more promising for expansion as the hardware of the Unified System is refined and accumulated.

The YeS OS offers the possibility of paralleling computing processes and includes support equipment for aggregating to set up multimachine systems. One of these means is a channel-channel adaptor which makes it possible to

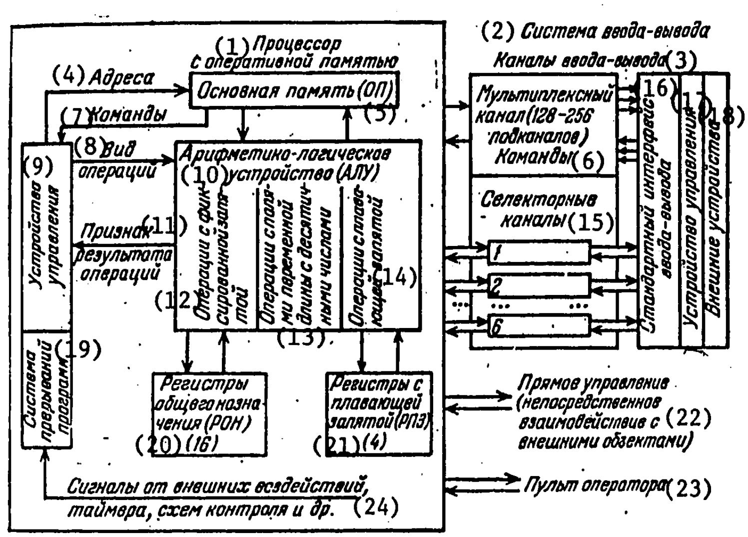

Figure 3.8. Structural Diagram of a YeS Computer.

Key:
(1) Processor with Main Memory;
(2) Input-Output System;
(3) Input-Output Channels;
(4) Addresses;
(5) Main Memory;
(6) Multiplex Channel (128-256 subchannels) of the Command;
(7) Commands;
(8) Type of Operation;
(9) Control Units;
(10) Arithmetic-Logical Unit;
(11) Sign of Result of Operation;
(12) Operations with Fixed Point;
(13) Operations with Words of Variable Length and Decimal Numbers;
(14) Floating Point Operations;
(15) Selector Channel;
(16) Standard Input-Output Interface;
(17) Control Unit;
(18) External Units;
(19) Program Interrupt System;
(20) General-Purpose Registers;
(21) Floating Point Registers;
(22) Direct Control (direct interaction with external objects);
(23) Operator Console;
(24) Signals from External Actions, the Timer, Monitoring Circuits, and the like.

---

connect directly channels of two (different) YeS computers, external memory units being used together, and direct control devices. Using this equipment the user may construct various configurations of multimachine systems, employing the aggregating software [377].

The operating systems include control and service programs, translators from programming languages (usually included in a particular programming system), system generation means for a particular set of hardware, and other equipment. The input languages adopted are Assembler, Fortran, PL/1, Cobol, Algol 60, and RPG (Report Program Generator).* The system has debugging and program editing units. The software also includes a large number of packages of different applied programs. In terms of input languages the DOS and OS systems are sufficiently compatible, but they are not compatible with respect to object programs received, that is, programs received by means of the programming system of one operating system cannot be performed under the control of the other operating system.

At the present time the computers of the Unified System are computers of the first and second phases of production (series one and series two).

The machines of the first phase are close in architecture to the machines of the IBM 360 family, and the YeS computers have program succession (preservation of the system of commands and principles of organizing external exchange and the operating environment of the IBM 360).

Second-phase machines are similar in architecture to the machines of the improved IBM 370 family. Second-phase machines preserve program succession in relation to first-phase machines and have a broader system of commands. This expansion concerns chiefly commands for the operating system (privileged commands), but the number of commands for users increases only slightly (the YeS-1035 machine, for example, has 172 commands). The precision of computation is higher and other improvements have been introduced.

Second-phase machines have improved logical structure over first-phase machines, as well as expanded monitoring and diagnosis equipment and better technical parameters. Their basic elements have higher characteristics than the integrated circuits of first-phase computers. The second-phase machines have a maximum productivity in the central processors of the family of up to 4-5 million operations a second, the capacity of main memory has been increased to 16 megabytes, and virtual addressing has been introduced.

It is important to observe that whereas machines of the first phase had a few units for aggregating to make multimachine systems, second-phase machines have broadened capacities for multimachine and multiprocessor organization of computer systems.

As a result of these steps, the transition from phase one to phase two should provide an improvement in the productivity-cost ratio of 2-3 times and approximately double their reliability and survivability.

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* The Algol 60 translator is included in the YeS OS.

Table 3.2 below gives the basic technical characteristics of Unified System computers of phases one and two [246]. It should be noted that different values are given in the literature of various years for certain computer characteristics.

The transition to phase two also involves an improvement in YeS software because it provides virtual memory, an expansion of the complement of translators and libraries, development of time-sharing regimes, dialog forms of interaction, remote processing means and means of insuring a real-time regime, the organization of data banks, development of problem-oriented programming systems, support for multimachine and multiprocessor systems, and the like. The operating system affords the possibility of combining up to four computing systems, each composed of a two-processor system, into a single complex [246].

The YeS-1065, for example, as the basic general-purpose variant provides a two-processor complex. A four-processor variant is also envisioned, but only for special applications, where there are good opportunities for paralleling computations.

The basic work on phase two of the Unified System in 1977 reached the final stage of technical design and preparation to submit a significant number of experimental models of hardware for testing [246]. The new YeS machines, including the YeS-1060 which has a productivity of more than 1 million operations a second, were tested in early 1978. The later and more powerful YeS-1065 works at more than 4 million operations a second [61].

Continued and comprehensive improvement of the Unified System of Computers is planned through development of phase (series) three using integrated circuits with a high level of integration as the basic element.

Table 3.3 below shows the basic characteristics of the hardware and software of YeS computers of phases I, II, and (planned) III [246].

3.3.2. Multimachine and Multiprocessor Systems Based on YeS Computers. It follows from a consideration of the structure of the YeS computers that during development of the YeS computer hardware and software provision was made for aggregation at the levels of the processor, channels, external memory (external units), and main memory. Multimachine systems are built by aggregation at the levels of the processor, channels, and external memory. This is typical of the small and medium-sized YeS models of Phase I. With aggregation at the level of main memory, preserving the capabilities of aggregation at other levels (all YeS models provide aggregation at the level of channels and/or general external units), multiprocessor systems are developed. This is typical of the YeS-1050 and Phase II models.

We should note that the logical structure adopted for the YeS system of computers in principle allows processors to work with a common main memory field, although program organization of such a regime is fundamentally more difficult than interaction of processors at the level of external equipment.

Table 3.2. Basic Technical Characteristics of YeS Computers of Phases 1 and 2.

No.	Developer-Country	Model	Phase	Productivity, Ops/sec	Maximum Volume of Main Memory Kbytes	Multiplex Channels No.	Multiplex Channels Carrying Capacity Kbytes/sec	Selector Channels No.	Selector Channels Carrying Capacity Kbytes/sec	Additional Units
1	Hungary	YeS-1010	I	3,000	64	1	16	-	-	-
2	Hungary	YeS-1012	I	6,000	128	1	20	-	-	-
3	Hungary	YeS-1015	II	12,000-16,000	160	1	20	1	-	VP [Virtual Memory]
4	USSR, Bulgaria	YeS-1020	I	10,000-20,000	256	1	16	2	300	-
5	Czechoslovakia	YeS-1021	I	20,000	564	1	35	1	250	-
6	USSR	YeS-1022	I	80,000-90,000	512	1	80	2	500	-
7	Czechoslovakia	YeS-1025	II	60,000	256	1	24	1	800	VP
8	USSR, Poland	YeS-1030	I	60,000	512	1	40	3	800	-
9	Poland	YeS-1032	I	200,000	512	1	40	3	400	-
10	USSR	YeS-1033	I	200,000	512	1	70	3	800	-
11	USSR, Bulgaria	YeS-1035	II	140,000	512	1	30	4	800	VP, BMR [Multiplex Regime Block]
12	East Germany	YeS-1040	I	400,000	1,024	1	50	6	1,250	-
13	USSR, Poland	YeS-1045	II	500,000	3,072	1	40	5	1,300	VP, BMR
14	USSR	YeS-1050	I	500,000	1,024	1	110	6	1,300	-
15	East Germany	YeS-1055	II	600,000	2,048	2	40	4	1,500	VP, BMR
16	USSR	YeS-1060	II	1,300,000	8,192	2	110	6	1,500	VP, BMR
17	USSR	YeS-1065	II	4,500,000	16,324	2	200	11	1,500	VP, BMR

Table 3.3. Technical-Economic Indicators of the Unified System

Objects of Comparison	Stages of Development of the Unified System		
	Phase I	Phase II	Phase III
Productivity-Cost Ratio (Standard Units)	1	2-3	10-15
Reliability and Survivability (Standard Units)	1	2	10
Software	Developed Operating Systems	Developed Operating Systems with Virtual Memory	Developed Operating Systems with Hardware Performance of Control Functions
Input Languages	High-Level Languages	High-Level Languages, Dialogue Versions	High Level Languages, National Versions, Languages to Describe Graphic Images
Structure of Computer Complexes	Multimachine Systems	Multiprocessor Systems	Systems of Functional Modules with Parallel Performance of Processes
Provision of Collective-Use Systems	Means To Organize Collective-Use Computer Centers and Distributing Computing Systems	Standard Computer Complexes and Means To Organize Distributed Computer Systems	Standard Superhigh-Productivity Computer Complexes and Standard Complexes of Equipment To Organize Data Processing Networks

[Table continued next page]

[Table 3.3 continued]

Objects of Comparison	Stages of Development of the Unified System		
	Phase I	Phase II	Phase III
Peripheral Equipment	Standard Assortment of Traditional Units	Expansion of Assortment with Large-Capacity External Memory Units and Group Data Preparation and Input Systems	Means To Simplify Communication with the Computer and Expand the Capabilities of Peripheral Equipment
	Phase I	Phase II	
Remote Processing	Extended Data and Assignment Input-Output	Intellectual Terminals and Dialog Processing	

Work with a common main mmeory is more important for highly productive machines and is not envisioned for such machines as the YeS-1020, YeS-1030*, and YeS-1040 [238].

The most popular aggregation schemes have been two-machine configurations for multimachine systems and two-processor configurations for multiprocessor systems because they are simple, improve reliability, and make it possible to raise productivity. The typical solution when a significant increase in productivity is required is to switch to a senior model relative to the one in use. This solves the problem up to the highest model. At the same time, provision is made to aggregate more than two models. This may be necessary, for example, in special applications.

Let us consider the means of aggregation at each of these levels [142, 247].

Direct control means, which include the commands DIRECT WRITE and DIRECT READ, provide exchange of control and synchronizing data among processors of a computer system or between the processor and an external unit. One of the processors may be connected with another processor or unit by means of the commands indicated above and an external interrupt mechanism. The physical linkage between the processors is accomplished by direct control interface cables. A computer complex control console may be connected to the direct control line linking the two processors. This enables the operator to follow and modify the working regimes of the computers and the complex (aggregate unit).

An adaptor is used for aggregating at the channel level. It has two outputs to a standard input-output interface and is connected to the selector (or multiplex) channels of two YeS models. The speed of data transmission through the adapter is close to the speed of data transmission through the channel. When the computer complex is in operation the speed of exchange is in fact determined by the speed of exchange through the channels if they are the same or the speed of the slower channels if they are different. The adapter in the channel works in a single-field regime. The adapter provides rapid exchange among processors of both control information and arrays of data.

Two-channel switches are used for aggregation at the level of external magnetic disk and tape memory.** The two-channel switch makes it possible to connect the magnetic tape and disk store control units to two channels of different computers, which forms a common memory field in the storage units they control. The work of a particular computer with the common external memory field is coordinated by special commands to the two-channel switches which reserve (or connect) the unit for the time it is working with the particular channel and free it after this work is completed. Because the

* The main memory equipment of the YeS-1030 model can be distributed among processors of the multiple system, forming a common memory field [142].

** This procedure is also called aggregation at the level of external unit control devices.

receipt and output of data by processors in this case is spread out over time, unproductive use of time by the pair of processors to interact with one another is reduced. However, this also reduces the speed of exchange compared to connecting channels by means of an adapter.

Where a two-channel switch is used aggregation is accomplished in fact at the level of the control units of external memory units. Aggregation is also possible at the lower level of the external memory units themselves by using a two-directional switch. Finally, both methods can be used to aggregate input-output units.

Connecting the processes through a common main memory field is the most flexible and fastest method. The common main memory field is organized on the principle of constructing a multimachine multi-input memory.

We should also note that it is possible for processors to interact by telephone and telegraph communications channels.

Now let us consider certain examples of aggregating models of YeS computers. We will begin with the YeS-1030 machine [437].

With the YeS-1030 computer it is possible to realize these multimachine systems: consisting of two computers connected by direct control lines; consisting of several computers with access to a common external memory field; consisting of several computers connected by a channel-channel adaptor.

In the systems in which two computers are connected by direct control lines exchange of information is usually accomplished by direct control commands. On these commands one byte of information is transmitted from one processor and interrupts the work of the other processor. This organization of the complex is efficient only in those cases when the volume and speed of data transmission are low.

When a multimachine system is organized connected by a common external memory field, data transmission by one processor and receipt by the other is not simultaneous, so the productivity of the interlinked computers is not reduced. Therefore, this kind of organization is more efficient than linking by direct control lines.

When a multimachine system is organized using a channel-channel adaptor, direct communication between computer channels is accomplished through a standard interface. Information exchange is carried on by bytes at a speed determined by the carrying capacity of the channels.

By aggregating two YeS-1030 computers it is possible to realize the two-machine system known as the VK-1010 computer complex [437].

The VK-1010 consists of two YeS-1030 computers interconnected by direct control lines through the state block of the computer complex, the separate external units, and a channel-channel adaptor. Figure 3.9 below shows the structural diagram of the VK-1010.

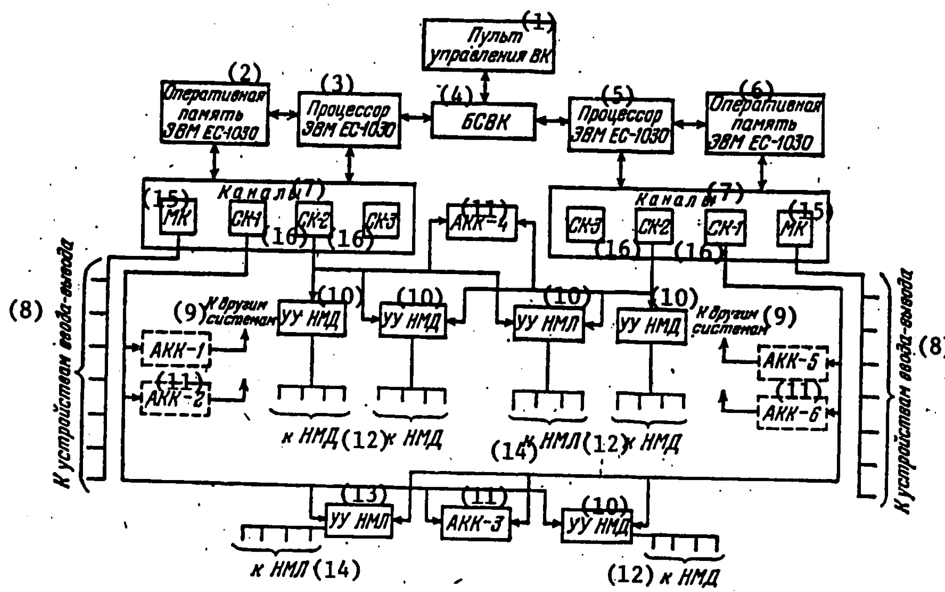

Figure 3.9. Structural Diagram of the VK-1010

Key:
- (1) Control Console of Computer Complex;
- (2) Main Memory of YeS-1030;
- (3) YeS-1030 Processor;
- (4) State Block of Computer Complex;
- (5) YeS-1030 Processor;
- (6) Main Memory of YeS-1030;
- (7) Channels;
- (8) New Input-Output Unit;
- (9) Two Other Systems;
- (10) Control Unit of Magnet Disk Storage;
- (11) Channel-Channel Adaptor [with appropriate number];
- (12) To Magnetic Storage;
- (13) Control Unit of Magnetic Tape Storage;
- (14) To Magnetic Storage;
- (15) Multiplex Channel;
- (16) Selector Channel [with appropriate number].

If both machines are in working condition, the computer complex has three possible work regimes. In the first regime both machines receive information from external units and process it, but only the primary computer outputs information. The other computer, therefore, backs up the first. If the primary computer is not able to perform its functions, the reserve computer assumes them in full. In the second work regime of the computer complex the functions of the primary computer are kept, but the reserve computer is taken out for preventive maintenance. In this regime work is done without a back-up unit. If the primary computer goes down, the maintenance work on the second computer can be interrupted and it can be put in a working regime (but this takes more time than for the first work regime). Finally, both computers can work as independent units; this is the third work regime of the computer complex.

The current state of each computer is registered in the form of a state byte and stored in main memory and the registers of the state block of the computer complex. The operator assigns the work regimes of the computers of the VK-1010 and switches them to the required state from the control console of the complex. It is also possible to change the state byte of the computers of the complex by program means using direct-control commands.

The state block of the computer complex is designed to store and modify the state of the machines of the VK-1010. It is connected with the computers by two standard direct-control interfaces. The channel-channel adaptors are designed to transmit arrays of data between the input-output channels of the machines of the VK-1010 and also for communication with other computers or systems (see Figure 3.9). The adaptor works in a single-field regime and transmits data at the speed of the slower channel of the two that are connected. For each channel to which the adaptor is connected, it is the external unit control device which is selected by the channel, receives and decodes channel commands like any external unit control device, but differs from them because it uses these commands not for work and control of the input-output unit, but rather to maintain communications among channels and to synchronize their work.

Figure 3.10 below shows the structural diagram of an adaptor. It includes two control blocks, each of which serves its own channel. These blocks are interconnected both directly by means of several signal lines and through a common single-byte buffer register.

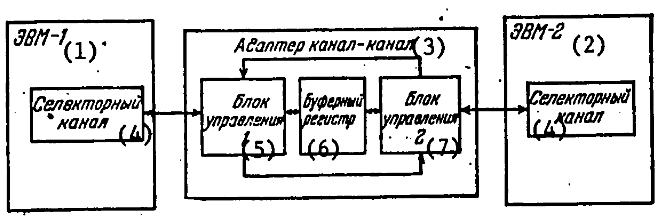

Figure 3.10. Structural Diagram of a Channel-Channel Adaptor

Key:
(1) Computer No 1;
(2) Computer No 2;
(3) Channel-Channel Adaptor;
(4) Selector Channel;
(5) Control Block No 1;
(6) Buffer Register;
(7) Control Block No 2.

The control devices for the magnetic tape and magnetic disk stores can be connected simultaneously to the selector channels of the two machines of the VK-1010. Through these separate control devices the channel of one computer can be connected with the storage of the other computer and vice versa (the channel of any computer can be connected with magnetic tape and magnetic disk storage) [437].

The OS K1 operating system is used to control the work of a VK-1010 consisting of two YeS-1030 computers. This system is an expansion of the YeS operating system with multiprogramming in the regime for a fixed number of problems. The aggregation software is included in the OS K1 operating system. It permits the possibility of controlling the aggregation hardware and information exchange using them at the level of the system macrocommands of the assembler and standard data control means. All access techniques of YeS computers can be used to construct the common memory field on magnetic disks because such a field can contain sets of data with any type of data organization permitted in the YeS operating system. Only sequential methods of access, the base technique or with queues, can be used for work with a common field on magnetic tapes. This also applies to the channel-channel adaptor equipment because the data transmitted using it has a sequential structure [247].

The VK-1010 computer complex can be characterized as an MKMDS/NsOr (KnPmPr) — a homogeneous system with multiple flows of commands and data and by-word processing, with a low level of interconnectedness by means of channels, common external memory, and direct linkage between processors.

The YeS-1035 machine has a number of distinctive features [256]. This machine is a model of the improved phase II YeS computers. The capabilities of the YeS-1035 are developed chiefly by expanding the system of commands (172 commands), organizing virtual memory, correcting lone errors when reading information from main memory, and detecting double errors. The computer provides for compatibility with the Minsk-32 computer [340], and a set of compatibility means has been developed for this purpose: convertors for the Minsk-32 Fortran and Cobol languages; an emulator of Minsk-32 programs on the YeS-1035, and data transfer means. The emulator is a program that works under the control of the YeS disk operating system; the work of the emulator is combined with performance of other YeS computer programs in the multiprogramming regime. The necessity of making the YeS-1035 processor at least as fast as the Minsk-32, given a marked difference in the principles of performing operations in YeS computers and the Minsk-32, established the microprogram base as the principal means of emulation [256].

The channel-channel adaptor in the YeS-1035 computer makes it possible to set up multimachine complexes on the basis of this machine by interlinking three computers, which may be other models of YeS computers. It is also possible to aggregate using a direct control block, which permits the processors that are joined into the system to exchange control information. The YeS-1035 has significantly expanded capabilities for organizing external memory because the model has an integrated file adapter which makes it possible to connect magnetic disk storage with a data transmission speed of up to 312,000 bytes per second directly to the processor (without a control unit) [218, 429].

The senior model of the phase I YeS computers has the highest productivity of the phase I models. This is the YeS-1050. Let us consider multimachine and multiprocessor systems based on this computer [439].

A distinctive feature of the YeS-1050 is that these machines can be joined into either multimachine or multiprocessor systems. They permit organization of linkages at the level of the processor, channels, external memory (external units), and main memory by means of aggregation devices, specifically: direct-control means, channel-channel adaptors, and two-channel switches of control devices for external units. They can also be connected by the reconfiguration console. This makes it possible to realize any combination of the above-listed variations of linkages. Linkage at the first three of these levels is possible for two or more processors, while linkage on the fourth level (constructing a common main memory field) is possible only for two processors. Figure 3.11 below shows a structural diagram of a two-processor system that includes aggregation at all four levels.

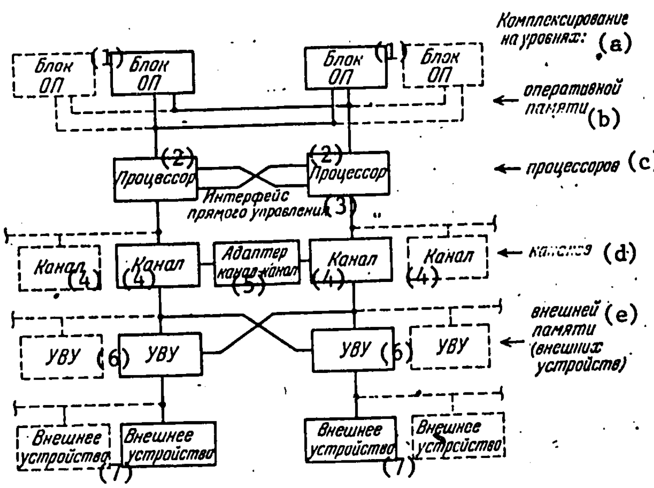

Figure 3.11. Structural Diagram of a Two-Processor System Based on the YeS-1050 Computer

Key:
- (a) Aggregation at Levels — ;
- (b) Main Memory;
- (c) Processors;
- (d) Channels;
- (e) External Memory (External Units);
- (1) Main Memory Block;
- (2) Processor;
- (3) Direct-Control Interface;
- (4) Channel;
- (5) Channel-Channel Adaptor;
- (6) Control Device for External Units;
- (7) External Unit.

The system should have two-output main memory units to organize a common main memory field (in the first YeS-1050 models the main memory did not have two inputs). In the two-processor system with common main memory, assignment of the work regime of the system, physical distribution of system resources among processors, and excluding malfunctioning units from the system are accomplished by means of the system reconfiguration console. The direct-address domain of the memory of one of the two processors is biased by prefixing the address to avoid superposing it on the direct-address domain of the memory of the other processor.

The two-processor system with a common main memory field, common memory field on external memory units, and linkage between processors through direct control equipment is the principal version of the computer system based on the YeS-1050. All means of aggregation are basically oriented to this variation. It is also possible, however, to construct computer systems with a larger number of processors on the basis of the YeS-1050.

Figure 3.12 below shows the structure of a computer system with three processors. It has one two-processor system with a common main memory based on YeS-1050 computers and one other processor. They are interconnected by means of channel-channel adaptors and have a common field of external units. Depending on the nature of the problems being solved the processor shown on the left of the figure may be another type of computer, not necessarily a YeS-1050. It may be less powerful than the YeS-1050, for example a YeS-2030 or YeS-1030 processor, and perform the functions of loading the system and distributing the general flow of problems between the other two processors.

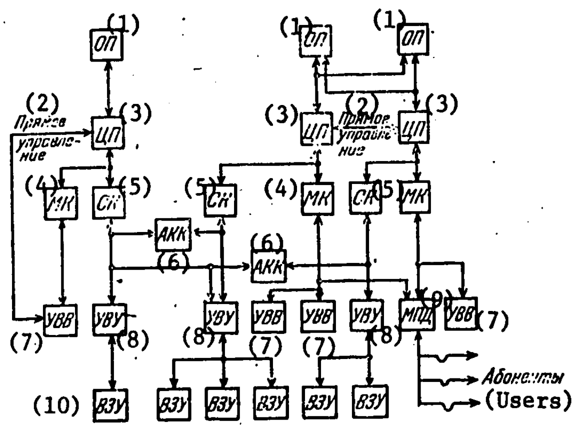

Figure 3.12. Structural Diagram of a Computer System with Three Processors Based on YeS-1050 Computers

Key:
(1) Main Memory;
(2) Direct Control;
(3) Central Processor;
(4) Multiplex Channel;
(5) Selector Channel;
(6) Channel-Channel Adaptor;
(7) Input-Output Unit;
(8) External Unit Control;
(9) Data Transmission Equipment;
(10) External Memory Unit[s].

The system that results from aggregation works under the control of an operating system which is based on a modification of the control program that provides multiprogramming with a variable number of problems. The basic functional capabilities of the multiprocessor version of the control program (the OS-MPR) are using the processors as a single resource for processing a queue of jobs, performing input-output for a problem done by one processor with the help of the other processor, processing hardware malfunctions by the two processors. The realization of these functional capabilities is based on use of direct control means: the commands DIRECT WRITE and DIRECT READ, the signal "Message of Error," and the commands TEST and SET [439].

Table 3.4 below gives basic data on aggregating.

It is possible to aggregate not only identical or different computers of one YeS family, but also YeS machines and machines of different types and classes. As an example, let us consider aggregating YeS computers and M-6000 minicomputers of the ASVT-M [Aggregate System of Computer Technology-M] [51]. In the resulting systems the minicomputers perform the functions of input-output processors, display units, switching processors, and the like.

Aggregation may be accomplished by linking channels or constructing a common external memory field. These alternatives require relatively minor modifications in the design of the computer and software. If rapid communication between computers of the system is needed, the alternative with communication through channels is selected.

An analysis of the logic of construction of the channels of the YeS family and M-6000 computers shows that the M-6000 input-output interface is simpler and more highly programmed. Therefore, when constructing the communications block (coordinator) it is wise to assign it some of the functions of hardware realization of the standard YeS computer interface, but to realize most of them by M-6000 programs. Figure 3.13 gives a structural diagram of the linkage of a YeS computer and the M-6000 (the structure of the ASVT-M is described in section 3.).

In the M-6000 computer the coordinator may be connected either to the program channel (Figure 3.13a) or the channel for direct access to memory (Figure 3.13b). Two interface cards, a control card and an information card, are used for the connection. The former is to transmit all control information and state bytes, while the latter is for data transmission. This distribution makes it possible to use the same interface cards to connect the coordinator to the program channel and to the channel for direct access to memory. The coordinator may be connected to the YeS computer through a selector channel as a high-speed external unit.

This variation of aggregating machines has been realized with a YeS-30 and an M-6000 [51].

The experimental computer system of the Latvian SSR Academy of Sciences is an example of a more complex, heterogeneous multimachine system [446, 447].

Table 3.4. Aggregating YeS Computers

Computer Units — Limits of Aggregation	Hardware and Software for Aggregation	What Is Realized as the Result of Aggregation	What Is Provided as the Result of Aggregation
Processor	Means of direct control (including direct control lines, synchronization lines, and special commands) and an external interrupt mechanism	Direct linkage between the two processors	Exchange of control information between the processors and the synchronization of their work necessary for this
Main Memory	Reconfiguration console, operating system means, and means of direct control	Common main memory field and direct linkage between the two processors	Rapid parallel access of processors to program and numerical information in the common main memory field, realized with participation by expanded direct control means
Channels	Channel-channel adaptor and operating system means	Interlinking the channel of one computer with the channel of the other	Rapid synchronized transmission of programs and digital information from the main memory of one computer to the main memory of the other computer
External Memory	Two-channel switch (input commutator) of the external unit control devices and operating system means	Common external memory field	Simultaneous and distributed-in-time access by the processors to large volume of program and digital information in the common external memory field

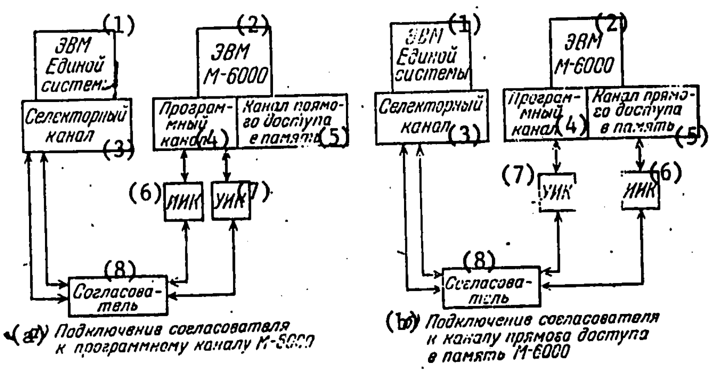

Figure 3.13. Structural Diagram of the Interlinking of YeS Computer and an M-6000 Computer

Key:
(a) Connection of Coordinator to Program Channel of M-6000;
(b) Connection of Coordinator to Channel for Direct Access to Memory of M-6000;

(1) YeS Computer;
(2) M-6000 Computer;
(3) Selector Channel;
(4) Program Channel;
(5) Direct Access to Memory Channel;
(6) Information Interface Card;
(7) Control Interface Card;
(8) Coordinator.

Let us consider its structure (see Figure 3.14 below).

At the end of 1977 the computer system included nine machines. Four of them make up the central computer complex, and five machines are the foundations of computer complexes at institutes. In addition, the system includes data transmission equipment (adaptors), units for switching the channels of the machines (channel switchers), and channels (communications lines between the adaptors). The experimental computer system was set up for scientific investigation of the architecture of computer systems and to construct the machine base for an academy-wide system to automate scientific research.

The three working machines (two YeS-1030's and one M-4030) of the central computer complex receive assignments, perform them, and issue results obtained to users. Users interact with one of the working YeS-1030 computers by means of displays working in a dialog regime. The supervisory machine (M-4030) of the central computer complex controls the channels, controls flows of information from the local input-output units, receives assignments from the users of terminal computers and transmits results to them, monitors the accuracy of information being received and repeats the receipt when errors appear, converts formats and codes, puts back-up copies of messages in main memory, and keeps statistics on the work of the computer system. In an emergency the functions of the supervisory machine are assumed by the working M-4030.

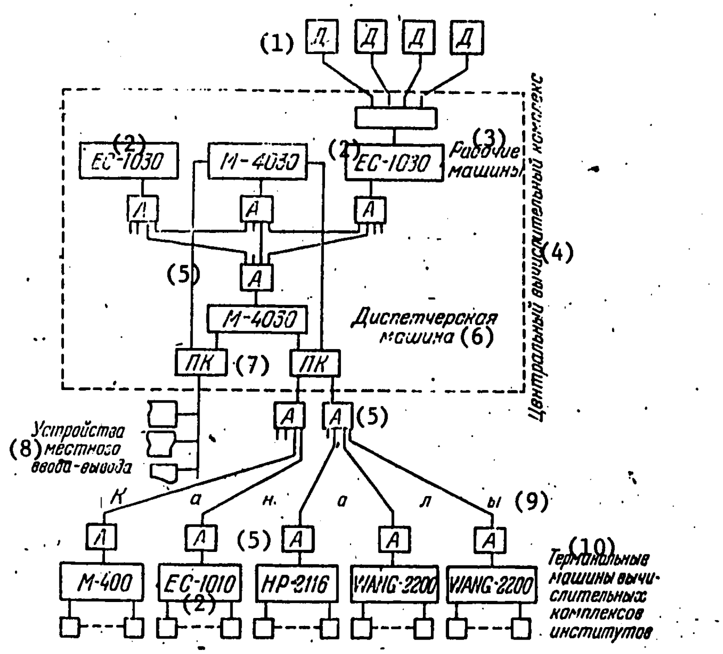

Figure 3.14. Structural Diagram of a Heterogeneous Multimachine Computer System

Key:
- (1) Display[s];
- (2) YeS-1030;
- (3) Working Machines;
- (4) Central Computer Complex;
- (5) Adaptor[s];
- (6) Supervisor Machine;
- (7) Channel Switch;
- (8) Local Input-Output Unit;
- (9) Channels;
- (10) Terminals of Institute Computer Complexes.

FOOTNOTES

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340. V. V. Przhiyalkovskiy, G. D. Smirnov, and V. Ya. Pykhtin, "Elektronnaya Vychislitel'naya Mashina 'Minsk-32'" [The Minsk-32 Electronic Computer], Moscow, "Statistika", 1972, 160 pages.

377. A. M. Larionov (editor), "Sistema Matematicheskogo Obespecheniya YeS EVM" [The Software System of the YeS Computers], Moscow, "Statistika", 1974, 216 pages.

429. A. A. Shelikhov, and Yu. P. Selivanov, "Vychislitel'nyye Mashiny: Spravochnik" [Computers -- a Reference Manual], Moscow, "Energiya", 1973, 216 pages; second edition, 1978, 224 pages.

437. A. M. Larionov (editor), "Elektronnaya Vychislitel'naya Mashina YeS-1030" [The YeS-1030 Electronic Computer], Moscow, "Statistika", 1977, 256 pages.

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ASVT-M AND SM SYSTEMS OF MULTIMACHINE COMPLEXES

Moscow PARALLEL'NYYE VYCHISLITEL'NYYE SISTEMY in Russian 1980 (signed to press 16 Sep 80) pp 146-149

[Subsection of Chapter 3 of book "Parallel Computer Systems" by B. A. Golovkin, Izdatel'stvo "Nauka", 10,000 copies, 520 pages]

[Text] 3.4.2. Multimachine and Multiprocessor Systems Based on ASVT-M [Aggregate System of Computer Technology-M] and SM [International System of Small Computers] Computers. Let us look first at complexes based on the M-4030 computer [17]. A two-machine system is constructed in the same way as a YeS computer two-machine system, using a channel-channel adaptor, control units for external memory, direct control equipment, and appropriate software. When the M-4030 is aggregated with other ASVT-M machines, the M-4030 performs the basic functions of the central computer (see Figure 3.15 below). In this case the ASVT disk operating system on the M-4030 should contain special programs for access to the processors of the lower level of the hierarchy in the system, while the operating systems of the latter should have service programs for the communications adaptor and a program for access to the central machine.

The communications adaptors connect the machine interfaces directly. Exchange among machines is carried on by byte. Interlinking devices that carry on exchange by byte in a semiduplex regime at the initiative of any of the interacting machines are used to organize remote (for distances up to three kilometers) communications among machines. Devices for communications with the object are normally used for communications with the objects being controlled.

There are several different multimachine complexes that can be constructed on the basis of the M-6000/M-6010 machines [68]: duplex systems; hierarchical systems with a tree structure and one-level systmes, for example with circular structure; systems with concentrators [M-40] at the lower level; hierarchical systems which use YeS computers at the highest level, and other types of systems.

The memory and input-output lines play an important part in aggregating M-7000 machines. Figure 3.16 below shows an example of the structure of a two-processor system based on M-7000 machines [115, 184, 429].

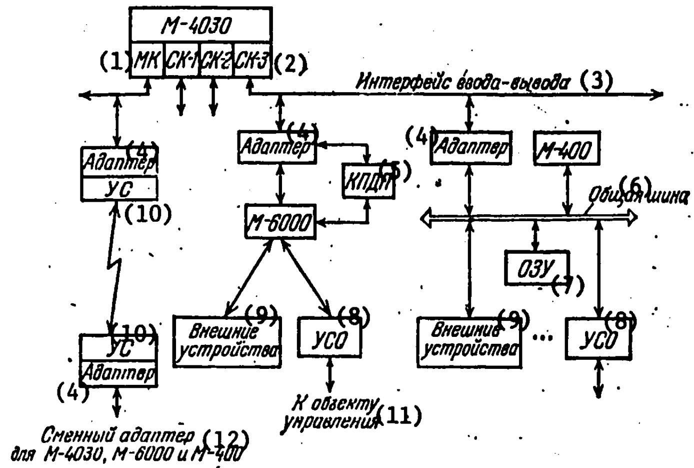

Figure 3.15. Structural Diagram of a Hierarchical Multi-machine System Based on M-4030, M-600, and M-7000 Machines.

Key:
(1) Multiplex Channel;
(2) Selector Channels [Nos 1, 2, 3];
(3) Input-Output Interface;
(4) Adaptor;
(5) Channel with Direct Access to Memory;
(6) Common Line;
(7) Memory Unit;
(8) Device for Communications with Object;
(9) External Units;
(10) Interlinking Unit;
(11) To Object of Control;
(12) Interchangeable Adaptor for M-4030, M-600, and M-400.

The functions and names of the devices in the figure are given in preceding subsection 3.4.1. The memory lines are connected, on the one hand, to as many as two processors and two channels for direct access to memory and, on the other hand, to as many as eight memory units with a total capacity of 128,000 words. The input-output lines in a system with common interface units are connected, on the one hand, to as many as two processors and two channels and, on the other hand, to as many as three input-output expanders, each of which has up to 16 peripheral units. Thus, by the use of lines the primary units become common within the system.

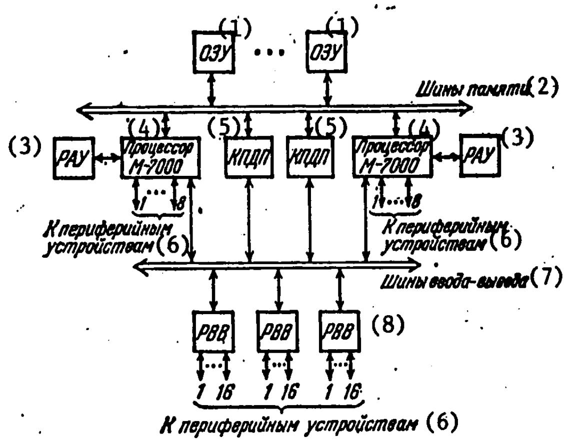

Figure 3.16. Structural Diagram of a Multiprocessor System Based on Two M-7000 Processors

Key:
(1) Memory Unit;
(2) Memory Lines;
(3) Expander of Arithmetic Unit;
(4) M-7000 Processor;
(5) Channel for Direct Access to Memory;
(6) Two Peripheral Units;
(7) Input-Output Lines;
(8) Input-Output Expander.

Figure 3.17 below provides an example of the structure of a multimachine system consisting of a two-processor system based on the M-7000 and M-6000 (or M-6010) machine [115, 429].

The channel for direct access to memory is controlled through a linkage; it is an ordinary peripheral unit in relation to this linkage. The fact that the channel has two control inputs makes it possible to control them from two complexes, so it performs the function of a multiprocessor communications channel for access to the main memory of the M-7000.

The multiprocessor system based on the SM-2 [359] provides with its operating system for simultaneous performance of the two highest priority problems on its two processors. The problems, like the operating system, are stored in one copy in the common main memory and are not assigned to processors in advance. If the problem being solved by one of the processors goes into a state of waiting for the occurrence of some event external to it, the processor switches to solving a less important problem that is not being performed by the other processor. If the problem is not ready for performance, the processor is switched to a dynamic halt. If the problem becomes

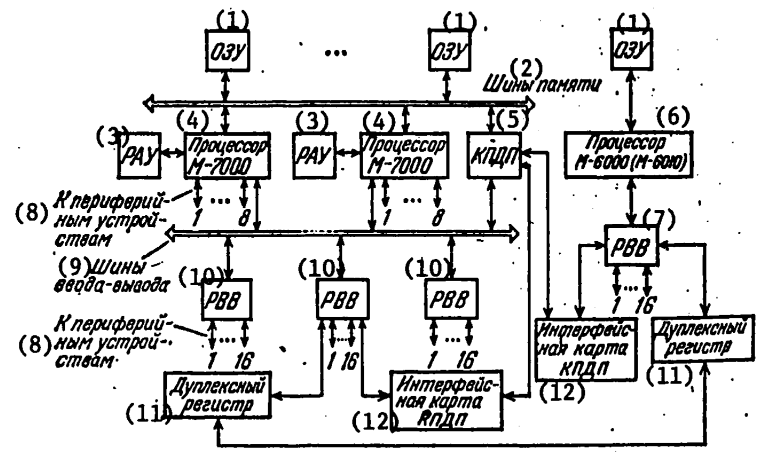

Figure 3.17. Structural Diagram of a System Based on M-7000 and M-6000 (or M-6010) Processors.

Key:
- (1) Memory Unit;
- (2) Memory Lines;
- (3) Expander of Arithmetic Unit;
- (4) M-7000 Processor;
- (5) Channel for Direct Access to Memory;
- (6) M-6000 (or M-6010) Processor;
- (7) Input-Output Expander;
- (8) Two Peripheral Units;
- (9) Input-Output Lines;
- (10) Input-Output Expander;
- (11) Duplex Register;
- (12) Interface Card of Channel For Direct Access to Memory

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ready for performance, it goes into the processor which is in the state of dynamic halt or the processor that is working on a lower-priority problem. If the processors are both working on higher-priority problems, they do not switch to the new problem. There is another possible work regime which takes into account the arrangement of problems in main memory.

FOOTNOTES

17. V. A. Afanas'yev, S. S. Zabara, and S. I. Okunev, "The Architecture of Multimachine Control Complexes Based on the ASVT-M" UPRAVLYAYUSHCHIYE SISTEMY I MASHINY 1974, No 3, pp 133-137.

115. L. V. Gomon, A. S. Nabatov, and I. I. Itenberg, "The M-7000 Control Computer Complex with Heightened Survivability," PRIBORY I SISTEMY UPRAVLENIYA 1977, No 4, pp 8-10.

184. I. I. Itenberg, L. V. Gomon, G. M. Lekhnova, and A. S. Nabatov, "The M-7000 Control Computer Complex," PRIBORY I SISTEMY UPRAVLENIYA 1976, No 2, pp 54-58.

359. V. V. Rezanov and V. M. Kostelyanskiy, "Software of the SM-1 and SM-2 Control Computer Complexes," PRIBORY I SISTEMY UPRAVLENIYA 1977, No 1o, pp 9-12.

429. A. A. Shelikhov and Yu. P. Selivanov, "Vychislitel'nyye Mashiny: Spravochnik" [Computers: a Reference Manual], Moscow, "Energiya", 1973, 216 pages; second edition, 1978, 224 pages.

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MINIMAKS MODULAR SYSTEM

Moscow PARALLEL'NYYE VYCHISLITEL'NYYE SISTEMY in Russian 1980 (signed to press 16 Sep 80) pp 371-374

[Subsection of Chapter 7 of book "Parallel Computer Systems by B. A. Golovkin, Izdatel'stvo "Nauka", 10,000 copies, 520 pages]

[Text] 7.2.2 The Minimaks System. The Minimaks System (Minimachine Program-Switchable System) is a modular homogeneous system and has program-switchable (rearrangeable) linkages with the elementary machines included in the system. The system was developed by the Institute of Mathematics of the Siberian Department of the USSR Academy of Sciences and the Impul's Science-Production Association in Severodonetsk. Work on the system was begun in 1971. The contract design was developed in 1976. In 1977 an experimental industrial model was manufactured and tested, and series production was envisioned beginning in 1978 [67, 150, 152]. One of the principal objectives in development of the Minimaks was to gain actual experience in building a modular system with a large number of processors and the capabilities of reconfiguration in case of malfunctions and adaptation of the structure to the problems being solved and a gradual increase in the number of modules in the system. Series-produced mini-computers were to be used as processors [207].

Figure 7.6 below shows a structural diagram of the Minimaks System [67]. The system contains elementary machines with program switchable linkages. The number of elementary machines in the system may range from two to 64. Each elementary machine contains a computer that performs data processing functions and a system unit that performs communications functions within the elementary machine and among elementary machines. A computer complex based on the ASVT-M (Aggregate System of Computer Technology-M), which includes an M-6000 processor (see subsection 3.4.1), is used as the computer. The system unit is an autonomous ASVT-M module. It provides interaction between elementary units by two-way linkages (type 1: communication with the four immediate neighbors on the left, on the right, above, and below) and by one-way linkages (type 2: communication with the two immediate neighbors on the left and right); in this case the corresponding extreme elementary machines are considered immediate neighbors (see Figure 7.6B). In addition, the system unit interacts with the

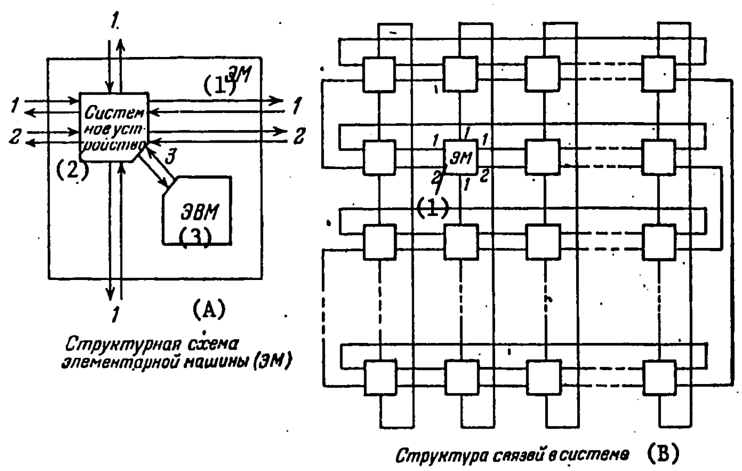

Figure 7.6. Structural Diagram of the Minimaks System:
(A) Structural Diagram of the Elementary Machine;
(B) Structure of Linkages in the System.

Key: (1) Elementary Machine;
(2) System Unit;
(3) Computer.

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computer of the particular elementary machine (type 3: communication between the system unit and the computer of the particular elementary machine accomplished from the computer in the way envisioned for its work with external units). Data transmission is synchronized by query/response signals, which provides transmission when the working speeds of the elementary machines do not match. When data is transmitted by types 1 and 2 linkages an even parity check is performed [67, 207].

Interaction between elementary machines in the Minimaks System may be of the control type or the exchange type. Interactions are accomplished in three stages. In the first stage the domain of coupling between the elementary machines participating in the interaction is formed. In the second stage the actual interaction is carried out, and in the third stage actions related to the possibility of using the elementary machine in other interactions are performed [207].

Typical interactions are: (1) copying data from the main memory of one elementary machine to the main memory of others (exchange); (2) synchronization of the work of elementary machines; (3) performance of a generalized unconditionsl transfer; (4) performance of a generalized conditional transfer according to the value of the generalized characteristic of this transfer; (5) programmed modification of the topology of system structure and the degree of participation by elementary machines in the above-enumerated interactions (adjustment). Interactions 1-4 are accomplished with type 1 linkages, while interaction 5 is done with type 2 linkage. The two-way feature of type 1 linkages provides a compromise between the flexibility and survivability of the system on the one hand, and the complexity of the system unit on the other. The relative infrequency of adjustments makes it possible to use one-way linkages (type 2) for them. In this case the survivability of the system is insured by closing the type 2 linkages in a circle (see Figure 7.6) and the possibility of bypassing malfunctions in type 2 linkages using type 1 linkages [67].

Interactions between elementary machines are assigned by special system commands which are realized by system hardware and the appropriate programs of the operating system.

An adjustment may be performed in both directions (left and right) from the elementary machine being adjusted along one-way type 2 linkages using adjustment registers which are available in each system unit. The adjustment register is a three-position unit; its contents may be modified by the computer of the particular elementary machine or the computer of any other elementary machine. The content of two positions of the adjustment register assigns one of the four directions of receiving data by type 1 linkages, while the content w of the third position indicates whether the particular elementary machine "consents" to interact by type 1 linkages (w = 1 — yes; w = 0 — no). Data transmission is accomplished in all four directions [207].

Several subsystems that work independently can be organized within the system; within the subsystem only one elementary machine transmits, while all the others are receiving or transit units. In the transit elementary machines w = 0 and data transmission is accomplished by the system unit without participation of the computers, which are not diverted from performance of current work. Each elementary machine is included in one of the subsystems formed on type 1 linkages and may or may not be included in one of the subsystems formed on type 2 linkages. An elementary machine which is included in a subsystem of either of these types may not participate in several interactions simultaneously. Subsystems of the first type may exist for several consecutive interactions, whereas subsystems of the second type are set up only for one interaction and are broken down after it is performed [67, 152, 207].

The operating system of the Minimaks provides parallel processing, autonomous work by machines, and a regime of mixed functioning where one subsystem performs parallel processing and the machines of the other subsystem work autonomously. The operating system includes a basic control system and an ASVT-M real-time supervisor. The parallel programming system contains languages for writing parallel algorithms which are an expansion of Mnemokod, Fortran, and Algol, program debugging means, an experimental algorithm paralleler, and linguistic means for organizing stable computing processes. The latter are based on assigning check points in the program at which a return is made by the operating system or operator in the case of breakdowns or malfunctions [207].

The sphere of application of the Minimaks System is determined by the ASVT-M equipment used in the system. Minimaks systems can work autonomously, as auxiliary subsystems aggregated with more powerful computer systems, and as part of distributed computer systems or networks [152].

FOOTNOTES

67. V. G. Vinokurov, Yu. K. Dmitriyev, E. V. Yevreinov, V. M. Kostelyanskiy, G. M. Lekhnova, N. N. Mirenkov, V. V. Rezanov, and V. G. Khoroshevskiy, "Homogeneous Computing Systems of Minimachines," in "Vychislitel'nyye Sistemy" [Computer Systems], Vyp 51, Novosibirsk, IM SO AN SSSR, 1972, pp 127-145.

150. E. V. Yevreinov, and V. G. Khoroshevskiy, "Homogeneous Computer Systems," in "Vychislitel'nyye Sistemy" [Computer Systems], Vyp 58, Novosibirsk, IM SO AN SSSR, 1974, pp 32-60.

152. E. V. Yevreinov, and V. G. Khoroshevskiy, "Odnorodnyye Vychislitel'nyye Sistemy" [Homogeneous Computer Systems], Novosibirsk, "Nauka", Siberian Department, 1978, 320 pages.

207. V. G. Kerbel', Yu. I. Kolosova, E. G. Krylov, V. D. Korneyev, and N. N. Mirenkov, "Programmnoe Obespecheniye Sistemy MINIMAKS" [Software of the MINIMAKS System], Novosibirsk, IM SO AN SSSR, 1979, Preprint OVS-09, 43 pages.

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SUMMA MODULAR MINICOMPUTER SYSTEM

Moscow PARALELL'NYYE VYCHISLITEL'NYYE SISTEMY in Russian 1980 (signed to press 16 Sep 80) pp 374-376

[Subsection of Chapter 7 of book "Parallel Computer Systems" by B. A. Golovkin, Izdatel'stvo "Nauka", 10,000 copies, 520 pages]

[Text] 7.2.3. The Summa System. The Summa (Minimachine Control System) is a modular homogeneous system with programmable structure. It was developed by the Institute of Mathematics of the Siberian Department of the USSR Academy of Sciences together with industry. Work on the system began in 1972 and the contract design was developed in 1976. In 1977 an experimental industrial model was built and tested, and series production was envisioned beginning in 1979 [19, 150, 152]. Let us consider the Summa System, following work [75].

The Summa System contains interlinked elementary machines. Each elementary machine contains an Elektronika-100I minicomputer and a system unit; the minicomputer may have any configuration all the way to a computer with a full set of external units. The variant of the operating system that has been realized is figured for between one and 11 computers. The minicomputer performs data processing functions. It has single-address commands, 12-bit words, and a main memory with a cycle of 1.5 microseconds and a capacity of 4,000 words (expandable to 32,000 words). The computer works at up to 30,000 fixed point operations per second.

The system unit performs machine interaction functions. It is a separate module and is connected to the computer as one of the external units. Each system unit may be free or engaged. In the first case it is a passive unit. The system unit can be switched to an engaged state by the guide unit relative to this system unit. This guide unit may be the computer of the particular elementary machine or another of the system units which is an immediate neighbor of the particular system unit. In any case the system unit can only receive information from the guide unit. The rate of exchange among system units is 2.6 million bits a second.

The system unit has information and control inputs and outputs which are connected respectively with the outputs and inputs of neighboring system units. The expandable communications network of the Summa System which is thus formed may have different configurations, for example those shown in Figure 7.7 below. Adjustment of the network involves shaping the

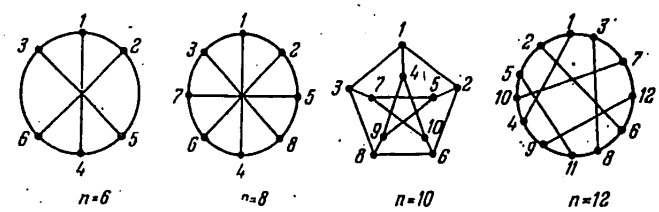

Figure 7.7. Variant Configurations of the Communications Network of the Summa System.

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connection functions and activating the high-speed computers. This is done through the action of information propagated through the network. The message format is standardized as a packet which has a service part and a data part.

The address field and the control field included in the service part of the packet are used to adjust the communications network. Each elementary machine can have several address which determine the degree of its participation in system interactions. The addresses are assigned by program. If the address in the service part of the packet corresponds to one of the addresses assigned to the system unit, the corresponding computer included within the particular elementary machine is activated to receive data coming to the system unit. In the opposite case the system unit relays incoming information as a transit junction of the communications network of the Summa System and the corresponding elementary machine does not participate in the particular interaction.

The software of the Summa System includes the nucleus of the operating system which controls the asynchronous interaction of Processors and a programming system, which makes it possible to write parallel programs. The programming system includes the Macro-8C input language and a translator from this language, a symbol editor, loaders, and service programs.

The Summa System is designed for use in control systems for industrial processes, scientific experiments, and the like. The nucleus of the operating system makes it possible to ajust the structure of the Summa System for definite work regimes such as the regime of matrix processing where it works as a system of the OKMD [expansion unknown] type, the regime of mainline processing where it works as a system of the MKOD [expansion unknown] type, and the processing regime where it works as a system of the MKMD [expansion unknown] type.

FOOTNOTES

19. V. P. Afanas'yev, V. L. Golodok, V. I. Goryachkin, A. P. Yeremin, M. P. Zheltov, M. N. Il'in, S. G. Sedukhin, Yu. F. Tomilov, V. G. Khoroshevskiy, and L. S. Shum, "The SUMMA Computer System," in "Vychislitel'nyye Sistemy" [Computer Systems], Vyp 60, Novosibirsk, IM SO AN SSSR, 1974, pp 153-169.

75. I. V. Prangishvili (editor), "Voprosy Kibernetiki. Vyp. 43. Vychislitel'nyye Mashiny i Sistemy s Perestraivayemoy Strukturoy" [Issues of Cybernetics. Issue No 43. Computers and Computer Systems with Rearrangeable Structure], Moscow, Nauchnyy Sovet po Kompleksnoy Probleme "Kibernetika" AN SSSR, 1978, 180 pages.

150. E. V. Yevreinov, and V. G. Khoroshevskiy, "Homogeneous Computer Systems," in "Vychislitel'nyye Sistemy" [Computer Systems], Vyp 58, Novosibirsk, IM SO AN SSSR, 1974, pp 32-60.

152. E. V. Yevreinov, and V. G. Khoroshevskiy, "Odnorodnyye Vychislitel'nyye Sistemy" [Homogeneous Computer Systems], Novosibirsk, "Nauka", Siberian Department, 1978, 320 pages.

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MARS ASYNCHRONOUS MODULAR SYSTEM

Moscow PARALELL'NYYE VYCHISLITEL'NYYE SISTEMY in Russian 1980 (signed to press 16 Sep 80) pp 411-415

[Subsection of Chapter 7 of book "Parallel Computer Systems" by B. A. Golovkin, Izdatel'stvo "Nauka", 10,000 copies, 520 pages]

[Text] 7.4.1. The Modular Asynchronous Developable System [263]. The conception of the modular asynchronous developable system (MARS) is based on a comprehensive approach to eliminating such widespread weaknesses of computer systems as the following: (1) architectural rigidity; (2) inadequate increase in total productivity when the characteristics of the units are improved and the power of the resources is enhanced, including an increase in the number of central Processors and memory volume; (3) unsatisfactory compatibility and transferability of software; (4) overexpenditure of time and resources for system processes at the expense of user processers; (5) inadequate introduction of convenient, reliable, and effective techniques of parallel programming, and the orientation of the architecture of multiprocessor systems to the techniques of sequential programming using group operations and to parallel-sequential techniques (not elaborate, highly parallel data processing).

To eliminate these shortcomings of computer systems the architecture of the MARS system envisions realization of the following basic principles:

1. Implementation of highly developed hardware support and hierarchical paralleling of both problem and system processes;

2. Construction of a hierarchical structure of the computer modules in the form of standard large block elements;

3. Organization of asynchronous interaction between modules and the user of both centralized and distributed means of organizing interaction with rearrangeable (programmable) control;

4. Convenient and effective adaptation of the system and, within certain limits, dynamic reconfiguration;

5. Use of the opportunities offered by future basic elements, including microprocessors, with due regard for the potential of microprogramming.

There are various ways to embody these principles in concrete structures. In the conception of the MARS system the structural organization is based first of all on comprehensive paralleling of all processes in the system and effectively representing them on the base level of the system. This envisions standardization of the rules and means of composing the system from modules of different levels, development of the functional capabilities of the system and its potential for adaptation by hardware means, virtualization and specialization of modules, and organization of the base system, computer processes, and programs on a uniform, asynchronous principle.

Hardware support and hierarchical paralleling of the entire complex of data processing processes provides an increase in the total productivity of the system.

To realize problem processors a small number of different types of processors is envisioned, for example, a scalar, matrix, or vector processor and, possibly, a processor for complex data structures.

The existence of a small number of such specialized processors in the system does not make switching and paralleling data more complex if the linkages among them are asynchronous, exchanges are accomplished through a common "data market," and the data themselves are tagged.

The organization of control and exchanges may change depending on the level of hierarchy of the processor, but it is wise to select the same method of organization for each particular level. At the lowest level, performing microoperations and operations, synchronous control (synchronous processors) and distributed memory should be used. At the level corresponding to computation of expressions and performance of group operations, synchronous processors and distributed memory should also be used, but with a rise in the level asynchronous organization becomes more efficient. Thus, whereas for the level of computing expressions and performance of group operations asynchronous distributed control may be used in addition to synchronous, for the computation of operators and work with average program modules it is advisable to employ asynchronous centralized control and common memory. With a further rise in the level, for work with large program modules (subroutines), asynchronous distributed control and distributed memory should be used.

System processes are maximally combined in time with user problem processes and are realized by means of equipment oriented to performance of these processes because they have the appropriate specific features and are standard for the system.

Processors in the base system or more complex modules are singled out for system processes, with equipment for processing and control processes separated into appropriate subsystems (it is even possible to break the control subsystem down further into subsystems for control of processes, assignments, data, and the like).

As observed above, modularity is one of the main principles of construction of the MARS system. Both the hardware and the software of the system are modular and this, together with the modularity of parallel programming languages, should insure the possibility of static and dynamic reconfiguration of the system and mutual adaptation of user programs, system programs, and the actual MARS base system.

The MARS system is shaped as a certain hierarchical structure following standardized rules made up of standard modules at different levels and for different purposes. The module in the MARS system is a functionally closed block of heightened qualification in the sense this term is used in work [166] (see subsection 4.1.1) and specializable or programmable for definite functions in the system. It can store and process data and has an autonomous control unit to organize and monitor the work of submodules and for communication with other modules. A module may be hardware, virtual (software) or mixed hardware-software.

Elementary and composite modules are identified in the hierarchical structure of modules. The composite modules contain submodules related to the interface, control, processing, and memory zones. The submodules of the interface zone support all control and information linkages between the particular module and other modules so that from the outside the module represents a "black box" with access for "viewing" only through the interface zone. The internal control of the module is autonomous and programmable and is accomplished by the submodules of the control zone which organize control and, in part, information linkages among submodules of the module. A kind of module operating system functions in the control zone. Assignments coming to the module are processed by the submodules of the processing zone. The data which are supplied to the submodules are stored in the memory zone. The submodule can, in its turn, be a composite module. Figure 7.19 below shows the general scheme of a module of the MARS system.

The parameters, concrete structure, and type of control of the module are determined by its designation within the system. Modules of different levels are described by means of the specification languages of the appropriate level which insure correspondence between the structure of the description of the system module and the structure of the module itself. The module description contains clearly understandable information for adjusting the module to the appropriate configuration and work regime. The internal autonomous control organizes the work of the module. During this the module goes through these states: passive; test of the trigger functions; analysis of the test result (return to passive state if the value is "false"); initiation of the module; active; and, completion.

The MARS system contemplates the use of microprocessors to control the work of particular specific units such as printers and for the performance of special functions within the system. It also envisions using microprocessors as fairly universal components of the base system, that is, as elementary modules. The modules must be refined (improvement of basic parameters and elaboration of the modularity and adaptability of the structure) for microprocessors to be used as elementary modules.

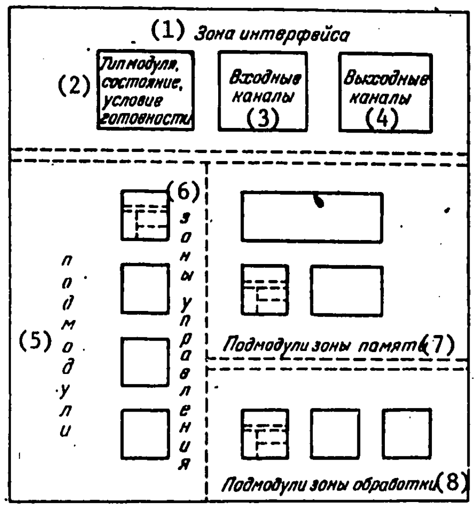

Figure 7.19. General Diagram of a Module

Key:
(1) Interface Zone;
(2) Type of Module, State, Condition of Readiness;
(3) Input Channels;
(4) Output Channels;
(5) Submodules;
(6) Control Zone;
(7) Memory Zone Submodules;
(8) Processing Zone Submodules.

With a fairly complete solution to the problems of modularity and rearrangeability, the spectrum of configurations of the MARS system may be quite broad with respect to both problem orientation and the power of the resulting systems, from minimachines to powerful general-purpose or specialized systems, distributed computer complexes, and the like. This brings together two lines of development of computer technology, one of which is building families of compatible systems of different power levels, while the other is developing standard microprocessor computer modules whose specific purposes are determined by the user when composing the computing system from these modules. The computer modules of the MARS system are used like standard microprocessor modules, but they are much larger units and cover a larger power range. When the configuration is fixed the MARS system becomes closed and represents a module that contains a hierarchical complex of modules. It is possible, however, to add new equipment to the system, expand its capacities, and modify its characteristics. From this standpoint the MARS system is an open system. To insure efficiency of computations in this case a static reconfiguration of the system is possible (adding or taking away hardware or software modules, replacement of modules, addition or replacement of system programs, and the like) where the system is fixed during problem-solving after reconfiguration. Dynamic reconfiguration (programmable changes in control regimes and processes in the modules, including in the elementary microprocessor modules); in this case changes are made during the transition from certain problems to others or even during the process of solving one problem.

The following may be given as the basic types of modules:

a. Modules for storage and preliminary processing of programs (peripheral processors, auxiliary memory modules, translator modules oriented to one programming language or one family of languages, and assignment control modules);

b. Main memory modules and modules for control of main memory, auxiliary memory, and files;

c. Problem-oriented processors (universal arithmetic, vector, matrix and associative, symbol, and special);

d. Modules of high-speed and special-purpose memory and modules to perform control processes, including the processes of virtualization of memory and processors, processing interrupts, and control of parallel processes;

e. Modules for organizing exchange and switching.

The conception of the MARS system makes it possible to organize essential system investigations and design. This requires the construction of experimental systems and models. It is possible at first to build prototype MARS systems with limited productivity and capabilities, but possessing all the principal features of the systems, and then steadily adopt proven architectural concepts, build up capacities, and standardize modules [263].

FOOTNOTES

263. G. I. Marchuk and V. Ye. Kotov, "Modul'naya Asinkhronnaya Razvivayemaya Sistema (Kontseptsiya). Chast I. Predposylki i Napravleniya Razvitiya Arkhitektury Vychislitel'nykh Sistem. Chast II. Osnovnyye Printsipy i Osobennosti" [Modular Asynchronous Developable System (Conception). Part I. Prerequisites and Directions of Development of the Architecture of Computing Systems. Part II. Basic Principles and Characteristics], Novosibirsk, VTs SO AN SSSR, 1978, Preprints Nos 86, 49 pages, and 87, 12 pages.

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CSO: 1863/147

DESIGN OF RECURSIVE COMPUTERS

Moscow PARALLEL'NYYE VYCHISLITEL'NYYE SISTEMY in Russian 1980 (signed to press 16 Sep 80) pp 415-418

[Subsection of Chapter 7 of book "Parallel Computer Systems" by B. A. Golovkin, Izdatel'stvo "Nauka", 10,000 copies, 520 pages]

[Text] 7.4.2. Recursive Computer Machines [284]. The structural and program organization of recursive computers is determined by the following basic principles [765]:

1. The internal language of the recursive computer includes recursively determined program elements as a generalization of machine commands and data elements as a generalization of machine words — operands which may have random complexities;

2. The recursive computer exercises recursive-parallel control of performance of the program, and the order of performance of program elements may be assigned implicitly by means of functional (in the general case recursive) relationships and determined during the process of performance of the program;

3. The internal memory of the recursive computer consists of blocks which may consist of cells or of blocks with program-rearrangeable linkages among them;

4. The external physical structure is uniquely determined by a finite number of recursive relationships;

5. The internal structure which determines links among computing processes in the recursive computer is flexible, rearrangeable by program, and dynamically reflects tle structure of the problems being solved.

These principles are very general and make it possible to construct many different kinds of recursive computers. We will consider below one of the subclasses of these systems, which take account of the contemporary level of microelectronic technology.

The structure of the recursive computer may be represented as a computer network whose assemblies are various types of processors, terminals, external units, and recursive machines of lower levels of the hierarchy. Unlike conventional computer networks and multiprocessor systems, the internal language of the recursive computer is oriented to parallel realization of computations with decentralized control. In the recursive computer, therefore, parallel programming is accomplished by interpretation of the internal language, not by external means using complex operating systems.

The basic method of control adopted in the internal language of the recursive computer is based in the principles of asynchronous control of computation processes [228] and control based on a data flow chart oriented to use in recursive computers [390-392]. Following this method the order of performance of statements is determined dynamically depending on the readiness of statements for execution; this is usually determined by the presence of all the operands of the statements under consideration. But this requires checking a large number of statements and data elements for readiness. This problem can be solved by setting up parallel control and minimizing the number of statements and data elements tested, which can be done by deep structuring of the programs and data. This approach makes it possible to preserve the natural parallelism of problems in the program and use it for parallel programming, and it does not require the participation of the operating system. But this approach has a number of shortcomings such as the fact that the traditional algorithms and languages of programming do not correspond to the method of controlling recursive computers, the need to use recursive processes instead of conventional iterative processes, the need to regenerate data if they are used repeatedly, and others.

A number of mechanisms are introduced into the internal language of recursive computers to interlock program elements and data elements, to remove the interlock, to erase variables, and other purposes in order to avoid or diminish the impact of the above-mentioned shortcomings. In addition, it is possible to use methods of controlling the computing process that correspond to conventional sequential control in the interpretation mode with the possibility of parallelism on the lower levels of the hierarchy, control on the basis of static parallel programming, and control on the basis of dynamic parallel programming, singling out particular processors for those program elements for which input data has been prepared.

The recursive computer includes two basic parts: a switching field and an operating field. The first consists of identical or different switching processors interconnected into a certain recursive structure. A multilevel structure in the shape of a pyramid with tree-like linkages between levels and matrix linkages between elements on each level is recommended. The operating field consists of the control and actuating processors and external units. Its elements usually do not have the correct links with one another and are connected to elements of the switching field of the lower level; it is also permitted to connect them to elements of the switching fields of higher levels. Connections between elements of the operating field are accomplished dynamically through elements of the switching field by tuning and retuning linkages between them. Control of the switching field is distributed among its switching processors which, during their work, use only information about their own state and the states of their immediate neighbors.

The internal memory of recursive computers is distributed among the processors, but any operations processor can use the memory of other operations processors by connecting them to itself. The programs operate with virtual memory. Addressing of data and program elements is accomplished only by means of indexes and names, and the transfer to physical addresses is organized only within the limits of the memory of the particular processor during the process of program interpretation.

The operating system of the recursive computer has the same structure in internal machine language as other programs, and user programs are considered internal blocks of the operating system. It is located in the switching processors, but when necessary can also be in the operations processors. Many ordinary functions of the operating system in the recursive computer are relegated to the functions of interpreters of elements of internal machine language thanks to its high level and recursive-parallel control method.

The possibilities of reorganizing the structure of the recursive computer and having switching processors monitor associated operations and switching processors give the recursive computer a higher level of reliability and survivability, while the deep structuring of programs in the internal language of the recursive computer insures localization of program errors.

It is possible when designing recursive machines to form a family of compatible computers that is practically continuous with respect to parameters and cost. In this case it is advisable to use similar operations processors in the small recursive machines, while in medium-sized recursive computers they may differ. In large recursive computers the number of actuating processors may include matrix or mainline processors. It is important to observe that the structure of the initial recursive computers does not have to be modified when recursive machines are combined or additional processors are added, and when the standard version of internal language is used the program does not depend on the structure and composition of the particular recursive computer.

It is advisable to begin realization of recursive computers by constructing mini-recursive computers based on microprocessors, limiting them to switching and actuating processors and also assigning these processors control functions. In terms of technical parameters, these mini-recursive computers will correspond to medium-sized (or even large) computers. For example, a recursive computer consisting of four 16-bit switching processors and four 16-bit actuating processors capable of operating with numbers of any format and having a total memory capacity of 256 kilobytes, is evaluated in terms of productivity as a machine that more than doubles the productivity of a YeS-1050 computer for solving various problems.

FOOTNOTES

284. V. A. Myasnikov, M. B. Ignat'yev, and V. A. Torgashev, "Recursive Computers," Moscow, ITM i VT AN SSSR, 1977, Preprint No 12, 36 pages.

765. V. M. Glushkov, M. B. Ignat'yev, V. A. Myasnikov, and V. A. Torgashev, "Recursive Machines and Computing Technology," PROC. IFIP CONGRESS 74, STOCKHOLD 1974, Amsterdam, North Holland Publ. Co, 1974, Vol 1, pp 65-70.

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COMPUTER SYSTEMS WITH REARRANGEABLE STRUCTURE

Moscow PARALLEL'NYYE VYCHISLITEL'NYYE SISTEMY in Russian 1980 (signed to press 16 Sep 80) pp 418-421

[Subsection of Chapter 7 of book "Parallel Computer Systems" by B. A. Golovkin, Izdatel'stvo "Nauka", 10,000 copies, 520 pages]

[Text] 7.4.3. Control Systems with Rearrangeable Structure [338]. Control systems with rearrangeable structure are designed chiefly for use in control systems in real time and systems to automate research which require productivity up to 100 million operations a second. The systems engineering and design principles of building these computer systems were developed by the Institute of Control Problems together with the Impul's Science-Production Association. The systems are built on the design basis on the SM EVM [International System of Small Computers].

An increase in the productivity, carrying capacity, reliability, and survivability of the control systems is achieved by their use of many processors and rearrangeable structure. The computing systems are given a problem orientation to improve the ratio of productivity to cost, and five models of systems are envisioned. Adaptation of the problem oriented system to the class of problem is static. It is determined by the types, number, and interrelationship of the models in the system. The second level of adaptation is dynamic, determined by the possibilities of rearranging the structure in the process of solving problems.

The configuration of a system with rearrangeable structure is usually based on a central computing complex with fairly broad capabilities for both data processing proper and controlling flows of information among the models. The other models are more specialized and designated for use as peripheral processors for the central computing complex and for independent work as specialized computer systems for appropriate classes of problems.

We will consider below the first two models of complexes: the central computing complex and the group data processing computing complex.

The central computing complex [335] is oriented to solve fairly well paralleled programs in a multiproblem regime, that is, it is classified as a system with multiple flows of commands and data. It contains one control field, a homogeneous decision field, main memory, and a monitoring subsystem.

The control field consists of similar command processing blocks that work asynchronously and independent of one another. Each command processing block operates with one branch of the program so that several branches, corresponding to the number of command processing blocks, of one or several programs can be performed in the system at the time. The functions of the command processing blocks include buffering commands and operands arriving from main memory and the results of computations received in the decision field. After commands are prepared for execution in the command processing block, they form a queue to enter the decision field. In addition to these functions the command processing blocks also perform some of the branch control functions, operate with eight-bit symbolic operands, and perform short operations on 16- and 32-bit operands with fixed points.

The decision field consists of similar arithmetic-logical modules which are processor elements (or microprocessors) with microprogram control. The arithmetic-logical modules perform operations on 32- and 64-bit operands with floating points and extended operations on 16- and 32-bit operands with fixed points. The arithmetic-logical modules work asynchronously and independent of one another, which makes it possible to perform similar and different operations on scalars and vectors with similar and different bit configurations and different operation lengths at the same time in the decision field.

The linkage between the control and decision fields is achieved through control and information lines through which commands and their operands which are ready for performance go to the arithmetic-logical modules and the results of performance of commands go to the command processing blocks.

The main memory forms a common field that is equally accessible to all command processing blocks and to the processor of the operating system. The memory is constructed on the modular principle and makes it possible to read or write several words at the same time. Linkage with main memory is accomplished through a modular distributor-switch. Both the main memory and the memory of the external units are virtual.

The monitoring subsystem performs the operating system and input-output functions. It is housed in a SM-2 two-processor complex (see subsection 3.4). The functions of the channels for exchange between main memory and the memory of the operating system are performed by specially developed exchange modules. Use of the SM-2 simplifies development of the operating system and makes it possible to use the peripheral equipment of the SM EVM and the M 6000/M 7000 ASVT-M [Modular System of Computer Technology-M] systems.

In addition to the usual levels of problem and command control, the system envisions control of problem branches and statements.

An autocode and high-level programming languages are envisioned for the central computing complex. The autocode makes it possible to use all the capabilities of the complex. A static parallel programming block is included in the translators from high-level languages and identifies such elements as linear segments, simple cycles, and the like in the initial program. Then the translation process combines particular statements in an intermediate language within the above-indicated program elements into parallel statements, forming parallel branches of the program.

Thus, after translation parallel branches have been identified and can be performed in parallel with due regard for appropriate logical conditions. Control of the branches is dynamic, and control functions are distributed between the command processing blocks and the processors of the operating system (SM-2). The distribution of command processing blocks among problems is done by the operating system processor, and after a particular command processing block is assigned to a certain branch it controls its performance fully independent of the work of other command processing blocks. In the command processing block control of statements and commands is done on the mainline principle.

Thus, during the problem solving process the resources of the control and decision fields are dynamically redistributed depending on the current needs of the computing processes, and parallel processing is done not only for the actual computation processes at different levels but also for the processes of computation control.

Let us move on to the group data processing computing complex. This computing complex is oriented to solving fairly well-paralleled problems in a single-problem regime (processing large arrays of data by standard algorithms) and is described as a system with a single flow of commands and multiple flow of data.

The homogeneous decision field of the complex consists of similar processor elements. The number of such elements is selected depending on the particular application. The processor element contains an arithmetic-logical unit for operations with fixed and floating points, main and high-speed memory, and devices for interlinking with other processor elements and the control unit. Thus, the processor elements have their own main memory and do not have control units. They operate by microcommands received from the common control unit which contains a main control memory, a main memory of microcommands, and a microprogram control block. Each processor element is interlinked with neighboring elements. The control unit is linked with all processor elements through a parallel leakage channel.

It is advisable to use group data processing computer complexes together with a central computing complex or machines such as the SM-1, SM-2, and M-7000 (see subsection 3.4). In this case these machines perform supervisory functions, provide communication with peripheral units, and perform computations which are not done efficiently in the group processing complex.

The software of group processing complexes envisions operating systems, libraries of standard procedures and packages of applied programs, program preparation systems, systems for communication with operators, and monitoring-diagnostic systems. The operating systems are developed on the basis of the SM-1 and SM-2 operating systems.

FOOTNOTES

335. I. V. Prangishvili, S. Ya. Vilenkin, L. N. Gorinovich, V. V. Ignatushchenko, L. V. Karavanova, and E. A. Trakhtengerts, "Rearrangeable Control Computing System Based on Homogeneous Structures," "Referaty Dokladov VI Vsesoyuznogo Soveshchaniye po Problemam Upravleniya" [Abstracts of Reports at the Sixth All-Union Conference on Control Problems], Moscow, "Nauka", 1974.

338. I. V. Prangishvili and V. V. Rezanov, "Multiprocessor Control Computing Complexes with Rearrangeable Structure," Moscow ITM i VT AN SSSR, 1977, Preprint No 10, 25 pages.

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SOFTWARE

EXCERPTS FROM THE JOURNAL 'ALGORITHMS AND PROGRAMS', SEPTEMBER 1980

Moscow ALGORITMY I PROGRAMMY in Russian No 9, Sep 80 pp 1-117

[Selected entries from ALGORITMY I PROGRAMMY (Algorithms and Programs), a bibliographic publication of GPNTB (State Public Scientific and Technical Library)]

[Excerpts]

3371. Vtoraya shkola po avtomatizirovannym sistemam massovogo obsluzhivaniya. Tezisy dokladov (Second School on Automated Queueing Systems. Summaries of Reports). Frunze, May 1980. Moscow, 1980, 59 pages.

3375. Matematicheskoye obespecheniye i programmirovaniye dlya vychislitel'nykh i upravlyayushikh sistem (Software and Programming for Computer and Control Systems).' Intervuz Collection. Moscow Institute of Electronic Machine Building, No 1, Moscow, 1979, 251 pages, bibliography at end of articles.

The articles discuss questions relating to mathematical and information servicing of computer complexes and control systems, programming theory and contemporary systems theory, general concepts of simulation and systems development.

3380. Problemy postroyeniya sistem ponimaniya rechi (Problems in Constructing Speech Understanding Systems). USSR Academy of Sciences, Institute of Problems in Information Transmission. Moscow, Nauka, 1980, 144 pages.

The book discusses speech-understanding systems for the control of automatic machines by means of natural language, the levels which include analysis of processes of speech formation and the parameters of speech signals, the recognition of words pronounced together, the use of syntactic and semantic information for the segmentation of fluent speech and the correction of errors in arrangement.

3384. Sostoyaniye i tendentsii razvitiya setey EVM i sistem peredachi dannykh za rubezhom (Status and Trends in Development of Computer Networks and Data Transmission Systems Abroad). Grigor'yev, V. S., Zorina, L. I., Kushner, E. F., and Starovoytenko, O. A. Kiev, 1980, 54 pages (Survey/UkrNIINTEI, Seriya 3.2 ASU, Computer Hardware and Office Equipment). Bibliography: 27 items.

3390. Yazyki i sistemy programmirovaniya (Programming Languages and Systems). Collection of Scientific Works/Computer Center, Siberian Department, USSR Academy of Sciences, Novosibirsk, 1979, 163 pages. Bibliography at end of articles. Contents:

3439. Use of mathematical models to calculate the technological and design parameters of a system of cleaning structures "primary settling tank-aeration tank-secondary settling tank." Istomina, L. P., Mekhanik, I. A., Netyuhaylo, A. P., et al. In book: Nauchnyye issledovaniya v oblasti mekhanicheskoy i biologicheskoy ochistki promyshlennykh stochnykh vod (Scientific Research in the Area of the Mechanical and Biological Purification of Industrial Waste Waters). Moscow, 1979, pp 29-37. Bibliography: 14 items.

The article presents a block diagram and description of an ALGOL program for callating the settling time in the primary and secondary settling tanks, the length and intensity of aeration in the aeration tank and the equipment dimensions.

3478. Basic principles of organization of the computer process on a special processor to solve boundary-value problems. Kork, S. Yu. In: Vychislitel'naya tekhnika i krayevyye zadachi (Computer Technology and Boundary-value Problems), Intervuz scientific and technical collection. Riga Polytechnic Institute, 1980, No 21, pp 82-89. Bibliography: 7 items.

The article describes the software of a special processor. The PL/1 language is used as the basic. Each recording of a file contains information needed for calculating one discrepancy vector element.

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3491. Biblioteka matematicheskikh programm na FORTRANe-IV: Materialy po MO (Mathematical Programs Library in FORTRAN-IV: Materials on Software). Bryzhina, M. F. Leningrad, 1980, 55 pages, Physico-Technical Institute Preprint No 650. Bibliography: 2 items.

The mathematical programs library (MATH SCIENCE LIBRARY or MSLIV) consists of high-quality programs with respect to computational mathematics. A systematic catalog of eight volumes is presented in which programs, series of references, requirements for storage, the results of comparative testing of programs (time, precision, reliability, etc) are listed and described, a description of and the form of reference to a protram, the input and output parameters are given, the names of the subroutines to which it refers are cited, etc.

3493. System of FORTRAN program debugging for the PDP 11/70. Viktorov, L. P. Moscow, 1980, 32 pages. All-Union Scientific Research Institute of Systems Research Preprint. Bibliography: 7 items.

The article describes the principles and possibilities of a system of interactive debugging of FORTRAN VDT programs and all instructions of the system.

3494. STRING--an interactive subsystem for agreed-upon output of textual data to a graphic terminal. Karpov, A. A., and Kirillov, A. S. Dubna, 1980, 14 pages. Joint Nuclear Research Institute Report No 11-80-202. Bibliography: 6 items.

3495. Subroutines for output of multifunction graphs to alphanumeric printers. Lagunov, V. A. Algoritmy i MO dlya fizicheskikh zadach: Materialy po MO EVM (Algotithms and Software for Physical Problems--Materials on Computer Software). USSR Academy of Sciences, Physico-Technical Institute, 1980, No 4, pp 90-99. Bibliography: 1 item.

The article presents FORTRAN subroutines GRAPHS and GRAPH for construction of graphs of many functions (1 to 35) without accumulation (GRAPHS) and with accumulation (GRAPH) of data in files.

3500. Package of programs SOLVER of a system of nonlinear functional and ordinary differential equations with rarefied Jacobean matrixes. Yeremin, A. Yu., and Mar'yashkin, N. Ya. Moscow, 1980, 31 pages. USSR Academy of Sciences Computer Center Report on Computer Software. Bibliography: 8 items.

The package consists of 90 FORTRAN subroutines. The package length is 40000_8 words in charging modules.

3531. Determination analysis of qualitative socio-economic data in an interactive mode. Sukhanova, G. B., and Chesnokov, S. V. Metodologiya kompleksnogo issledovaniya sotsio-ekonomicheskikh sistem (Methodology of Complex Investigation of Socio-economic Systems) Collection of Works. Scientific Research Institute of Systems, 1980, No 1, pp 89-94. Bibliography: 8 items.

The article describes the principles of the functioning of a pilot version of a system realized on the PDP-11-70. FORTRAN was used as the basic language.

3542. Densimetry of distorted objects in digital processing of images. Degtyareva, V. P., and Platonov, V. N. Moscow, 1980, USSR Academy of Sciences, Physics Institute Preprin. No 77. Bibliography: 4 items.

The article describes FORTRAN subroutines of the FOTOM image photometry program with geometric and photometric distortions taken into consideration. Key words: methodology, FORTRAN-4, HP-2100, image processing, photometry.

3544. Paket programm dlya obobshchennogo spektral'nogo analiza (Package of Programs for Generalized Spectrum Analysis), Part 1. Dagman, E. Ye., Kuzharev, G. A., Ponomarenko, A. P., et al. Novosibirsk, 1980, 56 pages. USSR Academy of Sciences, Siberian Department, Institute of Physics of Semiconductors Preprint No 49-80. Bibliography: 10 items.

FORTRAN programs are presented for the formation of initial matrixes for the transformation and re-ordering of vector and matrix cmmponents and rapid discrete orthogonal transformations.

3546. The KING system. Package of programs for kinematic interpretation of reflected seismic waves. Operative-informational Material. USSR Academy of Sciences, Siberian Department, Institute of Geology and Geophysics, Novosibirsk, 1980, 136 pages. Bibliography: 27 items.

The KING system is a set of programs in FORTRAN and in the MADLEN autocode and data for estimating the structural (boundary configuration) and velocity (seismic wave propagation in layers) parameters of two-dimensional laminated-heterogeneous model of a seismic medium. The volume of memory occupies is 24-32 sheets.

3551. Algorithm for minimizing the numbers of personnel of the ship transfer command. Davidovich, F. S., and Shibinskiy, V. M. VOPROSY SUDOSTROYENIYA. SERIYA MATEMATICHESKIYE METODY. PROGRAMMIROVANIYE. EKSPLUATATSIYA EVM, 1979, No 20, pp 29-34.

The article presents a solution of the problem of minimizing mooring tests of vessels with the drawing in of methods of heuristic programming in FORTRAN. The readout time is 2-3 seconds.

3693. Software for investigation and simulation of specific objects on the "Saturn-1" alphanumeric printer. Maksimov, M. M., Rybitskaya, L. P., and Sherbakov, B. D. Vychislitel'naya tekhnika i krayevyye zadachi (Computer Technology and Boundary-Value Problems) Intervuz Scientific and Techological Collection. Riga Polytechnic Institute, 1980, No 21, pp 58-74. Bibliography: 7 items.

The article describes the software for invesigating the development of oil deposits. The aggregate of programs and subroutines forms an aunusual and fairly flexible simulation language for the effective construction of the user's program, with the inclusion in it of original designs formulated as separate subroutines.

3709. Sistema malykh elektronnykh vychislitel'nykh mashin SM: Katalog tekhnicheskikh i programmnykh sredstv SM3, SM4 (SM System of Small Computers: Catalog of Hardware and Software, SM-3 and SM-4). International Center of Scientific and Technical Information, Institute of Electronic Control Machines. Moscow, 1980, 342 pages.

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The article presents information about the architecture of the system, the principles of constructive execution and possible areas of application, as well as the main characteristics of SM computer software.

3712. Instruktsiya po rabote s ALGEDITom (Instructions on Work With ALGEDIT). Vorob'yev, V. I., Kolesnikov, O. N., Troyan, A. I., and Fedorchenko, L. I. Leningrad, 1980, 29 pages. USSR Academy of Sciences, Leningrad Scientific Research Computer Center. Bibliography: 2 items.

The article gives a brief description of the work and instructions of an interactive text editor ALGEDIT for the CYBER-172 computer.

3716. REST--prosteyshiy interpretator dlya 8-razryadnykh mikroprotsessorov (REST--a Very Simple Interpreter for 8-Digit Microprocessors). Basiladze, S. G. Dubna, 1980, 12 pages. Joint Nuclear Research Institute Report No 13-13031. Bibliography: 6 items.

The REST language is based on the instructions list of 8-digit Intel-80 microprocessors and constructed according to the design of an interpreter. To simplify the language, reverse bracketless recording of expressions was adopted, and the symbolic markers are digital. The interpreter volume is 3K bytes.

3717. Instructions on programming of the macroassemblers 8080/8085. Myskin, A. V., and Torgashev, V. A. Materialy po MO (Materials on Software), Leningrad, 1980, 65 pages. USSR Academy of Sciences, Leningrad Scientific Research Computer Center. Bibliography: 6 items.

The article describes the machine-oriented language of the Intel 8080 and 8085 microassembler and architecture. Programming methods are presented with the use of machine instructions and macromeans of language, as are the controlling macroassembler parameters determining the translation mode and the form of the results.

3718. Instructions on PL/M-80 programming. Myskin, A. V., and Torgashev, V. A. Materialy po MO (Materials on Software), Leningrad, 1980, 67 pages. USSR Academy of Sciences, Leningrad Scientific Research Computer Center. Bibliography: 5 items.

The article describes the PL/M language for programming the Intel 8080 and 8085 microprocessors and the series K580. A program is presented in the PL/M language, one consisting of two modules (the main program module and a subroutine) and simple sorting of a series of 128 recordings, each of which contains two terms.

3734. Numerical two-dimensional method of calculating bipolar transistor parameters. Zubov, A. V., and Parmenov, Yu. A. Sbornik nauchnykh trudov po problemam mikroelektroniki (Collection of Scientific Works on Problems of Microelectronics). Moscow Institute of Electronic Engineering, 1978, No 40, pp 127-140. Bibliography: 8 items.

A FORTRAN program was compiled for calculating integrated transistors by a numerical method based on the solution of equations of continuity for holes and electrons and a Poisson equation in a two-dimensional approximation. The time required for computation of the transistor structure is 6 minutes.

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Moscow ALGORITMY I PROGRAMMY in Russian No 10, Oct 80 pp 1-79

[Selected entries from ALGORITMY I PROGRAMMY (Algorithms and Programs), a bibliographic publication of GPNTB (State Public Scientific and Technical Library)]

[Excerpts]

3819. Organization of the process of division of a fragment into images. Baykov, A. M., VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 1, pp 59-65. Bibliography: 5 items.

The process of division is simulated in the PL/1 language with use of images of stylized manuscript words and other symbolic-graphic information. Separation of individual letters and other image elements is studied on the YeS-1022 computer in about 0.08 second.

3822. Pseudorandom number sensors for YeS computers. Vitaliyev, G. V., Zhukov, A. V., and Chugunov, A. P. VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 1, pp 101-112. Bibliography: 6 items.

The article discusses program sensors of pseudorandom numbers in the PL/1 language on the basis of maximum length series and estimates their randomness.

3828. Data bank for storage of normative-reference information. Moscow, 1980, 39 pages. Programmy dlya resheniya zadach dorstroitel'stva na EVM (Programs for Computer Solution of Road-Building Problems). State All-Union Roads Scientific Research Institute.

The article examines the BHS-12 informational and software data base. An autonomous data manipulation language has been created which is a set of procedures in the basic algorithmic languages Assembler and PL/1.

3835. PAPOR--package of programs for computer-assisted search for an optimum solution. Petin, N. I. In book: Primeneniye tsifrovykh vychislitel'nykh mashin v yadernoy fizike i tekhnike (Application of Digital Computers in Nuclear Physics and Technology). Moscow, 1980, pp 86-93. Bibliography: 5 items.

The article describes the simulation of physical experiments by means of a package for computer-assisted search for an optimum solution, PAPOR. The volume of a package program is about 800 PL/1 language operators.

3844. Program for calculation of a correlation matrix. Ashkenazi, I. D. ELEKTRONNAYA TEKHNIKA. SERIYA 1. ELEKTRONIKA, SVCh, 1980, No 3, pp 108-109. Bibliography: 1 item.

The FORTRAN program includes a subroutine for dividing a given interval into subintervals with equal frequencies of incidence of the indicated parameter. The read-out time is proportional to the size of the selections and the number of parameters characterizing each object and does not exceed tenths of a second even for large selections.

3852. Program for calculation of delay and resistance of connection of a delay system according to experimental data obtained with an electronic sonde. Vasil'yev, V. I. ELEKTRONNAYA TEKHNIKA. SERIYA 1. ELEKTRONIKA. SVCh, 1980, No 3, p 113. Bibliography: 4 items.

3884. Algorithm for statistical optimization of hybrid integrated circuits. Golovkov, A. A., Kalinikov, D. A., Kraychik, A. B., et al. VOPROSY RADIOELEKTRONIKA, SERIYA OT, 1979, No 10, pp 133-138. Bibliography: 3 items.

A FORTRAN program is described which takes into account the real character and quantity of technological scattering of parameters of circuit components. The algorithm can be used to search for the global extremum of a determined function.

3885. Linear uhf circuits optimization program. Demeshko, V. N., Ledovskikh, G. N., and Ivanov, A. V. ELEKTRONNAYA TEKHNIKA, SERIYA 1. ELEKTRONIKA SVCh, 1980, No 3, p 111. Bibliography: 1 item.

The FORTRAN program for finding circuits consisting of an arbitrary combination of multipoles includes a subroutine for analysis of the frequency characteristics of uhf circuits, a library of subroutines for computing the scattering matrix of the basic components. The article describes the input language for assigning the initial data on the circuit topology, text and subroutine translator with the input language. The read-out time of a control example is 10 minutes.

3890. Software of a method of synthesis. Badanov, A. G., Solov'yev, G. N., and Chalyy, V. D. In book: Primeneniye tsifrovykh i analogovykh vychislitel'nykh mashin v yadernoy fizike i tekhnike (Application of Digital and Analog Computers in Nuclear Physics and Technology). Moscow, 1980, pp 75-86. Bibliography: 4 items.

The article describes FORTRAN programs for the creation of mathematical models of a series of subroutines of a linear accelerator of electrons to an energy of 75 MeV and a powerful multichannel controlled thermonuclear synthesis with layer heating of plasma.

3891. Algorithm for simulating logical circuit reliability. Bryunin, V. N., Bulatov, M. Kh., and Galitskiy, A. V. ELEKTRONNAYA TEKHNIKA. SERIYA 10. MIKROELEKTRONNYYE USTROYSTVA, 1980, No 1 (19), pp 82-90. Bibliography: 6 items.

The article presents a method of estimating reliability which takes into account the dependence of working capacity on the flow of failures of component logical elements, the logical characteristics of a specific circuit and correlation of input and output signals. The algorithm has been realized in the FORTRAN language. Construction of a reliability matrix using error distribution functions curtails the volume of intermediate computations.

3895. Organization of the process of simulatin on the "Saturn" alphanumeric printer. Maksimov, M. M., Rybitskaya, L. P., and Sherbakov, B. D. In book: Metody i sredstva modelirovaniya fizicheskikh protsessov (Methods and Equipment for the Simulation of Physical Processes). Kiev, 1979, pp 59-68.

The article describes the organization of the process of simulation of oil and gas filtration in a porous medium by means of the "Saturn" alphanumeric printer. A characterization is given of the GRAFOR package of applied programs in FORTRAN and of a complex of standard subroutines.

3904. Instrumental complex for development of software for the T-1600 minicomputer on the BESM-6 computer. Mikiychuk, A. M., Mikiychuk, N. M., Sorbachov, A. M., and Firsov, S. A. Voprosy atomnoy nauki i tekhniki. Seriya metodiki i programmy Chislitel'nogo resheniya zadach matematicheskoy fiziki (Questions of Atomic Science and Technology. Series: Procedures and Programs for Computer Solution of Problems of Mathematical Physics). Scientific and Technical Collection, 1979, No 1 (3), pp 38-42. Bibliography: 3 items.

The complex consists of a programming system (cross-assembler, communications editor and loader) and debugging system (T1600 simulator and interactive debugger).

3906. User's language for describing the process of data preparation on a carrier. Konoval'chuk, V. N. VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 1, pp 30-43. Bibliography: 2 items.

The article describes the structure, syntax and semantics of a language for automation of keyboard input elements. Rules of program organization are given.

3943. Programs for information exchange between the BESM-6 and minicomputers. Zakharova, A. N., Zaytsev, S. A., Karmazine, Ye. I., et al. ELEKTRONNAYA TEKHNIKA. SERIYA 1. ELEKTRONIKA. SVCh, 1980, No 3, pp 109-110. Bibliography: 6 items.

The article describes TADI and DITA programs in the BEMSh autocode which accomplishes information exchange in the presence of apparatus coupling of a minicomputer with the BESM-6 through a commutator of computers in a seventh direction.

3950. Structure of virtual memory control in a YeS computer operating system. Lebed', M. Ya. VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 1, pp 90-100. Bibliography: 2 items.

The articel describes a program for memory control in a multiprogramming mode with a variable number of tasks jointly using a virtual memory (SVS).

3961. Universal subsystem for automatic arrangement arrangement of electronic radio elements on a YeS computer. Vetchinin, M. P., Ginzburg, B. D., and Dodin, G. M. ELEKTRONNAYA TEKHNIKA. SERIYA EVT, 1980, No 1, pp 3-11. Bibliography: 5 items.

The article describes a universal algorithm for the arrangement of various-sized electronic radio parts on plates which take into account a tracing sequence during the division into parts and the disposition of other electronic radio parts only in nearby circuits.

3979. Package of applied programs RESURSY and its possibilities in the solution of problems in the control of large-scale scientific research and experimental design developments. Fateyev, A. Ye., Roytman, A. I., and Kulikova, L. G. VOPROSY RADIOELEKTRONIKI, SERIYA EVT, 1980, No 1, pp 113-120. Bibliography: 2 items.

3983. Computation of the directivity pattern of a radiating antenna-framework system with a radio-transparent aperture. Kaplun, V. A., Klyuchnikov, A. S., and Shpurgalov, Yu. A. VOPROSY RADIOELEKTRONIKI. SERIYA OT, 1980, No 1, pp 42-50. Bibliography: 5 items.

3997. Text editor EDIT. Bryzhina, M. F. Materialy po MO (Materials on Software), Leningrad, 1980, 55 pages. USSR Academy of Sciences, Physiotechnical Institute Preprint No 657. Bibliography: 4 items.

The article describes the possibilities of using a text editor which is included in various CDC operating systems in a time-sharing mode and in a package mode.

3998. Izmereniye partsial'noy shiriny raspadov $\eta \rightarrow \pi^0 \gamma\gamma$. Poisk i issledovaniye protsessov kumulyativnogo obrazovaniya η i ω mezonov. Proverka dinamicheskikh sredstv sokhranyayushchikhsya kvantovykh chisel. Proyekt eksperimenta na sinkhrofazotrone OIYaI (Measurement of the partial decay width $\eta \rightarrow \pi^0 \gamma\gamma$. Search for and investigation of the processes of cumulative formation of η and ω mesons are discussed. Verification of the dynamic properties of preserved quantum numbers i described, as is the plan of the experiment on the JNRI synchrophasotron). Arkhipov, V. A., Astvatsaturov, R. G., Volkov, M. K., et al. Dubna, 1980, 16 pages. JNRI Report No 1-13012. Bibliography: 13 items.

The article explains the divergence of decay $\eta - \pi^0 \gamma\gamma$ with experiment, which reaches three orders of magnitude. The installation works on a line with a HP-2116B computer. Needed for processing the experimental material, for an expected number of triggers of $\sim 10^6$, is $\sim$400 hours on a CDC-6500 computer.

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CSO: 1863/175

EXCERPTS FROM THE JOURNAL 'ALGORITHMS AND PROGRAMS', NOVEMBER 1980

Moscow ALGORITMY I PROGRAMMY in Russian No 11, Nov 80 (signed to press 13 Nov 80) Nos 4025, 4108, 4251, 4335, 4336, 4356, 4358, 4362 and p 109

4025. Specialized and sector fund of algorithms and programs. Compiled by Dashkiyeva, Ye. V., and Novoseletskaya, M. S. EKSPRESS-INFORMATSIYA/TsNIITEIpriborostroyeniya. PRIBORY, SREDSTVA AVTOMATIZATSIYA I SISTEMY UPRAVLENIYA, TS-3, ASU, No 5-6, Moscow, 1980, 48 p.

[Text] Annotations of 117 algorithms and programs included in the Specialized Sector Algorithm and Program Fund (SOFAP) are presented. They are available for examination at the SOFAP, Kiev ASU Planning and Design Office, 19 R. Rollan ul, Kiev 252158.

4108. Computer-assisted design of analog and digital filters. Mingazin, A. T. ELEKTRONNAYA TEKHNIKA. SERIYA 10. MIKROELEKTRONNYYE USTROYSTVA, No 4 (22), 1980, pp 3-8

[Text] The article describes a program in the PL/1 language for the design of digital recursive filters of low and high frequency, band and rejector.

4251. Some classes of recognition algorithms. (General Results). Rudakov, K. V. SOOBSHCHENIYA PO PRIKLADNOY MATEMATIKE/Computer Center, USSR Academy of Sciences, 1980, 66 p

[Text] Recognition algorithms and operators acting on their sets are examined as a reflection of Cartesian powers of sets. A classification is made of the algorithms and operators on the basis of general properties of those reflections.

4335. Questions regarding construction of the structure of a complex system in interaction with a computer. Ganin, I. A., and Solomatin, D. P. VOPROSY KIBERNETIKE, 1980, pp 24-29

[Text] The article presents a modification of an algorithm for construction of a binary amplification matrix with dimensions of 400 x 400. The time required for creation of such a matrix on a YeS-1022 computer is $\leq$ 20-25 s.

4336. Simulation of neuron structures with signal-energetic interactions. Yefimov, V. N., and Rybak, I. A. In book: Problemy iskusstvennogo intellekta (Problems of Artificial Intelligence), Elista, 1979, pp 53-63.

[Text] Examined as a network structural element is a neuron-glia complex, the model of which is called a "neuroglion" and is realized on a YeS-1020 computer.

4356. Software and hardware for increasing the effectiveness of use of the "Nairi-3-1" computer. Materialy po MO EVM (Materials on Computer Software) USSR Academy of Sciences, Komi branch. Syktyvkar, 1980, 18 pages.

4358. Organization of communications of the "Elektronika-60" computer with mini-computers and software development. Denisenko, A. A., Luk'yantsev, A. F., Maksimov, G. M., et al. IFVE Preprint No OEA-80-75, Serpukhov, 1980, 8 pages.

4362. Type 4S data transmission control procedure. Volgin, D. I., and Fedorov, V. M. Leningrad Scientific Information Computer Center, 1980, 33 pages

[Text] The main concepts regarding the structure and logical interconnection of network records are discussed. Type 4S data transmission control procedure is the basis for CDC systems and networks.

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EXCERPTS FROM THE JOURNAL 'ALGORITHMS AND PROGRAMS', DECEMBER 1980

Moscow ALGORITMY I PROGRAMMY in Russian No 12, Dec 80 pp 1-125

[Selected entries from ALGORITMY I PROGRAMMY (Algorithms and Programs), a bibliographic publication of GPNTB (State Public Scientific and Technical Library)]

[Excerpts]

4388. Sistemy i seti EVM (Computer Systems and Networks). Riga, 1980, 54 pages with ill. Nauchno-metodologicheskiye materialy (Scientific Methodological Materials). Latvian SSR Academy of Sciences, Institute of Electronics and Computer Technology No R-14. Bibliography: 96 items.

The article discusses tendencies in the development of methods of using computer technology, the construction of shared multicomputer centers and computer networks.

4509. Determining the necessary number of channels of loading control for aircraft wing tests with several designs. Brysin, N. V., and Miodushevskiy, P. V. Moscow 1980, 30 pages. Trudy TsAGI (Central Institute of Aerohydrodynamics imeni N. Ye. Zhukovskiy) No 2073.

4510. Program for design of a directed coupler on a circular wave guide with an H_{nm} wave. ELEKTRONNAYA TEKHNIKA, SERIYA 1. ELEKTRONIKA SVCh, 1980, No 5 pp 115-117. Bibliography: 4 items.

The article describes a FORTRAN program for synthesis and analysis of a longitudinal system of openings for the connection of a directed coupler. In the case of synthesis the program takes into consideration the coefficients and diameters of the connection openings, and in the case of analysis, the electrodynamic characteristics of the coupler in the given frequency range. The program read-out time during synthesis and analysis of apertures for 10 types of propagating waves at 8 frequency points is $\leqslant 1.5$ minutes.

4511. Methods of machine representation of a medium with obstacles in the task of planning manipulator motion. Vakhidov, M. V. In book: Voprosy teorii robotov i iskusstvennogo intellekta (Questions of the Theory of Robots and Artificial Intelligence). Kiev, 1980, pp 57-70. Bibliography: 3 items.

A method of representation is presented which requires a smaller memory volume and simpler realization. Algorithms are programmed in FORTRAN.

4512. Vremennye rekomendatsii po proyektirovanniyu i stroitel'stvu zakrytykh sobirateley v zamknutykh ponizheniyakh Leningradskoy oblasti (Temporary Recommendataions on the Planning and Construction of Closed Collectors in Closed Lowlands of Leningradskaya Oblast). Northern Scientific Research Institute of Hydraulic Engineering and Land Improvement. Leningrad, 1980, 40 pages.

The article presents a program for computation of distances between drains on a YeS computer.

4513. Programmy tsifrovoy fil'tratsii dvumernyy signalov (Programs for Digital Filtration of Two-Dimensional Signals). Grushin, V. A. Moscow, 1980, 19 pages. USSR Academy of Sciences, Institute of Space Research Preprint No 580). Bibliography: 3 items.

The article discusses the complex of a FORTRAN programs for experimental image processing on square screens with long sides, expressed by powers of the pair $M = 2^K$. Examples of application of the complex to solve tasks frequently encountered are presented.

4514. Complex program for analysis of electron-optical and thermophysical processes in metal-ceramic collector units. Datskovskiy, V. A., Kalinin, Yu. A., and Shustova, M. D. ELEKTRONNAYA TEKHNIKA, SERIYA 1. ELEKTRONIKA SVCh, 1980, No 5, p 114. Bibliography: 2 items.

The article describes a FORTRAN program for computing the thermal regime of a metal-ceramic collector unit with a conic-cylindrical current sensitive electrode. Taken into account in the program are the collection conditions of the system, the class of processing of joined materials and the thermophysical and elasto-plastic characteristis of the materials. The thermal load is found from the solution of electron-optical problems. The computations were made with consideration of the absence of stability of the electron beam characteristics in flight toward the collector. The read-out time of one variant is 5-60 minutes.

4517. Use of computers to expand the pracitcal application of quantitative estimation of corrosive cracking. Rassokhin, N. G., Gorbatykh, V. P., Gerigros, M., et al. Trudy MEI, 1980, No 474. Teplogidravlicheskiye i fiziko-khimicheskiye protsessy v yadernykh energeticheskikh ustanovkakh (Thermohydraulic and Physicochemical Processes in Nuclear Power Plants). Collection, pp 112-120. Bibliography: 5 items.

The article presents computational formulas, a FORTRAN formula and a nomogram for estimating the time until corrosive cracking of steel 18/8 as a function of the chlorine-ion concentration, hydrogen, the working temperature, the thickness of the metal and mechanical stresses.

4521. Program for computing the start characteristics by the input uhf signal of an M-type amplifier with a secondary emission cathode. Korolev, A. N., Leshinskiy, I. A., and Manylov, L. M. ELEKTRONNAYA TEKHNIKA. SERIYA ELEKTRONIKA SVCh, 1980, No 5, pp 108-112. Bibliography: 3 items.

The article describes a FORTRAN program for computing the coefficient of secondary electrons in a magnetron amplifier with a cold secondary emission cathode in the period of start of its input uhf signal. The computation is made in a single-wave approximation without taking the forces of the spatial charge into account. The obtained dependences of the accumulation coefficient on the regime parameters and properties of the cathode qualitatively coincide with the results of analytical examination of the starting process and the experimental results. The read-out time of the trajectory of a single electron fluctuates from units to tens of seconds. The time required for computation of the accumulation coefficient at n = 100 $\leqslant$ 50 minutes.

4585. Tekhnicheskiye protsedury proyekta BETA (BETA Project Technical Procedures). Pokrovskiy, S. B., and Stepanov, G. G. Novosibirsk, 1980, 27 pages. USSR Academy of Sciences, Siberian Department, Computer Center Preprint No 249.

The article describes procedures for obtaining and transforming programs in the Internal language and the general style of work with the memory and files.

4587. The problem-oriented BLOK language for describing the structure of hybrid integrated uhf circuits. Trifonov, M. M. ELEKTRONNAYA TEKHNIKA. SERIYA 1. ELEKTRONIKA SVCh, 1980, No 5, pp 104-108. Bibliography: 3 items.

Taken as fundamental are concepts of the basic element, the unit, combinations of basic elements and units by means of outputs. The language takes into account the specifics of hybrid integrated uhf circuits but is not oriented toward a specific type of computation (analysis of electrical characteristics, topology planning, etc). An example of circuit description is presented.

4588. Upravleniye robotami ot EVM (Computer Control of Robots). Yurevich, Yu. I., Novachenko, S. I., Pavlov, V. A., et al. Leningrad, Energiya, 1980, 261 pages. Bibliography: 94 items.

The article describes a complex approach to the analysis and synthesis of exponential devices and the principles of construction of an algorithmic system of robot control. The ROCOL (Robot Control Language) is described.

4672. Task control operators in an operating system. Materialy po MO (Materials on Software). Leningrad, 1980, 81 pages. USSR Academy of Sciences, Leningrad Scientific Research Computer Center. Bibliography: 7 items.

The work of equipment elements is controlled and coordinated by NOS1 (Network Operating System Version 1) consisting of a set of Peripheral Processor Unit programs, Central Processor Unit programs, macrodeterminations and symbolic determinations. NOS1 is a file operating system for the CYBER-172 computer system.

4673. Complex of UNIPLOT graphic programs for the CYBER-172 system. Materialy po MO (Materials on Software). Leningrad, 1980, 64 pages. USSR Academy of Sciences, Leningrad Scientific Research Computer Center. Bibliography: 1 item.

The article describes a complex of programs UNIPLOT (UNIversal PLOTting software) for information output in graphic form on any of the devices. The complex consists of two functionally independent parts: a library of graphic programs and a post-processor UNIPOST. Examples of programs are presented.

4675. Consideration of correlations of values of standard source characteristics in gamma-spectrometer calibration. Volkov, N. G., and Churakov, A. K. EKSPERIMENTAL'NYYE METODY YADERNOY FIZIKI, MIFI, 1980, No 6. Apparatus and methods for investigating the space-energy distributions of flows of charged particles and quanta, and also the nuclear physical characteristics of radionuclides and mechanisms of their transfer in various media, pp 76-81. Bibliography: 3 items.

Analysis of the influence of correlations of calibration line energies on error in energy determination by means of numerical experiment in which the parameters of detectors and other characteristics selected were close to real observed values. All the computations were made on a CDC-6500 computer.

4677. Method of solving one class of parabolic equations on a system of piecewise-uniform rods and its realization for tasks of control on hybrid computers. Kenig, K. E., and Korostelev, A. P. AVTOMATIKA I TELEMEKHANIKA, 1980, No 5, pp 180-187. Bibliography: 4 items.

The time required for solving a parabolic task on a system of 100 rods in 24 hours of real time amounted to 10.5 minutes on the GVS-100, and solution of the task by running on an ICL-4/70 computer took 110 minutes.

4678. Protsedura izmereniya snymkov s puzyr'kovoy kamery VEVS n avtomate MELAS (Procedure for measuring photographs from a VEVS bubble chamger on a MELAS automatic machine). Berezhnoy, V. A., Zhigunov, V. L., Kryutchenko, Ye. V., et al. Serpukhov, 1980, 18 pages. Institute of High-Energy Physics, OMVT [expansion unknown] Preprint No 80-98. Bibliography: 4 items.

The article describes the structure of the ICL computer measurement program, algorithms for automatic tracking and the role of the operator for photograph measurements.

4679. Histogramming system for ICL-1906. Belokopytov, Yu. A., Kaminskiy, S. V., Klemenko, S. V., et al. PROGRAMMIROVANIYE, 1980, No 1, pp 82-91. Bibliography: 5 items.

The article describes the software of histogramming, the basic element of statistical data analysis.

4686. Interactive procedure for modifying the shape of a curve. Ablameyko, S. V., and Vasil'yev, V. P. Avtomatizatsiya proyektirovaniya tekhnologicheskikh protsessov (Automation of the Planning of Technological Processes). Scientific-Technical Collection. Belorussian SSR Academy of Sciences, Institute of Technical Cybernetics, 1980, No 1, pp 32-35. Bibliography: 2 items.

4687. Avtomatizirovannaya sistema obrabotki snimkov RTFAS. Programmnoye obespecheniye podsistemy lokal'nogo upravleniya proyektorom (RTFAS automated photograph processing system. Local projector control subsystem software). Yurpalov, V. D. Serpukhov, 1980, 17 pages. IFVE Preprint No 80-93. Bibliography: 8 items.

The article describes the software of the subsystem for inspection and measuring projectors, its realization for projectors with a variable equipment composition, the functional scheme of projector servodrives, the requirements for the real-time system of the PDP-8 minicomputer. The volume of the RTS-8 monitor is 5 x 128 12-bit words. The response time to interruption is less than 150 microseconds.

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ACADEMICIAN SAMARSKIY DISCUSSES COMPUTATIONAL EXPERIMENT

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, Mar 81 pp 61-64

[Interview with Academician A. A. Samarskiy; interviewer, date and place not given]

[Excerpt] [Question] What are the methods of introducing such an effective instrument of investigations as a computer program (All-Union Fund of Algorithms and Programs and the package system)?

[Answer] First I will talk about the All-Union Program Fund. There is no doubt that the centralization and accumulation of program material--the working instrument of computational experiment--are useful. It is essential that programs appearing in such a fund (in particular, it exists in the USSR Academy of Sciences computer center) are accompanied by a definite All-Union State Standard for detailed documentation, which is equated with publication. These documents permit the researcher to find and use the program he needs.

Another form of dissemination of contemporary methods of investigating complex physical and technical tasks is presented by the introduction of problem-oriented packages of applied programs. Such packages are intended for the solution of a certain class of tasks (for example, tasks of unidimensional magnetohydrodynamics with thermal conductivity). The packages consist of a system part (a group of programs assuring interaction with the package) and a functional part containing program modules from which the system part compiles the version of the program required for the solution of applied problems and assures triggering of the task on the computer for computation. In that case analysis of the internal arrangement of the program and characteristics of the procedure is not required of the user of the package. Such a working style eliminates unnecessary duplication, when in several organizations large groups of associates are engaged in the invention of variants of the numerical solution of a given problem and the creation of corresponding programs. In that case different and, as a rule, better procedures are used in the programs. The transfer to those organizations of a specialized package created by highly qualified specialists not only permits avoiding harmful scattering of forces but also assures a high level of computational work.

I will add that a package can be equipped with an information service working in an interactive mode and making it possible to clarify which version the user needs. I will note that various physical, mechanical, chemical, biological and other phenomena permit similar mathematical descriptions. Consequently, the methods and packages of applied programs developed for one problem can be used to solve many other problems.

The "reduction" of complex procedures and programs to a state suitable for use in a package is a difficult task. Obviously that work should be additionally stimulated.

The connection of the package developers with the All-Union Fund of Algorithms and Programs, in my view, must consist in exchange of information: through the fund the interested organization (the user) finds the organization which created the package.

It should be noted that a large portion of the programs transferred to the fund remains unknown to a broad circle of users and proves to be "buried" in the archives. On the other hand, various programs written for a special particular case can be suitable as a program module in the compilation of a complex of programs intended for the solution of a complex multivariant task. However, to join programs written in a different manner and for different reasons sometimes is completely impossible for a user with average qualifications. That programs are not well known and have low adaptability toward work in a large complex are at least two reasons for expensive duplication and rewriting of programs.

Specialized packages transmitted by authors to users do not, in any case, have the second shortcoming (difficulty in use) of the program fund.

The creation of new packages can contribute to the dissemination of little-known fund programs. The total of fund programs must be regarded by system programmers as material for the development of specialized packages covering a given subject area. The creation of a scientific information journal on programs and algorithms can contribute to increase of the working effectiveness of the Fund of Programs and Algorithms. Such a journal is quite necessary.

[Question] What requirements are presented for specialists in computational physcs and how is their training carried out? Is it required in modifications?

[Answer] It should be said at once: the requirements are high.

A specialist in computational physics ought to combine knowledge of physics with exceptional theoretical preparation in differential equations of mathematical physics. Such a specialist knows how to indicate the range of applicability of physical approximation, study the properties of a mathematical model, select (or develop) the necessary numerical algorithm, rapidly write a program (module) which will occupy its own place in the package of applied programs and in a qualified manner conduct computations and an analysis of the results of computations.

Specialists who can be used in the area of computational physics (unfortunately, there are very few of them) are prepared by VUZ's with a physical profile, for example, the Moscow Physicotechnical Institute, the Physics Faculty of Moscow State University and the Moscow Engineering Physics Institute, and specialists with high qualification are also trained by the Faculty of Computational Mathematics and Cybernetics of Moscow State University. The further formation of qualification will depend to a great extent on the diploma work supervisor.

It seems to me that the working practice in a large collective of specialists studying within the framework of computational experiment the development of an urgent and vitally important problem must enter the process of training computational physicists. Undergraduate and graduate students could participate in that work as the developers of various aspects of the given problem, for example, as the authors of some modules of a package system or units of a complex computer program.

Finally, in the development and conducting of a large-scale computational experiment there is a division of labor and the cooperation of specialists with a narrow profile (in mathematical physics, numerical methods and programming). However, the work is supervised, as a rule, by a specialist in computational physics.

It is already clear now that not one large-scale problem of physics and technology can be solved without using numerical methods, without applying computational experiment. Therefore the need for specialists in computational physics (perhaps not always realized) is very great and is steadily growing, and the higher schools are not turning out enough of them.

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INTERACTIVE SYSTEM FOR BESM-6 TYPE COMPUTERS

Vilnius PROGRAMMIROVANIYE EVM: STRUKTURY DANNYKH I PROGRAMMNOYE OBESPECHENIYE INFORMATSIONNYKH I DIALOGOVYKH SISTEM in Russian No 4, 1980 pp 119-129

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[Excerpts] The basic interactive system of the Moscow State University Collective Use Computer System [sistema kollektivnogo pol'zovaniya EVM--SKP EVM], developed at the Faculty of Computers and Cybernetics of Moscow State University, is described in the article. The requirements are presented for a general-purpose interactive system, the main possibilities of the KRAB system are examined and some estimates of the delay time are given.

At the scientific research computer center of Moscow State University the KRAB general purpose interactive system has been developed for computers of the BESM-6 type within the framework of the Moscow State University collective-use computer system (SKP EVM MGU). With it one can create files, edit them, formulate tasks on the operating system input buffer and control them.

The prototype of the system was the KOP MGU [expansion unknown] [12,], which in turn was a modifiction of the KOP system. The KRAB system is the SKP EVM MGU basic general-purpose system and has been used at Moscow State University since October 1978.

1. Requirements for the SKP EVM MGU interaction system. In creating the design of the basic SKP EVM MGU interaction system a number of requirements were advanced which that system must satisfy. They include:

1.1. The system must assure the possibility of examining a listing of the problem to be solved on a display screen at once after the task is completed (direct interception mode), or after some time (post-interception mode). The user at his discretion can open the intercepted listing on a central BESM alphanumeric printer and/or a VT-343 alphanumeric printer connected to the display, or discontinues printing altogether.

1.2. The system ought to have a developed budget and statistical service, the purpose of which is to regulate the flow of orders from users and assemble the statistics on their work. The budget service must assure computation of the following parameters:

--the user's space in the general archives;
--the combination of proghibited directives;
--the quantity of generalized resources, that is, the units of some abstract payment for services which the system makes available.

1.3. The system must be extremely simple to operate for both the user and the administrator. But at the same time it must offer fairly wide possibilities of editing work from the files and the formulation of tasks.

1.4. In the system provision must be made for apparatus to protect the files against computer failures. In that case all the editings of files made by the user before the failure must be preserved.

1.5. The system must permit simultaneous work of at least 16 terminals in a shared-time mode, assuring an average reaction time in the range of 0.5-2 seconds.

1.6. The user must be provided the possibility of combining the working processes within the framework of the system and of recordng tasks in a mode of listing interception.

1.7. The maximum number of users in the system must be at least 2000 persons. When there is such a quantity many functions of the administrator must be transferred to other persons, for example, section administrators. In other words, a hierarchic structure of users of the system must be assured.

1.8. The system must assure an output to any interactive systems and interactive complexes of programs.

2. KRAB system components. Starting from point 1 the Krab system was created, consisting of a certain set of programs working in a mathematical mode under control of the DISPAK operating system [3].

The system nucleus is the subscriber monitor, intended for editing files, the formulation of tasks into packages of operating systems and the calling of subsystems.

The DIST program serves for examining the listing of a user's taks on a display screen and its listing in the KRAB system archives.

The budget and statistical subsystem serves for distribution of the budget and the processing of statistics on work of users within the framework of the KRAB system.

The SERVIS subsystem is intended for work with continuation of user archives on personal magnetic carriers (tapes and discs).

In the KRAB system there are a number of service tasks (the SLZAD program):

--duplication of the general archive;
--a system generator;
--opening up of archive catalogues;
--restoration of catalogues.

These programs are in the main intended for system programmers servicng the KRAB system, and for administrators of the system and sections.

The KRAB system provides the possibility of work with terminal tasks in the "subsystem" mode, which is very convenient for users who in the course of a single session utilize communications with the computers of several different interactive systems. Especially close connections are made with the service interactive system DZhIN [expansion unknown], developed in the Institute of Precision Mechanics and Computer Engineering of the USSR Academy of Sciences.

3. Work with the KRAB system. Work with the system is done in the name of the subscriber-terminal, a display, teletype or CONSUL typewriter, and is done by means of directives that can be set up on the panel of the terminal. KRAB system directives have the following form:

<directive> :: [<directive sign>] <directive identifier> <parameters>

The component enclosed in brackets can be absent. Each directive or other communication must end with the symbol "ETX". After the directive has been set up the system either performs the directive or requests additional information about it, namely, the file password, the editing task, the user's number, etc, and after obtaining that information performs the directive.

The user's work with the system starts with the subscriber monitor, who is called by key in terms of the DISPAK operating system. After connection of the terminal to the monitor the user must report his number (a digit in terms of the DISPAK operating system). If the user presses the kwy of the corresponding number, it is admitted to work with the system at the given number. In that case the user is permitted to formulate tasks and perform actions on it under the digit with which it entered the system. The statistical service registers the input time and the number of the machine and terminal.

Emergence from the system can occur for the following reasons:

--the user gave the directive for end of the work;
--a break in communications occurred;
--the user exhausted his resources;
--the machine or system failed.

During emergence from the system into the statistics the time of emergence and the quantities of formulated tasks and resources expended are recorded.

Instructions regarding the KRAB system are stored in the general archives so that each user can examine them on a display screen and copy them on an alphanumeric printer.

KRAB system programs can be adjusted to a different configuration, namely: the location of archives, the presence of standard subsystems and the presence of certain computer hardware. That work is done by the administration of the system in an interactive mode by means of the GENERATOR program.

4. The subscriber monitor. The subscriber monitor is intended for file editing, the formulation of tasks into DISPAK operating system packages and their control.

4.1. Work with an archive and editing. To preserve textual information, in the KRAB system a general archive is used, and so-called failure zones, situated on a magnetic disk. Failure zones are intended for the arrangement of a file previously rewritten from the archive in the process of editing. The work of each editing directive concludes with recording of the file from the main memory on the failure zone. In that case:

--the original file is preserved in the archive (in the case of an erroneous editing directive the file can again be read from the archive);
--during computer failure all editons of the user remain on failure zones;
--there is smaller probability of file damage as a result of machine failure leading to underrecording of a certain part of the file in the archive.

It should be noted that KRAB system users have a treelike hierarchy of three levels. In other words, a user standing on a high level of the "hierarchic ladder" has access to the files of those "subordinate" to him.

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APPLICATIONS

SOVIET ASU EXPERIENCE

Kiev VITCHYZNA in Ukrainian No 3, Mar 81 pp 160-166

[Article by V. M. Glushkov, academician, hero of socialist labor]

[Text] Time has suggested the theme of this issue. The time of the 26th CPSU Congress, the events and scales of which have already entered history in an authoritative manner. The time of the Eleventh Five-Year Plan, which we, the scientists, and also all the Soviet people, connect with a great many cherished events and plans, to the successful accomplishment of which we generously give our forces, faculties and abilities.

For the first time our cybernetic demands for a full voice resounded at the end of the 1970's in the draft of directives of the 26th Party Congress. This resulted from the growing difficulties in managing the national economy, on the one hand, and certain experience in overcoming them by means of automation, on the other.

What does this experience consist of? There already was a computer center in the USSR Academy of Sciences before the mid-1950's. In 1955 it was decided to create similar centers in a number of republic academies so that a wide circle of institutions could utilize their services. In 2 years a computer center was formed in Kiev on the basis of the computer technology laboratory of the Institute of Mathematics of the UkSSR Academy of Sciences. A year later the computer center began serious work on the organization of technological processes on the basis of electronic computers. From the time of issuance in 1961 in Kiev of our country's first control machine, the "Dnepr-1," digital automated systems for control of technological processes date their family tree.

And the idea of creating shared multicomputer centers for the solution of tasks in economic planning, advanced in 1962 by Academician V. S. Nemchynov and a group of his pupils, served, in my opinion, as the first real impetus to use electronic computers in the control of economic facilities and in economic simulation.

In the same year I was asked to prepare a national program of the Soviet Union in the area of use of computers for the automation of management in the economy. A special commission then reviewed the proposed rough draft. Proposals were then prepared regarding the creation of automated systems for the management of large enterprises and the organization of multiple-user computing and data processing centers for small facilities. The concept also arose of state networks of communication channels to connect computer centers. These ideas and proposals were later included in real plans and projects. In 1963-1964 computer centers began to be formed in the USSR Gosplan and union republic gosplans and in a number of ministries.

In 1967 we started the first unit of an integrated enterprise management system (in which all the documentation of the facility where the ASU has been installed passes through the computer). It was developed at the L'vov Television Plant, rapidly received recognition and was "mass-produced" in the group of the machinery-building brance. The same systems were organized at the Moscow "Frezer" Plant and the Leningrad Optico-Mechanics Association, and preparatory work was started at the Minsk Tractor Plant, etc.

These were separate and small islets in an ocean of manual ("paper") technology for the formation of information connections, centers of automation of organizational and economic control in our country. That is, they gave initiative to successful practice in the use of computer hardware in the matter of planning and management on the enterprise level. Also of use was experience in the methods of planning and management in construction and some other sectors. All this also suggested the certainty that in the correct development of this direction and in the presence of a perfected structure of the economic mechanism as a whole the ASU becomes that very basic link, thanks to which the entire chain of effective management of the economy is successfully obtained.

And the technology itself impels searches for management systems corresponding to its possibilities. This was felt even before the 24th Party Congress, and the historic statement appeared in its directives: "Create a general state system of information gathering and processing for the computation, planning and management of the national economy on the basis of a state network of computer centers and a unified automated communications network of the country. In that case assure from the very start implementation of the principles of organizational, methodological and technical unity of this system."

In the development of decisions of the congress new and rather considerable contributions were made. Thus the task of developing and introducing ASU into production has grown considerably. Serious disruptions have also occurred in the training of personnel. A number of faculties and specialties in applied computational mathematics and cybernetics have been opened in vuz's of the country. Such faculties have already been functioning at Kiev and Novosibirsk universities. An offensive began to be developed over the entire front. Such an offensive has grown considerably, although the inertia of the old period still makes itself felt. On the one hand, a great hunger for personnel was experienced, but the essence of the matter and its importance were not understood by many traditional economists, the practical ones in particular, and on the other, a rather curious phenomenon developed. Since the ASU problem was raised to a fairly high level, for many managers it became fashionable to have computer hardware at their enterprises or institutes. Often instead of thinking deeply and creating a really effective system they hurried to purchase computers and other devices and put them into production. And when it turned out that even the computer did not solve difficult production problems, complaints were heard and some even began to refuse them.

Strange, but a fact. Although we anticipated complexity in the organization and operation of new technology. To change a computer into an ASU it is necessary to create and build in a data bank or an informational model of the enterprise, sector or other object it is desired to control or manage. This model (data system) has to be reconstructed and renewed constantly and in time. When, for example, some units, parts or tools have been found at a plant warehouse or, on the contrary, they are no longer there, the computer ought to investigate that at once and not when a deficiency for some reason starts to harm the shops. It will not be able to save time in the calculation of wages, when appropriate information has not been obtained promptly regarding the closing of each unit. Without a data bank, without a memory, an electronic computer is just a gold adding-machine, no more. To provide such a memory for the "L'vov" system of the L'vov "Elektron" Association we were forced to re-write the entire system of that clock enterprise and put it in the computer. Even during abridged coding this established over a billion positions. Many more than control of a space vehicle requires.

And this is far from all. It is necessary to breathe life into information gathering or with our language organize automated form flow. This means that various publishing houses, units, etc, should be replaced so that the machine receives them without translator-programmers because, as a rule, they lead to considerable expenditures of time and additional errors. Our Institute of Cybernetics has studied the use of form flow for computers for over 4 years with all its forces.

It must be noted that this process is complicated by the fact that some documents have been approved by the USSR Ministry of Finances and it not a simple matter to change them completely. Some of them we also have not successfully modified.

In the year the "L'vov" ASU was started the increase of production in the association was 12 percent, whereas earlier it had not exceeded 4-5 percent. The additional 7 percent of increase, the L'vov workers themselves think, was obtained through internal resources, and primarily through the elimination of working time. This occurred because data were continuously fed into the computer from five warehouses, 40 conveyors and other sensors from each working place.

Quality control was arranged so that in the absence of an automatic sensor the worker has before him a television screen and a special metal writing-pad with 16 apertures and a special card. Setting up the card, he looks at the television set and strikes one of the openings with a punch. Nothing has to be recorded, the signal has already been put in the computer. Theworker has a small panel and tumblers. He knows that during interruptions in the supply of electric power it is necessary to switch the eighth tumbler, and when the instrument fails, another. And he does not run, he does not seek it, does not dispute it. Thanks to synchronization of the activity of various services and the efficiency of individual workers, downtime also was reduced.

Unfortunately, the main part of expenditures of working time, on account of interruptions in supplies, remained the same. We encountered a paradox: the information conveyor in the ASU is designed for precision in minutes, but deliveries of materials and equipment, as earlier, are planned with a precision of 3-4 months. Though the many plusses which electronics gives the enterprise, mobilizing its reserves, are lost through inferior external couplings.

I would like to emphasize still another complication in ASU introduction. We succeeded rather well in automating the control activity of the Kiev transport offices. Electronics took upon itself the solution of planning tasks, the idle running of machines was sharply curtailed and other indicators were improved. But we did not succeed in achieving the effect, for the introduction of unified form flow proved to be beyond our capabilities. Strictly speaking, it was developed, but informational problems stood in the way of introduction.

The fact is that the Kiev transport workers deliver freight of enterprises of all the ministries of four republics--Russia, the Ukraine, Belorussia and Moldavia. For the successful work of the ASU of the transport office it is necessary to have a single computation form with all the freight receipts and dispatches, but to reduce it to computer series on the scales of a single transport enterprise is impossible. A local problem grows at once into a nationwide problem, and therefore has to be solved on a corresponding level.

There also were complicating factors in the ASU distribution. Firstly, because of a shortage of personnel. During the course of the Five-Year Plan, with very great efforts (we calculated this together with the USSR Ministry of Higher and Secondary Specialized Education) the number of qualified ASU workers only doubled. Why not more? We could have expanded this institute and faculty, but there have not been enough qualified instructors. And it would take years to train them.

The party organizations helped us, especially the CPSU Central Committee. Retraining of personnel was widely organized and the Institute of Management of the National Economy, at which managers have begun to be retrained, was founded. And that is how it is at all other institutions. However, the shortage of qualified instructors has greatly stimulated the training of personnel in ASU operation.

Another complicating factor was that decisions were not made in time regarding the transition to third-generation hardware and the introduction of new technology was delayed. For example, we obtained YeS computers only after the end of the Ninth Five-Year Plan, whereas they were to be obtained earlier according to the plan.

A third complicating factor is the organizational. The fact is that the expanded program of ASU introduction can be successfully controlled by means of a transition to a new technical policy, namely a policy of standard planning solutions. Thus, for example, these have been introduced into construction. For the first time, standard designs of buildings are made, then are rapidly linked with a specific locality and constructed.

In the group of sectors in which we work the transition to standard ASU was already accomplished in 1967-1968, and this gave an exceptional effect. In particular, in the USSR Ministry of Machine Building the labor productivity of planners was 3.5-4 times as large. This was a result of standardization of ASU plans.

Unfortunately, such an effect was successfully achieved only in individual sectors. In most cases, instead of ASU, pseudo-ASU were created which, except perhaps the name, provided nothing automating the national economy. And then in the course of the Ninth Five-Year Plan certain improvements in the organization of control in a new way were successfully achieved, and initial experience accumulated, which is the main thing. Far from all of it was positive, but in science negative experience is also experience, for it warns which path should not be pursued.

That's how it was, and the first assault position was taken. With more efforts than were contemplated and with considerable expenditures, but the products were perceptible and promising.

The ASU's had to take a second assault position in the Tenth Five-Year Plan. It was already on a qualitative, and not a quantitative level (although the number of control systems had to more than double). "Assure the further development and increase of effectiveness of automatic control systems and computer centers..," it was emphasized in "Main Directions." And there were all the grounds for that. Then, as in the previous Five-Year Plan, institutes and computer centers were only being created, the just assembled cadres had no real experience and at the start of the Tenth there already were the necessary skills and fairly fruitful systems appeared which began to save the state many hundreds of millions of rubles. In particular, these are the ASU's of the Ministry of Instrument-Making and Means of Automation and a number of machine-building ministries.

In general this made it possible to cope with the task in the Tenth Five-Year Plan as regards repayment of the costs invested in automation, but we could not be completely satisfied with that result. The main fault here lies in the fact that the ASU's are developed to a considerable degree in a different variety of improvement of the economic mechanism, and that this has to be accomplished in a close interaction and according to a single plan. And it is important for them to come to understand the order of precedence. Each installs its own ASU and hardware. All as it were, is well, I go in the first line of the NTR [expansion unknown]. And they do too.

Suppose I am a minister or director and you are in an analogous rank, I am your supplier and you are my consumer. You want me for some reason to write to you, but I do not at all want to complicate life for myself and I limit myself to a formal answer or expressively shrug my shoulders, as if to say, one would be glad, but unfortunately... And when I would like, without the possibility of making independent decisions, to have my computer center compute all the pros and cons regarding your proposals and present those data to me. And you have the same exhaustive data before you. Wouldn't that help us to more quickly come to understand and arrive at a solution mutually advantageous for our sectors or enterprises (and for the state itself)?

That someone could become the Minister of Information. He could not only provide the solution of numerous interdepartmental problems, but also contribute considerably to the further growth of the technology and economic potential of the country.

Therefore today the main task consists in, together with the further development of ASU's in breadth, the improvement of means of information, the automation of productive processes and the nonproductive sphere, the planning of science and other important aspects assigned unprecedented importance in "Main directions of economic and social development of the USSR in 1981-1985 and in the period up to 1990," without losing the basic reference point--the creation in the future of a statewide automated system for collection and processing of information for the computation, planning and control of the national economy.

In the Eleventh Five-Year Plan we must take perhaps the most complicated third assault position. In the first place, this means that we should work with full force on the further improvement of computer hardware, its elementary base and the software, methods and systems. This is accomplished in two directions. The first is the development of traditional lines which had their beginning in the Ninth and Tenth five-year plans. The second is the appearance of completely new tasks.

As regards traditional lines, this is mainly the development of YeS computers. Such machines of the first series were introduced in the Ninth Five-Year Plan, of the second series in the last and of the third in the present period. This is evolutionary development with continual improvement of the quality indicators, improvement of the technical and economic characteristics, etc, the final goal of which is optimum solution of tasks of ASU's and automation in the broadest sense of the word.

The second direction is the small computer system [SM], or minicomputer system. Work is now being done on the second generation of those machines.

In addition, very large computers, new in principle, are being designed, machines necessary for automation of the planning and solution of especially complicated tasks in the management of the economy on the macrolevel, the levels of the USSR Gosplan and the union republic gosplans. They are in part also a contribution of the Tenth Five-Year Plan. This includes our development of the "Yel'brus-1" and "Yel'brus-2." The latter computer performs up to 120 million operations per second. It is produced by the Moscow Institute of Precision Mechanics and Computer Technology imeni Lebedev. We are making for that system a so-called collective intelligent terminal which will serve as a unique translator from languages used by programmers of various classes into the languages of that very high-speed computer.

In the last year of the Tenth Five-Year Plan we also are developing our own line. By the end of 1982 the first macroconveyer computer, with a capacity of over 100 million operations per second is to consolidate its position. It will open up the possibilities of emerging at the end of the Eleventh Five-Year Plan in experimental sectors beyond a billion operations per second.

Another new direction is microelectronics, microcomputers. A child of the last Five-Year Plan, it also will find wide application in the Eleventh Five-Year Plan. What does it consist of? In "Main directions" there are references to the need to improve the elementary base. This means that the technology of large integrated circuit production created during the last two five-year plans, which made it possible to change to the construction of fourth-generation computers and microcomputers, requires improvement and above all automation. Jointly with the Ministry of the Electronics Industry we are also automating that old, traditional technology, bringing it to the contemporary level. Thanks to this the rejection percentage is reduced and the quality indicators of the systems are increased. Along with that a technology new in principle is being prepared, electronic lithography. Our institute is developing the automation for this. This novelty will serve to put microelectronics on a level new in principle in the Eleventh Five-Year Plan. Thus, shall we say, if the microcomputer is formed at once of several (up to 10 circuits) according to the new technology, it will be possible to contain the entire computer in a single circuit with a volume of 1 cm^2. This is achieved because the circuit is not produced photographically but applied on a plate by electron exchange.

Thanks to this new direction energy consumption will be reduced in the future and computer costs will be reduced, which is very important. The mass production cost of microcomputers made with the new technology is not more than several hundred rubles, which makes the automation of relatively small processes advantageous. If the cost of a minicomputer reaches 100,000 rubles and an average computer 500,000 to a million rubles, then it is understandable that they can be used only for the automation of especially valuable objects--rolling mills, slab mills, etc. And if their price drops to the expected several hundred rubles, it becomes possible to automate even motor-vehicle engines and many other things.

Provisions are also made for the wide use of microcomputers built into automated systems for the control of technological processes. They will also appear in television sets, telephones, washing machines and other household equipment.

In "Main directions" the task is set of "expanding the automation of planning and designing and scientific research work with the use of electronic computer technology." For the first time in our country planning and design tasks were solved by means of automation on the first Soviet computer, the "Kiev," in 1951. Today no important aircraft, ship or engine building design office can dispense with the computer. And now questions are being raised not only regarding the expansion of automation but also regarding putting it on a new qualitative basis. Today people make sketches for a purpose. But in an automated design system only suggestions remain for it; this arrangement is not suitable, that is transferred here, that there, rooms are laid out better here... But the computer makes all the computations and drawings and prints all the necessary documents. After such complex automation the labor productivity, depending on the type of design work, increases by several times, and in one case I know of it achieved a 25-fold growth. In that case the quality of plans improved considerably and the possibility of errors was completely eliminated. That acceleration of planning is simultaneously acceleration of scientific and technological progress, it seems, is self-evident.

Thus the task of increasing the labor productivity of scientists is the most serious task facing us. But it did not come upon us suddenly. In December of last year an act was signed relating to the acceptance of a new automated laboratory in the Institute of Power Problems of the UkSSR Academy of Sciences. Machines make all the measurements in it. Depending on the experiment the labor productivity of a scientific worker increases by from 2 to 3 times in simple cases to several thousand times in complicated cases. During the time of a few investigations it grew by 5000-6000 times.

This is the first but not the last aspect in the matter of the automation of research.

Automated control systems using microprocessors and microcomputers envisaged by "Main directions" are obtaining further use in medicine. If, shall we say, a blood luminescence analyzer can make from two to four measurements per day (and this is a very important diagnostic means in the early stages of oncological diseases), then in a pair with the microcomputer it gives an analysis in one or two minutes. This device alone costs from 10,000 to 15,000 rubles. How many would be needed to provide for all the polyclinics? And with the new method in a single tandem with a computer and a spectrometer, diagnostic measurements can be made for an entire city.

Already today by means of a computer combined with an ultrasonic locator it is possible to observe on a display screen palpitation of the heart much better than on an X-ray photograph, and even determine its volume, rhythm, etc. If one has X-ray apparatus with a mobile head and separates the effects of X-raying on a computer, one can obtain contrast images of internal organs, which is very important for the diagnosis of diseases.

The development of manipulators and the creation of automated shops and plants also represent special tasks of the present Five-Year Plan. In this direction, firstly, the production and use of first-generation robots will be expanded--robots having no sensory organs but only working organs of the type of a simplified human hand. They can replace parts and accomplish transport loading, elementary warehousing and other operations. Secondly, the volume of their use is increasing sharply.

The latter, like the development of all computer technology in general, depends to a great degree on the programming. It has become a critical aspect of this development, it can be said. Thus, whereas earlier in first-generation computers the hardware cost 95 percent and the programs 5 percent, now the cost of programs exceeds 50, and at times reaches 70 percent of the cost of the system. In order to transfer programming for a broad class of tasks from the rails of the art and set it on industrial rails, new subscribers to this technology are needed. We are developing the so-called R-technology of programming, which makes it possible to increase programmer labor productivity by 10-15 times. It is already starting to be introduced. Consequently, it is again a matter of maximum use of machines and generally industrial organization of work, of its distribution among individual programmers, the creation of production lines for the manufacture of program product, where on the input are the tasks and on the output is the finished documentation, debugged programs, etc.

Those are unusually important for robots. More precisely, for their operation. If it is possible to rapidly and easily reprogram them, then it is effectively rearranged for the output of new production.

Also especially important is the development of peripherals. In particular, various sensors for ASU's for technological processes, special cash registers for trade, the automation of savings banks, etc. Almost no scientific problems remain in this sector; they were completely solved in the last Five-Year Plan. It remains to turn attention to this matter.

Some may say that the dash register is also a problem for them. And there is such a problem, not a small one, one of statewide importance. Our cash registers now used in commerce record only the sum of money paid for goods and do not record what was purchased. Therefore there actually is no material record of sales. Certain data on supply and demand become known only after inventories are taken at the end of the year. In practice, March of the following year is more likely. At that time the annual tasks have already been turned in and it is too late to introduce corrections. That is, in the system of observation of supply there is a two-year delay built into the technological information cycle itself.

Modern automated cash registers can "read" the register number of a sold commodity by means of a photoelement, and its cost is also recorded in the machine. Thus the financial computation system is not basic for them, but auxiliary. The main thing is the registration of what and how many are sold. This makes it possible to take inventory with lightning speed at any hour, without awaiting the end of the year. And, self-evidently, to watch the competition and the demand, to react in time to the fluctuations of the arrow of a market barometer. Enterprises also acquire the possibility of being reconstructed with the output of goods sooner than old goods began to be created. Well, perhaps it is not worth while to especially record what is an important distinct bilateral connection of trade with production. I will only say that both the state and each one of us will end up a winner in this.

In the Eleventh Five-Year Plan further development of shared multicomputer center networks and further increase of the effectiveness of the ASU for the organizational plan are also provided for. What resources do we have there? First for all ASU's is automation of the form flow, that is, the transition to peperless forms of control. Organizational control is now accomplished as follows: a computer center with some auxiliary personnel is separated from production. Data on slips of paper arrive from production (norms, information about receipts, computations, etc), and have to be translated by people into the machine language. This increases the cost of operations, the possibility of errors and the delay or reaction time of the system. Therefore methods have been developed which make it possible to monitor the activity of the technologist, the warehouseman, etc, with lightning speed, note bottlenecks at the place of production and, using the entire power of the machine, "undo" them. In this way the effectiveness of production control and of the ASU increase sharply, and expenditures are reduced.

A no less important task is integration of automated control systems. Whereas earlier ASU's for technological processes were developed separately, and organizational control separately, and it was the same with systems of measurement and planning, then the process of their combination, integration and horizontal and vertical integration is constructed at once. Vertical integration, where bilateral connections are undertaken with associations, the sector and the Gosplan for automatic data transmission and interactions in computer networks. Horizontal integration is connection along the line of movement of material flows. This means that the director of an enterprise or a manager of something of a different rank can effectively through his computer center make contact with the computer center of his supplier or the user and acquaint them with all the nuances of their interrelations without sending "reminders," telegrams, etc.

To what extent is this important? Only for computations putting the delivery schedules in order in sectors of the national economy is it possible to double the ultimate labor productivity. Only the elimination of expenditures on the boundaries between the administrative and technological links is capable of assuring a tenfold increase of the output of end product (expressed in costs) from a cubic meter of wood, and also without a final boundary.

There is no doubt that "intelligent machines" which have caused a revolution in science have led to radical changes in the economy and production and in total capacity to exert oneself also on implementation of immense plans of the Eleventh Five-Year Plan and will help the Soviet people to take a new assault position on the way to construction of a communist society in our country.

2174
CSO: 1811/41

UDC 620.178.53

TEST SYSTEM TEST RESULTS

Kiev DISKRETNYYE SISTEMY UPRAVLENIYA in Russian 1980 (signed to press 26 Jun 80) pp 3-7

[Article by S. V. Abramovich, P. I. Dekhtyarenko, V. A. Klimachtov, V. V. Kokhanyy, Yu. V. Krementulo, O. P. Paliy, S. R. Raykhman, V. V. Skoriy and P. F. Tsizh]

[Excerpt] The article presents the results of tests of an automated system for the reproduction of TEST nonstationary vibroprocessors developed by the Institute of Cybernetics, the Institute of Electrodynamics and the experimental plant of the Institute of Physics and Mechanics, all of the Ukrainian SSR Academy of Sciences.

The use of known systems [1] to solve the task of reproducing nonstationary processes does not appear to be possible, since they are intended to control the statistical characteristics of random processes and by virtue of that have a low operating speed.

The TEST system [2,3] consists of a 15-channel hybrid automated control system intended for reproduction at a given point of a polygraphic article (with amplitudes of the harmonics variable in time according to certain laws) or a specially formed random test vibroprocess, with power equivalent to full-scale in distribution, averaged in a small time interval by spectrum and in time. The system can function in both a mode of control and a mode of analysis, assuring in the latter case preprocessing of a full-scale vibroprocess.

The system includes:
-- a digital part: a programming unit and a data input-output unit;
-- an analog part: a master generator unit, a regulator unit and an analyzer unit.

The purpose of the tests is to verify the technical characteristics of various units and systems as a whole.

Principal Technical Characteristics

1. Duration of reproducible processes	2-1000 s
2. Number of test signal harmonic components	15
3. Pitch of frequency	25 or 50 Hz
4. Frequency range	50-4950 or 25-2475 Hz

5. Maximum level of accelerations g (at an accelerometer sensitivity of 10 mV/g) — 100 g

6. Harmonic component parameters:

-- minimum voltage	2 V
-- noise level	2 mV
-- error in frequency	less than 0.05 Hz
-- instability in frequency	less than 0.1 percent

7. Signal parameters on master generator output:

-- maximum voltage of summary signal	11 V
-- coefficient of nonlinear distortions of a harmonic component	less than 2 percent
-- noise level	less than 12 mV

8. Depth of amplitude modulation of harmonic components — 0-100 percent

9. Dynamic range of regulators of regulator unit — more than 40 dB

10. Analyzer unit parameters:

a) during narrow-band analysis

--filter pass band	5 Hz
--attenuation on axial channel	more than 26 dB
--nonlinearity of amplitude characteristics	less than 4 percent
--precision of spectrum analysis	5 percent

b) during three-octave analysis

--central filter frequencies	75, 100, 125, 150, 200, 250, 325, 400, 500, 626, 800, 1000, 1250, 1600, 2000 Hz
--attenuation on adjacent channel	more than 15 dB
--nonlinearity of amplitude characteristics	less than 4 percent
--precision of spectrum analysis	7 percent

c) averaging devices

--time constants of averaging (second degree)	$0.5 \cdot 10^{-3}$ to 5 s
--mean error of time constants	less than 15 percent
--nonlinearity of amplitude characteristics	less than 2 percent
--irregularity of amplitude-frequency characteristic in range of 60 Hz to 100 kHz	less than 3 percent

11. Program unit and data input-output unit parameters

a) program parameters:

--quantized program (task) interval in time	5, 10, ..., 10,000 ms
--maximum number of quantized program intervals in time	127
--program quantization step by level	0.1 V
--maximum number of program quantization steps by level	127

b) principal operations:

- --set and correlation of program with key input device
- --memory and storage both given (direct) and processed (reverse) system program
- --automatic output of direct and reverse information on punched cards and digital printing
- --automatic program input from punched tape
- --visual minotoring of direct and reverse information on alphanumeric display board and oscilloscope
- --monitoring, indication and signaling to detect typical errors in program selection, input and output

12. Precision of response of protection of articles against overloading:
    --with respect to acceleration 20 percent
    --with respect to output voltage of generator unit 20 percent

2174
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INVESTIGATION OF THE PRECISION OF WORK AND RESULTS OF TESTS OF SOFTWARE OF AN AUTOMATED SYSTEM FOR CONTROL OF VIBRATIONS

Kiev DISKRETNYYE SISTEMY UPRAVLENIYA in Russian 1980 (signed to press 26 Jun 80) pp 14-15, 22

[Article by I. F. Borisov, M. A. Gnatyuk, V. S. Konchak, B. Yu. Mandrovskiy-Sokolov, and M. I. Ryzhkov]

[Excerpts] An automated system for vibration control [avtomativirovannaya sistema upravleniya vibratsiyami--ASUV] performs the following principal operations [1]:

--generation of a vector random process with given characteristics;

--computation of elements of the spectral matrix of a vector random process;

--control of the spectral characteristics of a vector random process.

These tasks are solved by means of a single algorithmic base based on algorithms of rapid Fourier transforms (RFT) and inverse Fourier transforms (IRFT).

Included in the ASUV-3 software are [1]:

--a program of algorithms for rapid direct and inverse Fourier transforms (RFT and IRFT);

--a program for generation of three-dimensional vector stationary random processes with a controlled spectral matrix;

--a program of spectral analysis of a vector random process;

--a program for identifying the frequency characteristics of a multiply connected vibrator-article channel;

--a program for obtaining a mathematical model of a system for control of a three-dimensional process spectrum and search for zero approximation of controlling parameters;

--a program realizing an algorithm for iterative control;

--a dispatcher program which accomplishes execution of the above programs in a given sequence in various ASUV operating modes.

The ASUV-3 system has the following principal technical characteristics:

--working frequencies band	0.5 - 250 Hz
--pitch in frequency	0.5 Hz

--number of harmonics	$M = 512$
--length of the process	$T = 2$ s
--number of ordinates of discrete sequence	$N = 2048$
--quantization interval/step in time	$t = \frac{T}{N} = \frac{2}{2048}$ s
--range of allowable variation of spectrum task	up to 40 dB
--range of allowable variation of amplitude-frequency characteristic of the object	up to 20 dB
--number of ordinates of evaluated spectra	$L \geq 10$

Conducted tests have shown that in the working frequencies band of 0.5 - 250 Hz for an allowable irregularity of the frequency characteristic of an object of 20 dB and irregularity of the spectral task density of 40 dB, a depth of crosswise connections of up to 30 percent the ASUV-3 system assures a precision of spectrum generation and analysis of not worse than 10 percent and an error of spectrum reproduction in a control mode of not worse than 10 percent (after three iterations), which satisfies the technical requirements.

2174
CSO: 1863/166

DISCRETE CONTROL SYSTEMS

Kiev DISKRETNYYE SISTEMY UPRAVLENIYA in Russian 1980 (signed to press 26 Jun 80) p 69

[Table of contents from book "Discrete Control Systems", edited by L. V. Tverdova, Ukrainian SSR Academy of Sciences, Scientific Council for the Problem "Cybernetics" and Institute of Cybernetics, 450 copies, 72 pages]

[Text] CONTENTS Page

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DISTRIBUTION OF A CHARGE OVER THE SURFACE OF A CYLINDRICAL ELECTRODE OF FINITE LENGTH

---SBORNIK NAUCHNYKH TRUDOV CHELYABINSKOGO POLITEKHNICHESKOGO INSTITUTA in Russian No 224, 1979 pp 120-124

ZAYTSEVA, G. A.

[From REFERATIVNYY ZHURNAL: ELEKTROTEKHNIKA I ELEKTROENERGETIKA no 10, Oct 80 Abstract No 10A32]

[Text] The problem posed was solved in several steps. In the first step it was assumed that two cylindrical infinitely long electrodes are in an infinite homogeneous conducting medium. To the electrodes are supplied charges of different signs but equal in magnitude. The charge is uniformly distributed over the surface of the electrodes. Outside the electrodes the field is as though this charge were uniformly distributed along the axis of the electrodes. The assumption was made that under the influence of the field of the adjacent electrode the charge is redistributed over the surface of an electrode, remaining evenly distributed over its length. Outside the electrodes this redistribution is evidenced in displacement of the axis along which the charge is distributed relative to the axis of the electrodes, by a certain amount of s. The next step is to take into account the length of the electrodes. The potential at a distance of 0.5 mm from the surface of the electrodes was computed with a "Nairi-K" computer, for the purpose of verifying the distribution function gotten for the charge over the surface of the electrodes. It was demonstrated that the values of the potential, ϕ, computed for various points on the surface of the electrodes are close to unity. This provides a certain basis for stating that the method suggested makes it possible to find the distribution of a charge over the surface of a cylindrical electrode of finite length satisfying the requirement of equality of the potential on the surface of the electrode. This makes it possible with a sufficient degree of certainty to make calculations of all the electrical parameters of the system discussed, e. g., the capacitance (self- and relative), resistance, etc. 3 figures; 1 table.

8831
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UDC 025.4

RESULTS OF EFFORTS TO REGISTER CLASSIFIERS IN 1978-1980

Moscow KLASSIFIKATORY I DOKUMENTY in Russian No 4, Apr 81 pp 14-16

[Article by L. N. Pavlova and O. D. Poznanskaya, All-Union Scientific Research Institute of Technical Information, Classification, and Coding]

[Text] In 1976 the country created a unified system for registering classifiers for technical-economic information (all-union, intersector, sector, republic, and enterprise classifiers).

Classifiers are registered with the goal of upgrading the quality of republic and sector classifiers and enterprise classifiers (at the time of their registering, they are subjected to scientific-technical expert evaluation), to prevent redundancy in development of classifiers for the same types of information (unification of classifiers), and to make use of the developed classifiers possible. All of this is aimed at raising the efficiency with which data support to automatic control systems is planned, and at reducing unjustified expenditures associated with creating such systems.

The table below summarizes the classifiers that were registered in the years under consideration:

Classifier Category	1978	1979	1980	Total
All-union	89	9	7	105
Intersector	2	1	-	3
Sector	978	305	202	1485
Republic	82	34	20	136
Enterprise	1520	511	486	2517
Total:	2671	860	715	4246

Enterprise classifiers make up the numerically largest group. They have a number of significant shortcomings, insufficient unification within the limits of the sectors being the main one.

The quantity of republic classifiers is relatively small, which is connected with the use of all-union classifiers, or selections from them, in the union republics.

The figures for registration of internal classifiers in 1978-1980 show that the total number of classifiers registered in the sectors and republics decreased in 1980. This can be explained mainly by the fact that the bulk of the classifiers created in the 10th Five-Year Plan, and presently in effect, had already been registered.

An analysis of information on the internal classifiers that have been registered permitted combination of classifiers of different categories, in terms of their content, into the following basic groups of information types:

functional subsystems and tasks of automatic control systems;

technical-economic indicators;

characteristics of production and jobs;

organization of construction jobs;

types of jobs and services;

financing and bookkeeping;

standards and their amendments;

quality characteristics and causes of waste in article production;

causes of plan failures and idleness.

Most registered classifiers (especially the enterprise classifiers) contain information on financing and bookkeeping (for example on the types of payments and automatic deductions, outlays, bookkeeping accounts, financial estimation items, balance items, operations associated with money transfers).

The consequences of registration of different categories of classifiers in 1978-1980 by the State Committee for Standards and by ministries (departments) of the USSR and the union republics was that these classifiers could now be accounted for on a common basis, their quality could be checked, and the foundation for unifying, within each sector, classifiers for homogeneous kinds of information could be laid.

11004
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NEW TASKS OF INFORMATICS

Novosibirsk NOVYYE ZADACHI INFORMATIKI in Russian 1979 pp 4-5

[Foreword from book "New Tasks of Informatics", edited by A. P. Yershova, USSR Academy of Sciences, Siberian Department, Computer Center]

[Excerpt] Foreword

One thing unites the articles presented in the collection in all their variety--they all are connected with new computer applications. The word "new" must be treated carefully, of course. Those tasks are undoubtedly new to the Computer Center. Also correct will be a general observation, namely, that whereas planning, engineering, scientific and economic applications predetermined the course of computer affairs in the 1950's and 1960's, now the center of scientific problems has shifted in the direction of processing textual information in the broad sense, and also of mass applications of computers.

A second unifying factor was the fact that the articles offered the reader form the first "intersubject" collection issued by a new subsection of the Computer Center, the Informatics Section. The section, consisting of two laboratories, the laboratory of experimental informatics and the laboratory of artificial intelligence, conducts investigations in the directions presented in the collection.

In accordance with the methodology which has been formed in the Computer Center, starting on new consumer applications, we have been striving a fairly long time to stick to meaningful examination of the problem, starting with study of its practical aspects. In some cases the practical problem has a model character; in others, it is necessary to start with a production experiment. This stage of scientific research has found reflection in the materials of this collection.

The first four articles of the collection are connected with the very urgent problem of computer application in automating the preparation of printed publications. The most valuable positions developed in these first publications, it seems to me, are the system analysis of the problem of preparation of book publications, developed in the article of A. A. Bers, the block principle of arrangement of formular and tabular texts in typesetting (A. A. Bers and V. A. Letushev), the use of the concept of triplet files, which led to a very economical solution in planning a system of retrospective analysis of newspaper data (A. A. Bers and Yu. A. Pervin) and the possibility of organizing efficient analysis of text when there is a rich assortment of search patterns (S. K. Chernonozhkin).

The next four articles are connected with problems of interaction with a computer in a natural language, which is studied in the artificial intelligence laboratory. That theme, in contrast with the polygraphic, has been developed in the section from an earlier time, and so the first publications have preceded this collection and appeared in other places. Those articles reflect a number of intermediate stages overcome on the path of construction of elementary linguistic processors. Initial success in describing the semantics of time ratios achieved in the VOSTOK-O experimental system permitted accomplishing a test development of the semantics of the space ratios (Ye. Yu. Kandrashina). An interesting application of the SETL system as an instrumental language is organization of the standard subroutine library in the same system (I. B. Virbitskayte and D. Ya. Levin). Experience in the experimental development of a universal dictionary, obtained on a BESM-6 computer, permitted adopting a number of planning decisions on organization of a dictionary for linguistic processors being developed for YeS computers (Ye. L. Levina). A scheme of multivariant ascending analysis proved to be applicable to the accomplishment of analytical transformations connected with integration (T. M. Yakhno).

The experimental informatics laboratory has already been conducting for several years investigations directed toward the inclusion in the scholastic educational process of fundamental concepts of programming and, on the basis of them, limited use of the computer in the school. One of the happiest observations is that work with computers convincingly opens up the creative potential of students, realized in the creation of useful program product even in the earliest stage of acquaintance with informatics and machines. Asya Salikhova, an eighth-grade student, appears in this collection as a full-fledged co-author of the work, having written a number of components of the experimental software of the scholastic eductional process.

2174
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INFORMATION SECURITY IN AUTOMATING PROCESSING

Moscow NOVOYE V ZHIZNI, NAUKE, TEKHNIKE. SERIYA "NAUKA I TEKHNIKA UPRAVLENIYA": SOKHRANNOST' INFORMATSII PRI AVTOMATIZIROVANNOY OBRABOTKE in Russian No 4, 1981 pp 2-4, 56, 62-63

[Annotation, introduction, conclusion and table of contents from book "Information Security in Automated Processing", by Valeriy Sergeyevich Bondarenko, candidate of technical sciences, in: "News in Life, Science and Technology: Series 'Science and Control Technology'", Izdatel'stvo "Znaniye", 29,600 copies, 64 pages]

[Excerpts] Annotation

In countries of the West, with distinctive features of capitalistic economics taken into consideration, much attention is given to questions of information security in automated processing systems and methods of its protection against accidental and intentional destruction, damage or unsanctioned acquisition.

Means of providing information security are discussed in the brochure on examples taken from the experience of foreign companies.

Introduction

Information objectively reflecting processes and phenomena of the real world, the laws of its existence and development and scientific, technological, socio-economic and political facts have a high social value. It is proper to regard such information as an economic resource of society. The value of information depends on many factors, the most important of which is its significance for improvement of the ecological and socio-economic living conditions of people, the resources expended on obtaining them and the degree of their dissemination in the world.

The volume of information at the disposal of mankind is enormous. According to the estimates of some specialists it increases by 12-15 percent annually, doubling each 5-6 years; this is acknowledged to be not only a regular phenomenon but also a necessary condition of sicientific and technological progress and the economic development of society.

Labor and considerable material resources are expended on obtaining, processing and storing information, and ao any socially useful information, especially that obtained as a result of scientific research, planning and design work, engineering geological and other types of prospecting, has value. The preservation of such information is a task of the enterprises and organizations which have it. Information can be confidential and secret if it relates to questions of commercial secrecy or state security. The requirements for security of such information are high, naturally.

Assuring information security during automated information collection, transmission and processing is an important matter. In automated systems it is possible to obtain access more secretively to information archives concentrated in a single place in large volumes. In addition, the possibility has appeared of obtaining information remotely through terminals at a distance from places of data storage. Therefore information security requires methods and devices new in principle, developed with consideration of the value of the information, the working conditions, the technical and programming prossibilities of computers and other devices for data gathering, transmission and processing. The steady improvement of computers, the variety of technical use of modern systems, the application of microcircuits and microprogramming and the complexity of programs, on the one hand, make unsanctioned access to information difficult and, on the other, complicate organization of its reliable security (protection).

Interest in questions of information security and its protection from accidental and intentional destruction, damage and unsanctioned acquisition appeared when computers began to be used widely in the econommic, defense and socio-political spheres. In the first years of the introduction of computer technology such questions did not disturb users much, as in almost everyone who worked with computers there arose the impression of their incredible complexity which in itself guarantees protection of the information. With the development of computer hardware and expansion of the spheres of its application these questions have acquired significance.

Misuses connected with the illegal acquisition and use of information from automated data processing systems occur mainly in countries of the West. In recent years they have become especially frequent. Such phenomena are not characteristic of socialist countries. Before examining the experience of foreign companies, let us become acquainted with what security of automated systems is and with the types of misuses.

In the West more than 20 monographs have been published on various methods of decipherment in which, in particular, the principles of cracking some ciphers in the period of World War II have been described. In I. Garlinskiy's book "Intercept," for example, methods used by Polish cryptologists to crack German military ciphers in the 1930's are described. He also reports that the American ciphers were cracked by the British in the war years, and the British ciphers by the Americans, and that together they attempted to crack Soviet ciphers without success.

Wide and open discussion of questions of decipherment technique causes concern in Western intelligence centers. The director of the National Security Agency of the USA, one of the most secret institutions in the world, recently required the development of special legal norms limiting the publication of materials in this area, stating that, due to those publications, measures to assure the national security have proven to be threatened and that open discussion of questions of cryptology can harm the ability of the agency to effectively conduct intelligence activity on the basis of radio interception. This type of intelligence, called SIGINT (from "signals intelligence"), as is well-known, has been long and widely practiced by Western intelligence agencies.

CONTENTS

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PUBLICATIONS

ABSTRACTS FROM 'REAL-TIME SYSTEMS HARDWARE AND SOFTWARE'

Kiev TEKHNICHESKOYE I PROGRAMMNOYE OBESPECHENIYE SISTEM REAL'NOGO VREMENI in Russian 1980 (signed to press 17 Jul 80) pp 70-72

[Abstracts of articles from book "Real-Time Systems Hardware and Software", edited by M. I. Sakharova, UkSSR Academy of Sciences, Scientific Council for the Problem "Cybernetics", Institute of Cybernetics, 450 copies, 72 pages]

UDC 621.394/395.52

APPLICATION OF COMPUTER HARDWARE IN COMMUTATION COMMUNICATIONS SYSTEMS

[Abstract of article by Strutinskiy, L. A.]

[Text] The status and prospects of application of computer hardware in commutation stations and assemblies of channels and lines are examined. A survey is given of foreign quasielectronic and electronic systems with program control. Distinctive features of the controls of those systems are described.

UDC 621.394/395.52

ARCHITECTURAL AND STRUCTURAL FEATURES OF THE 'NEVA-1' CONTROL COMPLEX

[Abstract of article by Kukharchuk, A. G., Nikitin, A. I., and Strutinskiy, L. A.]

[Text] The article examines distinctive features of the architecture and structure of the "Neva-1" control complex, intended for control of quasielectronic and electronic commutation stations and assemblies for various purposes. Distinctive features of the organization of redundancy of machines of the complex, distinctive features of the structure of the machines and distinctive features of the logical structure of the central processor and its order set are described.

UDC 681.3.06

ORGANIZATION OF SOFTWARE OF THE 'NEVA-1' SPECIALIZED CONTROL COMPLEX

[Abstract of article by Konozenko, V. I., Lavrishcheva, Ye. M., Nikitin, A. I., and Mashbits, G. Ya., and Yaffe, V. A.]

[Text] The article examines the composition and organization of the software of a the control complex, which is the basis for the creation of any real-time automated control system. The principal functions performed by each component of the system are described.

UDC 681.3.06

HARDWARE AND SOFTWARE OF REAL-TIME SYSTEMS

[Abstract of article by Mashbits, G. Ya.]

[Text] Questions regarding construction of a complex of control programs for a specialized control system are examined. The main attention is given to questions in increasing the effectiveness of the computation process through decentralization of the functions among various components of the complex and a multilevel priority scheme of the work.

UDC 681.3.06

SUPERVISOR AND I/O SYSTEM FOR THE 'NEVA-1' CONTROL COMPLEX

[Abstract of article by Golovin, V. V., Zarubina, R. A., and Sukhovol'skaya, A. I.]

[Text] Distinctive features of the realization of a specialized control complex supervisor are shown, features resulting from specialization of the system and the extensive set of "Neva-1" control system hardware. The principal functions of a supervisor are described.

UDC 681.3.06

SOME QUESTIONS REGARDING THE DEVELOPMENT OF THE ASSEMBLER LANGUAGE OF A SPECIALIZED CONTROL COMPLEX

[Abstract of articld by Yaffe, V. A.]

[Text] The article describes a procedure that can be used for the development of a machine-oriented language of a specialized control complex, with two main requirements taken into consideration: continuity with other programming languages and effectiveness of the created programs. A brief characterization of the language is presented.

UDC 681.3.06

REALIZATION OF THE 'NEVA-1' CONTROL COMPLEX PROGRAMMING SYSTEM

[Abstract of article by Kutsachenko, L. I., Prikhod'ko, M. Yu., Semenyuk, M. V., and Sokolova, T. V.]

[Text] The article examines the principles of construction of a programming system for a specialized control complex realized on the same complex. Characteristics of the system realization result from the limited volume of the main memory and the presence of an external memory only on magnetic tapes. The principal algorithms for the functioning of all system components and the relations between them are described.

UDC 621.394/395.52

DISTINCTIVE FEATURES OF DATA PROCESSING IN THE CENTRAL PROCESSOR OF THE 'NEVA-1' CONTROL COMPLEX

[Abstract of article by Borshch, N. S., Gritsenko, L. M., and Zelenskiy, N. S.]

[Text] The article examines questions regarding the combined execution of commands in the central processor fo the "Neva-1" control complex, intended for the control of quasielectronic and electronic commutation stations and assemblies of channels and lines. Also examined are distinctive features of the organization of hardware assuring the effective detection and location of defects.

UDC 681.31

ORGANIZATION OF THE I/O SYSTEM OF THE 'NEVA-1' CONTROL COMPLEX

[Abstract of article by Mil'ner, Ye. V., and Moroz, A. D.]

[Text] The authors examine the structure, organization of the work and a method of increasing the reliability of the I/O system of the specialized control complex. A method is presented for the functional checking of the system by means of built-in equipment which simulates the work of a peripheral.

UDC 621.394/395.52

ORGANIZATION OF THE 'NEVA-1' CONTROL COMPLEX MEMORY

[Abstract of article by Verbovskiy, A. M., and Kapulovskaya, E. K.]

[Text] The authors examine questions regarding the structure of memory couplings and the organization of exchange with memory units in the "Neva-1" control complex for commutation communications systems.

UDC 621.3.019.3

ORGANIZATION OF A SYSTEM ASSURING RELIABILITY OF THE 'NEVA-1' CONTROL COMPLEX

[Abstract of article by Abakumova, N. M., and Belkina, L. M.]

[Text] The authors describe a reliability assurance system of a two-machine control complex in which provision is made for various hardware and software which assure a maximum service life of the complex. The principal functions and working principle of the reliability assurance system supervisor are described, as well as the organization of work of the complex in the presence of defects.

UDC 621.3.019.3

ANALYSIS OF CONTROL COMPLEX RELIABILITY CHARACTERISTICS

[Abstract of article by Abakumova, N. M.]

[Text] The author examines a method of analyzing the reliability criteria of a control computer complex with a variable configuration by means of a mathematical model of the hardware. Examples are presented of models of real duplicated devices included in the complex. As a result of the computations, values of downtimes of the complex as a function of the recovery time of the complex, the allowable values of the recovery time were determined for various devices and the probability of incidence of a pair of devices in different states of failure.

2174
CSO: 1863/165

NEW BOOK DISCUSSES SYSTEMS WITH VARIABLE LAG

Moscow SISTEMY S PEREMENNYM ZAPAZDYVANIYEM in Russian 1980 (signed to press 27 Aug 80) pp 4-6, 9-11

[Annotation, table of contents and introduction from book "Systems With Variable Lag", by Aleksandr Vasil'yevich Solodov and Yevgeniya Aleksandrovna Solodova, Izdatel'stvo "Nauka", 2850 copies, 384 pages]

[Text] The extension of the areas of application of automatic and automated control systems with digital computers and the use of communications channels with a variable signal transmission time have resulted in the need to study systems with a variable time lag. In this monograph are discussed the general properties of systems and determinate and stochastic processes in systems with a lag and an example is given of the investigation of a concrete system.

This book is intended for a wide range of specialists working in the area of designing control and communications systems, as well as for VUZ students.

CONTENTS

Introduction

Systems with variable lag is a relatively new area of the theory of systems, the subject matter of which has still not been delineated fully. On the other hand systems with constant lag and constant parameters as an area of the theory of automatic control have been described in sufficient detail. Individual problems which arose earlier, in whose solution it was necessary to some extent to take into account a change in lag, were usually discussed from the viewpoint of the classical apparatus of frequency methods, typical of the study of stationary systems, with the thereby inevitable approximations and assumptions. However, with the passing of time the number of these problems began to grow, and their content to become ever more complicated. Among researchers a natural desire and need arose to broaden the scope of the range of problems of systems with lag by means of the possible generalization of results already gotten for nonstationary cases. It was partly possible to do this, but this approach did not go beyond the scope of the methodology which had dominated for a long time in the theory of automatic control. Its essence consisted in a successive exposition of the fundamentals of the applied theory and of methods and approaches for designing and calculating systems of a specific class, right to the point of obtaining specific numerical results. The mathematics of an investigation were regarded as a support for applied problems; therefore, they were as a rule restricted to classical analysis.

Now this structure of the material cannot be accepted as modern. A distinctive feature of the development of the theory of automatic control in the last decade has been its distinct division into two branches--the mathematical and applied. It can be assumed that a new scientific trend has basically already been formed, which has determined the foundation of practically all areas of the theory of control--the general theory of systems.

Thus, a discussion of systems with variable lag from the modern viewpoint must rely on the theoretical plane on definitions and methods of the general theory of systems, which for practical problems will provide a firm scientific base.

In addition to the methodological aspect of the matter mentioned above, a considerable number, if not the majority, of problems in the study of systems with variable lag do not follow as a generalization of the theory of systems with constant lag, and the corresponding mathematics--the theory of equations with a deviating independent variable--are totally different.

A peculiar situation has been created at the present time. On the one hand, there are a great number of studies on the theory of equations with a deviating independent variable which are typified by the profundity and rigor of the discussion, and the theory itself has undergone quite considerable development. Furthermore the efforts of mathematicians in this area have been increasing steadily. In this connection it is not possible not to mention the books, perfect in the methodological respect and deep in content, by L.E. El'sgol'ts and S.B. Norkin [37] and by S.B. Norkin [19], which can be used to advantage in studying systems with variable lag. On the other hand, special handbooks are also needed for systematic work in this area, but their number is quite limited. Of the few books devoted to a discussion of systems with lag from the general viewpoint of the theory of systems, one must point firstly to the monograph by M.N. Oguztoreli [20], which most fully reflects the range of problems of these systems. However, a discussion of any practical problems and examples is lacking in this book. The relatively recently published book by R.T. Yanushevskiy [38], devoted to the important and topical problem of the optimum control of entities with lag, is limited to problems with constant lag.

All this has created serious difficulties for specialists working in the area of studying and designing control systems. The ever more extensive use of digital computers for control purposes, the need to process large arrays of informative data and to transmit them over great distances by using space communications lines, and the inclusion of the human operator in the control process have created the prerequisites for the appearance of control system structures which contain variable lag elements as essential elements. Thus, the technical implementation of systems with variable lag is already at hand. An urgent need has arisen for appropriate handbooks on the theory and design of these systems. Obviously, one of the best ways of solving this problem would be to develop a scientific work containing all the necessary theory and the most typical scientific problems, expounded on a high methodological level. This requires the team work of a number of specialists and a rather long time. Another, shorter, way is to create a series of handbooks devoted to a discussion of some scientific problems of practical importance within the scope of a specific class of systems, employing the entire basis of modern theoretical concepts. One of the key factors determining the success of such a work is the proper choice of scientific problems, the intelligent combination of general theoretical statements and practical recommendations at a level accessible to a broad range of specialist practitioners, and a sufficiently simple method of exposition.

The present book is an attempt to solve this difficult and important problem.

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PAPERS ON COMPUTERIZED PROCESSING OF METEOROLOGICAL INFORMATION

Leningrad TRUDY ORDENA LENINA GIDROMETEOROLOGICHESKOGO NAUCHNO-ISSLEDOVATEL'SKOGO TSENTRA SSSR: AVTOMATIZATSIYA OPERATIVNOY OBRABOTKI METEOROLOGICHESKOY INFORMATSII in Russian No 217, 1980 (signed to press 25 Nov 80) pp 2, 104, 107, 109, 111

[Annotation, table of contents and abstracts from collection of articles "Transactions of the USSR Order of Lenin Hydrometeorological Scientific Research Center: Automation of Operational Processing of Meteorological Data", edited by K. A. Semendyayev, doctor of physical and mathematical sciences, and O. M. Kastin, candidate of physical and mathematical sciences, Gidrometeoizdat, 600 copies, 111 pages]

[Text] Annotation. The collection contains a number of articles giving the results of development of an automated system for data processing at the USSR Hydrometeorological Center: organization of system control, informational support of the special programs incorporated in the system, primary processing and checking of the operational hydrometeorological information, algorithms for preparing synoptic charts, and also the results of other studies along these lines. This collection of articles is intended for specialists concerned with computerized data processing.

Contents

Abstracts

UDC 681.142.37:551.5

SOME ASPECTS OF DEVELOPMENT OF AN AUTOMATED SYSTEM FOR THE PROCESSING OF OPERATIONAL INFORMATION ON AN ELECTRONIC COMPUTER (ASOOI)

[Abstract of article by Kastin, O. M. and Katayev, V. V.]

[Text] The article gives some characteristics of the set of special programs involved in different links of production of numerical forecasts. The authors set forth the principles for integration of programmed and informational support for operational prognostic problems and the principles of programmed control for the operational processing of data which served as a basis in creating an automated system for the processing of operational information on the basis of a BESM-6 electronic computer within the framework of the OS DISPAK (ASOOI-6) operational system. The structure of the first two variants of the system -- ASOOI-6.1 and ASOOI-6.2 -- is described. Figures 4, tables 2, references 12.

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ASOOI-6 CONTROL SYSTEM

[Abstract of article by Gleyzer, N. Yu. and Katayev, V. V.]

[Text] The control system for the automated system of operational processing of information is described. It was developed on the basis of application of the capabilities of the DISPAK operational system and the "Dubna" monitoring system. Its internal logic and an operational algorithm are described. The makeup and structure, parameters and quantitative characteristics of the ASOOI-6 control system are given. Figures 3, references 6, appendices 1.

UDC 681.142.37

SYSTEM FOR CONTROL OF THE ASOOI-6 DATA BANK

[Abstract of article by Antsypovich, V. A. and Al'tshuler, V. R.]

[Text] The problems involved in the organization of access of special modules to hydrometeorological information with assurance of the nondependence of the modules on structure of the data are examined. The developed algorithm for the system for the control of the data bank and the possibilities of its use are discussed. Figures 6, tables 1, references 4.

UDC 681.142.37:551.5

RECEPTION OF HYDROMETEOROLOGICAL INFORMATION IN THE ASOOI-6

[Abstract of article by Katayev, V. A., Antsypovich, V. A. and Gleyzer, N. Yu.]

[Text] The process of reception of hydrometeorological information in the second variant of the ASOOI-6 system is considered. The creation of mathematical support of the BESM-6 electronic computer for tie-in with the "Minsk-32" electronic computer is described under the conditions of the actually realized means for the tie-in of equipment and the existing technology for the operational processing of data on the "Minsk-32" electronic computer. The possible prospects for the development of tie-ins among the electronic computers at the USSR Hydrometeorological Center are discussed. Figures 1, references 9.

UDC 681.142.37:551.5

PRIMARY PROCESSING OF OPERATIONAL INFORMATION IN THE ASOOI-6

[Abstract of article by Kastin, O. M., Al'tshuler, V. R. and Gural'nik, Ye. M.]

[Text] The general organization of the system for the primary processing of operational hydrometeorological information operating within the framework of the ASOOI-6 is described. The characteristics of the programmed and information support of the system are given. Also examined is an algorithm for the functioning of the operational part of the system for the processing of the initial data arriving from another electronic computer and the capabilities of service programs constituting the nonoperational part of the system. Certain processed information obtained in the course of system operation is given. Figures 1, tables 5, references 16.

UDC 681.142.37:551.5

COMBINED MONITORING OF GEOPOTENTIAL AND TEMPERATURE AT STANDARD ISOBARIC SURFACES

[Abstract of article by Antsypovich, V. A.]

[Text] An algorithm for the combined monitoring of geopotential and temperature at standard isobaric surfaces, applied using a BESM-6 electronic computer, is described. Attention is given to the effectiveness of the algorithm, especially in selecting the influencing stations and the reduction of the number of uncorrectable errors. The algorithm is employed in the operational work of the USSR Hydrometeorological Center. Figures 2, tables 1, references 7 .

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ALGORITHM FOR COMPUTING AND PLOTTING ISOLINES ON AN ELECTRONIC COMPUTER

[Abstract of article by Semendyayev, K. A.]

[Text] The article describes an algorithm for computing the coordinates of points on field isolines stipulated at the points of intersection of a regular grid in a rectangle and for the plotting of isolines using a two-coordinate instrument. The algorithm was developed for a BESM-6 electronic computer in FORTRAN language. Figures 5, references 3.

UDC 551.5:681.142.37

SOME PROBLEMS IN CONSTRUCTING A DIGITAL FACSIMILE SYSTEM FOR THE TRANSMISSION OF METEOROLOGICAL CHARTS

[Abstract of article by Ovcharov, V. I. and Vakulenko, A. V.]

[Text] The structure of the "Rastr" complex, which is being developed, is described. It is intended for generation of the image of meteorological charts, their storage and transmission in digital form in a communication channel. Proposals are made on the use of the complexes in the network. The need for the considered studies is validated. Figures 1, references 2.

UDC 551.5:681.142.57

METHOD FOR THE PROCESSING OF HYDROMETEOROLOGICAL DATA ON A SCIENTIFIC RESEARCH SHIP

[Abstract of article by Gleyzer, N. Yu. and Katayev, V. V.]

[Text] A possible approach to the combining of programs for the processing of meteorological data into a packet of special programs for scientific research ships on the basis of integration of input and output data is discussed. Also examined is the makeup, structure and functioning of a packet of special programs in the example of computation of the characteristics of mesoscale atmospheric processes. The advantage of this approach for the technology of processing of data is demonstrated in comparison with the traditional single-program method. Figures 1, references 5.

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