JPRS L/10466

19 April 1982

USSR Report

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

(FOUO 5/82)

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000500050042-5

JPRS L/10466

19 April 1982

USSR REPORT

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

(FOUO 5/82)

CONTENTS

PUBLICATIONS

HARDWARE

UDC 681.3:65.011.8

IMPROVED YeS-1055M COMPUTER

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 81
pp 7-9

[Article by engineer-economist A. Gruenewald, German Democratic Republic]

[Text] As every year, the VEB Kombinat Robotron presented its latest articles in the field of information processing and office equipment at the Leipzig Spring Fair in March 1981.

The main exhibition among them was the improved YeS-1055M computer of the Unified Computer System (Ryad-2). The YeS-1055M computer (see figure) was shown at the fair in the following configuration:

the YeS-2655 central processor (German Democratic Republic);

a specialized processor--the MAMO matrix module (German Democratic Republic);

operator console with YeS-7069 display (German Democratic Republic);

YeS-5567/5067 plug-in disk store with capacity of 100 Mbytes (Peoples Republic of Bulgaria);

YeS-5517/5017.02 magnetic tape store (German Democratic Republic);

YeS-7033M parallel printer (Polish Peoples Republic);

YeS-6016 punch card input device (CSSR);

YeS-8371.01 remote data processor (Polish Peoples Republic) connected through modems to the YeS-8577 programmable multifunctional user station (German Democratic Republic);

YeS-7902M equipment complex (German Democratic Republic);

YeS-7920M display system (German Democratic Republic);

YeS-5075 floppy disk store (CSSR).

The new SVM/YeS operating system and the improved OC/YeS system are used in the YeS-1055M computer.

The innovations related to modernization of the YeS-1055 are described in this article.

The YeS-2655M Central Processor

The YeS-2655M central processor differs from the YeS-2655 processor in the following improvements.

1. Internal storage (OZU) is realized on the basis of highly integrated microcircuits, its capacity was increased to 4 Mbytes and all 4 Mbytes are based on two panels and are located in the processor rack.

The doubled capacity of the internal storage (4 compared to 2 Mbytes) facilitates organization of the user operating mode, contributes to an increase of task processing productivity and thus ensures an increase of computer operating efficiency. When functioning in the virtual memory or working file rewrite mode in the internal storage, the external stores, for example, plug-in disk stores, are freed.

Due to the absence of a special cabinet for the internal store, the total volume of devices and the area occupied by the central processor are reduced to 1.74 m^2 (compared to 3.7 m^2). The power supply unit is designed on the transformerless principle and due to using new integrated circuits for the internal storage, the consumed energy was reduced to 4kW (compared to 7.4 kW). The required output of air conditioners was reduced in this case.

The microprogram store based on PPZU [semipermanent memory] (memory for storage of constants) was replaced in the YeS-2655M processor by a reprogrammable microprogram storage device based on statistical components of the PZU [read-only memory]. It consists of a main rigidly programmed part and a freely loaded auxiliary part with capacity of 1K microinstructions (unlike the 32 microinstructions of the YeS-2655). Loading speed is considerably increased due to the presence of a loadable microprogram storage device.

The Matrix Module (MAMO)

The matrix module is a specialized processor for expanding the capabilities of the YeS-2655M processor when performing certain calculating operations (for example, matrix and vector calculations, correlation calculus, rapid Fourier transforms and so on). The MAMO module is not an independent device but operates under the control of the YeS-2655M processor. To do this, the corresponding control programs are provided in the SVS (system with vertical memory) and OS/YeS operating systems.

The MAMO module controls the instructions in machine code. To do this, the set of instructions of the YeS-2655/2655M central processor is supplemented with nine control instructions (for debugging and accounting) and 28 instructions for preparation of fields and lines.

Debugging microprograms, direct error-detection programs, error analysis system, debugging programs and special components of the operator's console have been developed for convenience in operating the matrix module. A diagnostic bus, new in its solution, provides access to all flip-flops of the matrix module and to all cells of the read-only memory of the matrix module. The presence of a special diagnostic device in the matrix module creates good conditions for servicing and diagnosis of the matrix module.

The structure of the matrix module permits parallel and independent performance of the following functions: microprogram control, data storage in a buffer, operations on numbers with floating point and operations on exponents.

An increase in the productivity of the matrix module is achieved by realizing parallel performance of operations and the assembly-line method of processing instructions, storage of data in a buffer, induced processing (which provides a saving of memory and machine time), selection of versions without increasing machine time and programming simplicity.

In this case productivity is increased compared to usual fulfillment of programs approximately 10-50-fold and depends on the file size, loading density and communication algorithm.

New YeS-7902M and YeS-5075 Peripheral Devices

The new YeS-7902M complex is an input-output device with standard interface of the Unified Computer System using papertape and cassette magnetic tape as data carriers. The YeS-7902 papertape complex used until now has been replaced by this device. The device is produced in two versions: M1 as papertape devices and cassette magnetic tape store and M2 as only papertape devices. The main advantages of the YeS-7902M device compared to the YeS-7902 papertape complex are the following: higher reliability due to use of modern component base, less occupied area (0.6 instead of 1.5 m^2), lower mass (260 instead of 325 kg) and lower volume (0.8 instead of 1.45 m^3).

The YeS-5075 device--a floppy disk input-output device (CSSR)--was first offered in the closed operating mode and permits direct reading from floppy disk carriers. A device of this type is used widely in the decentralized computer equipment devices of the VEB Kombinat Robotron.

Improved OS/YeS Operating System

The expanded version 6.1 of the OS/YeS can operate on the YeS-1040, YeS-1055 and YeS-1055M modems. Part of the number of the expanded functions is realized in configuration of SVS control programs and can therefore be used in the YeS-1055 and YeS-1055M. The functional expansions are compatible in a "bottom to top" operating system or are alternatives in use.

The following modifications have been made.

1. Functional task servicing expansion. The "Spool" system, which offers a number of advantages to users, has been introduced: maximum operating speed

of devices with systems input-output for punch card input or punch card output devices and printers, increased capacity for tasks, better utilization of disk sections of direct access devices to memory, new capabilities of control of YeS-5075 floppy disk store and new functions and improved reliability with systems output to punch card output printer.

2. The capabilities in sorting and fusion of data have been expanded. The sorting process is accelerated due to new methods. However, these methods can be used only in new models of the Unified Computer System since they are implemented only with expanded instruction reserve.

3. Joint use of OS/YeS and SVM/YeS systems. The function of combining systems in expanded version 6.1 of the OS/YeS was developed to increase the operating efficiency of the SVS under the control of the SVM/YeS. This function is realized in several components of the SVS control program and ensures efficiency of the SVS both in real and virtual machines.

4. Software of user stations of the Unified Computer System. The VEB Kombinat Robotron has developed software for Unified Computer System user stations using the direct access method during remote data processing (VTAM and TSAM) within the framework of the production program "Decentralized computer equipment."

The use of new devices in the system permits a considerable expansion of user stations (terminals) and thus permits one to take into account the most diverse user requirements.

These devices include the YeS-8577 programmable multifunctional user station, YeS-7925M and YeS-8556 programmable display user stations and YeS-8551 universal programmable user station designed to solve scientific, engineering and economic problems.

Realization of the Concept of Virtual Machines Using the New SVM/YeS Operating System

The general operating principle in virtual computers, being the basis of the SVM/YeS system, consists in the fact that parallel operation of several users on the same computer is also carried out in addition to multiprogram processing. In this case a virtual machine is offered to each user. The internal storage is determined so that each user has his own. The central processor is offered to each user in the time-sharing mode for equal intervals. Input-output devices are shared or designated so that each user has at his disposal a specific number of input-output devices.

The SVM/YeS operating system adjusts virtual machines to the real configuration of computers and provides servicing and control of parallel operation of virtual machines. Every virtual computer operates for the user as an independent computer with its own resources and under the control of its own operating system selected with regard to user requirements.

Because of parallel operation of several virtual machines, the user can control the selection of operating modes--batch processing, dialogue, debugging and system servicing.

The SV/YeS operating system is distinguished by its broad capabilities:

it permits a) parallel operation in dialogue and batch processing modes, b) performance of systems programming and technical servicing tasks parallel with the production process and c) parallel processing of the most diverse problems on the same computer. Its advantages are the absence of idle times related to replacement of inoperating system, high operating reliability and reliability of data due to independence of virtual machines and simplicity for operators to master.

The following can be used as operating systems operating under the control of the SVM/YeS system for virtual machines:

1. The OS/YeS operating system, which can be used not only for batch processing but for dialogue problems as well. It can function in parallel with all configurations of control programs (MFT, MVT and SVS). Adjustment to operate under the control of the SVS/YeS system has been realized for the configuration of SVS control programs to improve the efficiency of the system as a whole.

2. The DOS/YeS [Disk operating system of Unified Computer System] operating system, which can be used under the control of the SVM/YeS as a batch processing system. In this case the users having program packs for the DOS/YeS do not have to rework them for new versions of the operating systems.

3. The PTS programming and debugging system related to the SVM/YeS file. The PTS system is designed to develop, debug and fulfill programs in the dialogue operating mode, for which the PTS system has been provided with its own instruction language and control files. The PTS system is distinguished by high flexibility in use and simplicity to master.

4. The FRTS remote file transmission system, being a component of the SVM/YeS and controlling file transmission between distant input-output devices and virtual machines and between RFTS data stations. The main designation of the RFTS consists in transmission of control data, programs and results of debugging when working out programs under the control of the PTS system at remote displays.

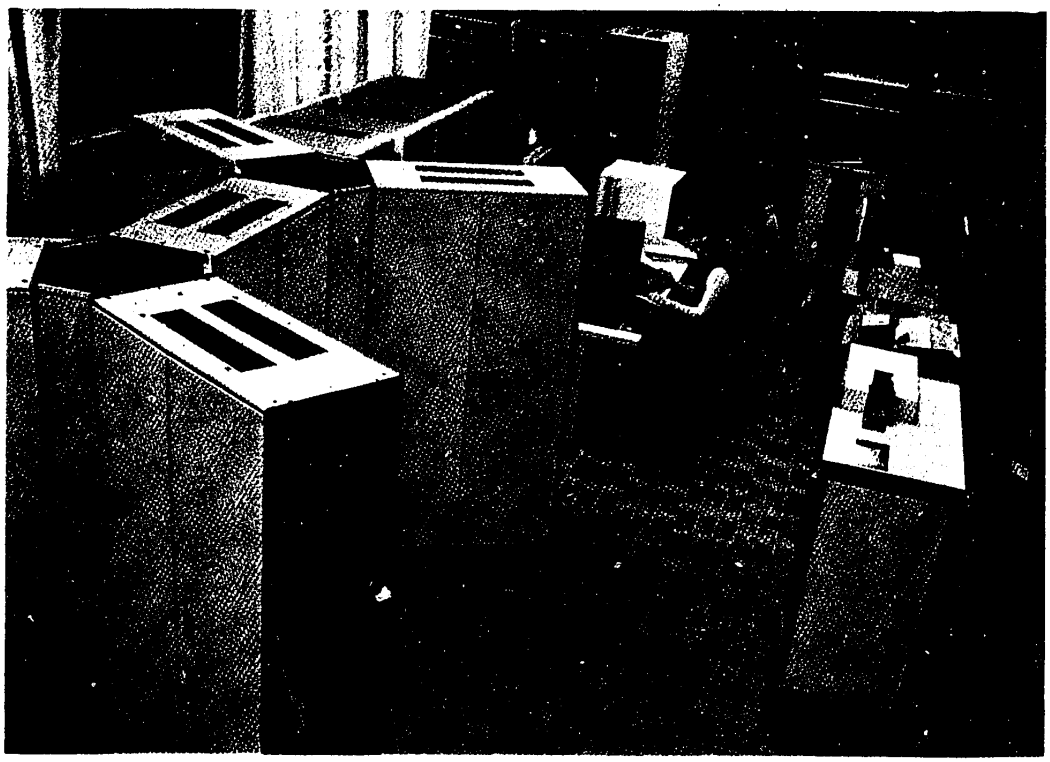
5. The PDAS error analysis system--a component of the SVM/YeS system, having special modules and procedures for error analysis and used to supplement the PTS system. The PDAS system is used as a valuable auxiliary device for the systems programmer for gathering, servicing and analysis of errors of the SVM/YeS operating systems and devices.

The YeS-1055M computer displayed at the Leipzig Fair corresponds to modern international trends in development of computer equipment with extensive use of microelectronics and the related increase of productivity with a simultaneous reduction of consumed energy, occupied area and volume and also its own modern software and common characteristics of the system.

6521
CSO: 1863/69

PS-2000 COMPUTER COMPLEX

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 4, No 1, Jan-Feb 82 inside front cover



[Text] PS-2000 computer complex developed by the Scientific Research Institute of Control Computers and the Severodonetsk Impul's [Pulse] Scientific Production Association together with the Moscow Institute of Control Problems. Designed for high-efficiency processing of data obtained as the result of geophysical and oceanographic research, tests of various complicated equipment and the like.

8831
CSO: 1863/95

UDC 537.212.001.24

QUESTIONS OF SIMULATING LARGE BOUNDARY PROBLEMS BY APPROXIMATE DIAKOPTICS METHOD

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 4, No 1, Jan-Feb 82 (manuscript received 13 Jun 80) pp 40-46

[Article by Yakov Il'ich Tetel'baum, junior scientific associate, All-Union Petroleum and Gas Scientific Research Institute, Moscow]

[Excerpts] In [1] a description is given of the method of approximate diakoptics for a machine solution with limited equipment of large two-dimensional boundary problems represented by means of electrical nets with a very great number of nodes. This method is applicable for "net - digital computer" ("Saturn-1") hybrid computer complexes or for digital computers with a working storage capacity insufficient for accommodating the entire field. Direct methods of calculating complex electrical and electronic circuits have been developed on the basis of diakoptics [2-6]. By the method of diakoptics a large system (electrical circuit) is broken down into several small subsystems each of which is calculated separately and then the particular solutions are united by means of a "skeleton intersection circuit" (skeleton diagram). This is a general major system described only by means of variables included in the conditions for joining subcircuits, i.e., variables (e.g., voltages) at boundaries at points of sections. The skeleton diagram of the general circuit is made up of the skeleton diagrams of subcircuits, whose parameters are determined from experiments in short-circuiting and breaking the circuit (no-load) for the boundary points of the joining of subcircuits. These experiments are performed on a computer by means of digital or analog simulation.

The boundary problem for a system with distributed parameters is replaced with the accuracy of a finite difference approximation by a system of linear algebraic equations simulated by means of a resistive electrical net representing an electrical circuit for which it is possible to obtain a precise solution by the method of diakoptics. As compared with a complete system of finite difference equations for the entire region represented by the electrical net, the equations of the skeleton intersection diagram contain considerably fewer variables (just for points of the joining of subregions), which simplifies the solution.

Methods of diakoptics are effective when the circuit is divided into parts at a limited number of points. In the case of the finite difference representation of boundary problems subregions are divided along boundaries regularly containing a great number of nodal points. The advantage of the direct method of diakoptics

here is practically reduced to nought because of the labor intensiveness of a precise determination of the parameters of the skeleton diagrams of individual subregions. Consequently, a new method became necessary (called the method of approximate diakoptics) which is based on simplification of the skeleton intersection circuit for determining voltages at the boundaries of joined subregions [1]. This method either directly or with refinement through iteration makes possible a substantial reduction in machine time, and the direct method of approximate diakoptics is not in opposition to iteration methods, but organically supplements them when the initial approximation is unknown. The method of approximate diakoptics in terms of the number of exchanges with the external storage is consistent with just a single block iteration, since experiments in breaking the circuit (no-load) and short-circuiting require only a one-time call of a subregion to the parallel processor (net) or to the working storage.

Experience has demonstrated the high accuracy of approximate diakoptics solutions, which results in a considerable saving of machine time. This is obvious from the graph shown in fig 1.

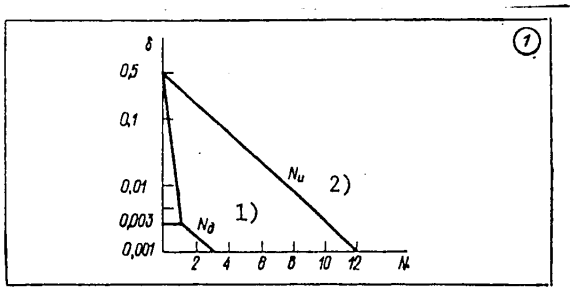


Figure 1. Curve Comparing Convergence of Solutions by the Method of Block Iteration and the Method of Approximate Diakoptics with Refinement

Key:
1. N_d [diakoptics]
2. N_i [iteration]

The rate of convergence of iterations [7] has the form

$$r = -\frac{1}{N} \ln \frac{\delta_{k+N}}{\delta_k}, \tag{1}$$

where δ_{k+N} and δ_k are measures of the error vector (k + N) and of k iterations (mean values).

Designating the initial error of the iteration process as δ_{oi}, the initial error after diakoptic approximation as δ_{od}, the maximum permissible error of the analog parallel processor or of digital refinement as δ_p, the number of iterations without diakoptics as N_i, and the number of refining iterations with the existence of a diakoptic solution as N_d, from (1) we get

$$N_{и} = -\frac{1}{r}\ln\frac{\delta_{п}}{\delta_{0и}}; \qquad N_{д} = -\frac{1}{r}\ln\frac{\delta_{п}}{\delta_{0д}}.$$

Let for the boundary nodes of the joining of subregions (from the experience of solving problems) $r = 0.45$, $\delta_d = 0.003$, $\delta_p = 0.001$ and $\delta_{oi} = 0.5$; then, taking into account the fact that the time for a diakoptic solution corresponds to a single iteration, we have the following saving of time for a hybrid computing complex of the net - digital computer type: $N_i/(1 + N_d) = 4$ times and with $r = 0.45$, $\delta_p = \delta_{od} = 0.003$, we have $N_d = 0$ and $N_i = 10$ times.

Relatively high accuracy is obtained for approximate diakoptics in spite of the rough approximation of the skeleton diagrams of subregions as compared with the precise skeleton diagrams determined by the method of diakoptics for electrical nets. According to the procedure described in [1] the connection of subregions is performed not at all boundary nodes, but with a certain spacing of the "lattice of net electrodes," whereby in determining the parameters of the skeleton diagrams of subregions only the major connections between electrodes are taken into account. The rough approximation of skeleton diagrams substantially simplifies machine calculation of the field; however, the simplifications cannot be universal since from this it would follow that the complex problem would be equivalently reduced to a simple one. Therefore, the use of skeleton diagrams of a specific type is justified only with a corresponding restriction of the class of problems which can be solved: The broader the class, the more important the organization of iteration control of the accuracy of the method and, when necessary, the performance of additional refinement of the results. With this the use of the approximate diakoptics method always gives a good initial approximation.

All practical calculations and the introduction of the method have been performed for multipolar fields (containing a great number of sources of different signs corresponding, for example, to injection wells and operating holes of oil fields). In this case the problem is formulated as a problem with sources of the first and third kind distributed by region and exerting a specific shielding effect on the boundary potentials of joined subregions and the less the exchange of current (nodal transfers) between subregions and the more identical the subregions joined, the higher the accuracy.

Below a theoretical verification is presented of the method of determining voltages at the boundaries of joined subregions, a procedure is presented for solving a boundary problem in a large region part by part and questions relating to the interpolation and iteration refinement of the boundary voltages of joined subregions are discussed.

The method described can be extended easily to several subregions, is quite simple for purposes of algorithmization and possesses good convergence. Practically speaking, problems in which a region was divided into 2 to 15 subregions have been solved [1]. The program which has been written for the machine solution of large problems with the "net - digital computer" ("Saturn-1") hybrid computer complex

with a parallel processor for 1024 nodes is designed for four subregions, i.e., for 4096 nodes of the net. Information on some problems which have been solved is presented in the table.

Table 1.

Number of problem	1	2	3	4	5
Number of net nodes	730	1500	1500	1300	4096
Number of subregions	4	2	2	15	4
Number of sources	60	19	19	36	172
Number of net electrodes	25	8	4	38	33
Spacing of net electrodes	2	4	8	4	4
Mean arithmetic error of determination of boundary voltages, percent	0.3	0.93	0.3	1.96	0.85

Bibliography

1. Tetel'baum, Ya.I. "Solution of Difference Equations for Boundary Problems of the Elliptical Type by Circuit Theory Methods," ELEKTRICHESTVO, No 5, 1978, pp 57-60.

2. Kron, G. "Issledovaniye slozhnykh sistem po chastyam--diakoptika" [Study of Complex Systems Part by Part--Diakoptics], Moscow, Nauka, 1972, 544 pages.

3. Khepp, Kh. "Diakoptika i elektricheskiye tsepi" [Diakoptics and Electrical Circuits], Moscow, Mir, 1974, 344 pages.

4. Pukhov, G.Ye. "Direct Methods of Calculating Electrical Circuits," ELEKTRICHESTVO, No 10, 1963, pp 23-28.

5. Nagornyy, L.Ya. and Zhukov, I.A. "On the Question of Simulating Low-Density Systems of Nonlinear Differential Equations of Large Dimensionality on a Digital Computer and Hybrid Computer Complex," ELEKTRONIKA I MODELIROVANIYE, No 15, 1977, pp 9-11.

6. Baranov, A.V. "Elements of the Theory of Coupled Systems," Moscow, VESTNIK MGU, SER. 3, No 4, 1965, pp 36-40.

7. Vazov, V. and Forsayt, Dzh. "Difference Methods of Solving Partial Differential Equations," Moscow, Izdatel'stvo inostrannoy literatury, 1963, 487 pages.

8. Danilina, N.I., Dubrovskaya, N.S., Kvasha, O.P. et al. "Chislennyye metody" [Numerical Methods], Moscow, Vysshaya shkola, 1976, 368 pages.

9. Tetel'baum, I.M. and Tetel'baum, Ya.I. "Modeli pryamoy analogii" [Models of Direct Analogy], Moscow, Nauka, 1979, 384 pages.

8831
CSO: 1863/95

UDC 681.32

ASSOCIATIVE PROCESSOR FOR PROBLEMS OF CONTROLLING AFFILIATED SYSTEMS

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 4, No 1, Jan-Feb 82 (manuscript received 8 Dec 80) pp 55-58, 96

[Article by Gennadiy Aleksandrovich Nikitin, candidate of technical sciences and assistant professor, Boris Vasil'yevich Vinnikov, junior scientific associate, Yevgeniy Vasil'yevich Kapranov, junior scientific associate, and Igor' Leopol'dovich Kaftannikov, instructor, Chelyabinsk Polytechnical Institute]

[Text] Among problems of controlling large numbers of systems in real time can be distinguished those which are characteristic of systems possessing the following features:

All controlled systems are homogeneous (of the same type) and form a single hierarchical level.

Local control of an individual system is independent and is carried out according to one and the same algorithm.

The data files describing each controlled system have identical structures and dimensionality and form the system's data base.

Global control requires taking into account the interrelationships of systems and forming from their data bases a unified file of data to be processed.

We will call such controlled systems affiliated, e.g., machine tools with program control when processing identical parts (performing one and the same operation).

Problems of the local control of affiliated systems (checking parameters, detecting impermissible deviations, etc.) are reduced to processing various data bases according to the same algorithm and create the prerequisites for system multiprocessing [1], which is most effectively implemented with a parallel computing structure. Global control (ordering the operation of systems and displaying the progress of processes) is based on the sorting of files formed from data bases, which requires the use of associative processing methods [2].

Associative Processor with the Classical Structure

The classical organization of a parallel associative processor (PAP) assumes structuring its memory on the basis of associative memory elements (fig 1).

By means of an input unit containing data and mask registers access is made possible to one or more bit slices of memory words. Any operation (arithmetic, logical, search) on multibit operands is performed by microprogram "simultaneously" on all words of the memory by means of elementary polling and write micro-operations. Control signals are formed by a central control unit (TsUU) and a local control unit (MUU) makes possible the modification of microinstructions to be executed by taking into account the information to be processed in each word of the associative memory, which in this case it is appropriate to call the associative decision field (ARP).

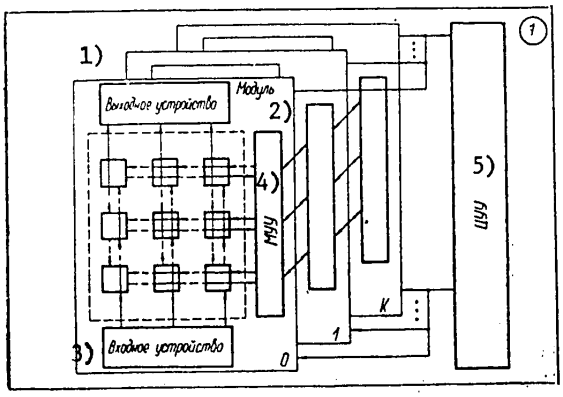


Figure 1. Classical Structure of Associative Processor with Modular Organization

Key:
1. Output unit
2. Module
3. Input unit
4. Local control unit (MUU)
5. Central control unit (TsUU)

For the purpose of organizing parallel processing, the data base for each system must be accommodated in a single word of the associative memory. Obviously, this kind of organization for a PAP is not distinguished by structural flexibility, since changing the number of controlled systems or the size and structure of their data bases results in the necessity of changing the dimensions of the associative decision field. A modular structure with a layer-by-layer arrangement of data bases is preferable (cf. fig 1). A layer is formed by memory words of the same type of all modules, which makes it possible relatively easily to increase the capacity of the PAP when changing the dimensionality and nature of problems solved. A channel for regular communication between modules of the ARP in solving problems of a given class can be executed most simply in the form of lines for the parallel transfer of the results of associative processing successively from one module to another (in parallel for all words).

Generally, control problems include not only logical and search operations, but also arithmetic processing. Since any processing in an ARP is performed in

synchronism, then for the purpose of characterizing the speed of any operation it is possible to use the number of elementary polling and write microinstructions required to execute it.

Investigations have demonstrated that the algorithms for arithmetic processing in an ARP developed in [2] are insufficiently fast. Shortening the length of microprograms as the result of combining polling and write micro-operations or adding a one-bit adder to each string of the associative memory [3] somewhat improves the algorithmic speed of the ARP. However, formation of the mass result of an arithmetic operation is performed serially bit by bit, and in parallel (simultaneously) only for subsets of words activated by a given microinstruction. This results in the fact that multiprocessing at the microinstruction level proves to be considerably inferior to that potentially possible.

Of interest is the development of algorithms which make possible the fruitfulness of each polling and write micro-operation simultaneously for the entire set of operands to be processed. One of the simplest is the inverse write-in method [4], based on the possibility of writing into a location of the associative memory the direct or inverse write-in code depending on the results of associative polling. This method makes possible the arithmetic processing of a single operand bit after a single microinstruction, but the operation is performed serially bit by bit. The synchronous implementation of the principles of asynchronous summing [5] makes it possible to form with a single microinstruction no less than one bit of the mass result, but requires additional hardware costs and hampers the use of a standard associative memory as the basis for constructing a decision field.

Thus, with considerable amounts of arithmetic processing in problems of controlling affiliated systems the use of the classical structure for an associative processor proves to be inadequately effective.

Processor with Parallel-Associative Processing

Development of the arithmetic capabilities of an associative decision field has resulted in the structure of a processor with parallel-associative data processing [6]. This processor is in the form of a set of independent processor elements (PE's) operating under the control of a central control unit (fig 2) which forms control signals for the next microinstruction and feeds them simultaneously to all PE's. A local control unit for each PE, taking into account the data to be processed, modifies the microinstruction to be executed and forms for the central control unit signals informing of the result obtained.

The data to be processed from controlled systems is entered via an interface by means of an input unit into the processor's memory, formed by the memory units of individual processor elements. Data bases are arranged layer by layer. The memory addressing mechanism implements both address and associative methods of accessing. In address accessing the principle of separation into layers with sectionalization of the memory is employed, which makes it possible to process in parallel data bases placed in the memory units of various processor elements with an identical relative address. Associative addressing makes it possible to activate for subsequent processing data bases located in any layers of the processor's memory. When performing associative and nonassociative operations with an operand identical for all words to be processed, the processor is placed in a

general register. The input unit contains registers used not only for inputing information but also for organizing associative processing. Information is output through a readout buffer. Each processor element is assigned its own readout register for the purpose of increasing speed. Both address and associative access to data to be read out are possible; furthermore, any word is identified by its address.

The basic functional unit is the processor element (fig 3), containing a sectionalized memory and independent logic for performing arithmetic and associative processing. The entire memory field of a processor element can be broken down into the following areas in terms of type of processing: arithmetic processing (RAM memory area); associative-arithmetic processing (associative memory areas connected to an adder); associative processing (associative memory areas not having access to an adder); and the working area (associative memory area used for the local control unit).

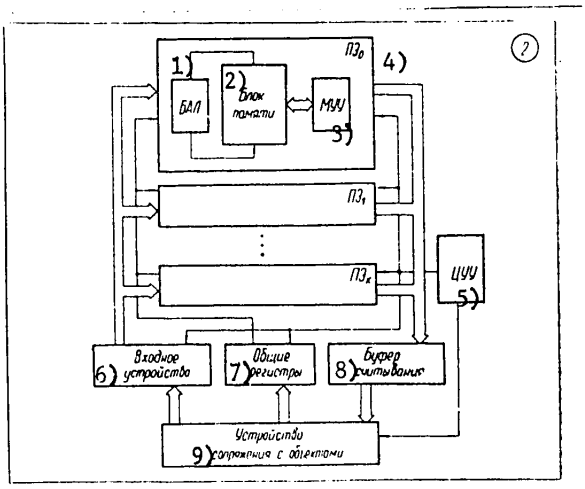


Figure 2. Structure of Processor with Parallel-Associative Data Processing

Key:

1. Arithmetic-logic unit (BAL)
2. Memory unit
3. Local control unit
4. Processor element
5. Central control unit
6. Input unit
7. General registers
8. Readout buffer
9. System interface

Arithmetic-logic processing is performed in the arithmetic field formed by the arithmetic-logic processing units (BAL's) of all processor elements. In this case processor elements operate in parallel (according to a single algorithm), making possible system multiprocessing of the problem to be solved for data bases preliminarily activated by the associative method or those located in a single layer of the memory. The arithmetic-logic superstructure equipping the processor elements contains a 2-byte combination adder (SM) with an output register (RSM). Operands for summing can be supplied from various areas of the memory unit. For the associative processing of files (sorting, ordering, search and the like) the

associative memories of all processor elements are united into an associative decision field making possible access to any bit slice of operands.

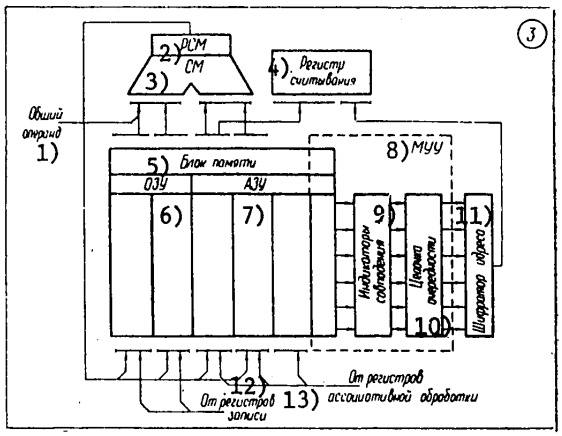


Figure 3. Structure of Processor Elements

Key:

1. Common operand
2. Output register (RSM)
3. Combination adder (SM)
4. Readout register
5. Memory unit
6. RAM
7. Associative memory
8. Local control unit
9. Coincidence indicators
10. Priority chain
11. Address coder
12. From write-in registers
13. From associative processing registers

This organization of the processor, as the result of some restructuring of the decision field, makes it possible to create the computing structure best suited to specific algorithms to be run. An increase in the dimensionality of problems to be solved and in the number of controlled systems, without altering the basic structure of the processor, is compensated either by a proportional increase in the capacity of each memory unit or by the addition of additional processor elements.

Instruction Set Features

The familiar principles of informativeness and logical complexity form the basis for developing the instruction set [7], which has made possible the high effectiveness of programs and has made it possible to take into account the features of parallel, group and associative processing. The instruction set includes "rapid" instructions of the "register-register" type and instructions for a complicated search in a file.

By taking into account the architectural features of a processor with parallel-associative processing it is possible to create economical formats for instructions for processing in the decision field which in terms of their content are closer to

the statements of a high-level programming language than to traditional computer instructions. The instruction set has been structured as an open one with great capabilities for expansion as the result of the addition of new instructions and modifications of those already implemented. The use in the processor of an automatic check of the level of the location of data bases (of the size of the area occupied) frees the programmer from the need to take into account the size of files to be processed.

The data addressing unit is an area of the processor's memory (cf. fig 3), and a single address field of an instruction can address several areas of the memory simultaneously. By changing the number of address fields instructions of the same type of various lengths are obtained (the most used instructions have the shortest format).

According to the kind of operations performed, all instructions are divided into arithmetic, associative-arithmetic and associative processing instructions and auxiliary instructions. Operands can be files or subfiles (groups) and individual words which are placed either in the memory or in the general register or directly in an instruction. For the purpose of programming kinds of data processing differing from "statement" instructions, in the instruction set associative polling and write instructions are provided for any area of the associative memory through a random control character with masking, and these instructions have the longest format.

A distinctive feature of control instructions involves the fact that in parallel processing of a file in the processor a multiple transfer condition is formed (e.g., the presence of just a single word in the memory with the required control character). In this case it is a good idea to separate instructions for forming conditions and for organizing direct transfer.

A program is formed as a file which can be placed in a program memory with page organization. Here a transfer instruction makes possible the transfer of control within the limits of just the current page, and for the purpose of transfer between pages an instruction for setting the page register is used.

Thus, problems of controlling affiliated systems make possible a high degree of multiprocessing. The information bases of a group of systems are processed most effectively by means of a parallel processor and it is appropriate to use associative processors for the mass comparison and sorting of files.

A parallel-associative processor with a modular structure of the associative decision field, which makes it possible to increase its capacity with a change in the dimensionality and nature of problems solved, has the greatest structural flexibility. The disadvantages of an associative decision field are associated with the relatively low degree of multiprocessing at the micro-operation level in arithmetic processing. Employment of the inverse write-in method or of the synchronous implementation of the principle of asynchronous summing make it possible to increase algorithmic speed in forming the mass result of arithmetic operations.

A computing structure with parallel-associative data processing unites the advantages of parallel arithmetic and associative decision fields. Reordering of the structure of the decision field as a function of the processing algorithm is

made possible. Employment of the principles of direct and associative addressing of data make it possible in addition to the usual vector processing to implement group processing according to control characters. The modular structure of the decision field makes it possible to increase its computing capacity by adding additional processor elements.

The instruction set is oriented primarily toward the vector and group processing of files and has great capabilities for expansion. Associative polling and write instructions for any control character are provided for the purpose of programming any kind of processing.

Bibliography

1. Vilenkin, S.Ya., Intenberg, I.I. and Nabatov, A.S. "Multiprocessing in Processors with a Single Stream of Instructions and a Multiple Stream of Data," UPRAVLYAYUSHCHIYE SISTEMY I MASHINY, No 3, 1980, pp 61-65.

2. Prangishvili, I.V., editor. "Odnorodnyye mikroelektronnyye assotsiativnyye protsessory" [Homogeneous Microelectronic Associative Processors], Moscow, Sovetskoye radio, 1973, 280 pages.

3. Medvedev, I.L., Prangishvili, I.V. and Chudin, A.A. "Mnogoprotsessornyye vychislitel'nyye sistemy s perestraivayemoy strukturoy" [Multiprocessor Computing Systems with a Rearrangeable Structure], Moscow, 1975, 74 pages (Institute of Control Problems Preprint No 85).

4. Vinnikov, B.V., Kaftannikov, I.L. and Nikitin, G.A. USSR Patent No 700863, "Processor Module," published in BYULLETEN' IZOBRETENIY, No 44, 1979.

5. Kaftannikov, I.L. and Nikitin, G.A. "Asynchronous Method of Performing a Group Addition Operation" in "Informatsionnyye i upravlyayushchiye elementy i sistemy" [Data Processing and Control Elements and Systems], Chelyabinsk, 1979, pp 149-151.

6. Nikitin, G.A., Vinnikov, B.V., Kapranov, Ye.V. and Kaftannikov, I.L. "Processor with Parallel-Associative Data Processing" in "Parallel'nyye mashiny" [Parallel Machines], Kiev, 1980, pp 32-34. (Preprint No 223, Ukrainian SSR Academy of Sciences Institute of Electrodynamics).

7. Arlazarov, V.L., Dinits, Ye.A. and Yemel'yanov, N.Ye. "One Approach to Constructing a High-Level Instruction Set" in "Mnogoprotsessornyye vychislitel'nyye sistemy" [Multiprocessor Computing Systems], Moscow, 1975, pp 45-53.

8831
CSO: 1863/95

ANALOG MEMORY UNIT OF ANALOG COMPUTER

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 4, No 1, Jan-Feb 82 inside back cover

[Text] The analog memory unit developed at Kazakh State University is a unified component of special-purpose analog computers in which resistive networks are used. The unit's circuit contains access and storage circuits connected in parallel and operating alternately over time to store and compile analog information obtained in the resistive network. Information is stored in the form of voltage of a specific magnitude in the plates of the memory's capacitor. The analog memory unit is designed for the cyclic precision transfer of the analog voltage value from one point in the resistive network to another.

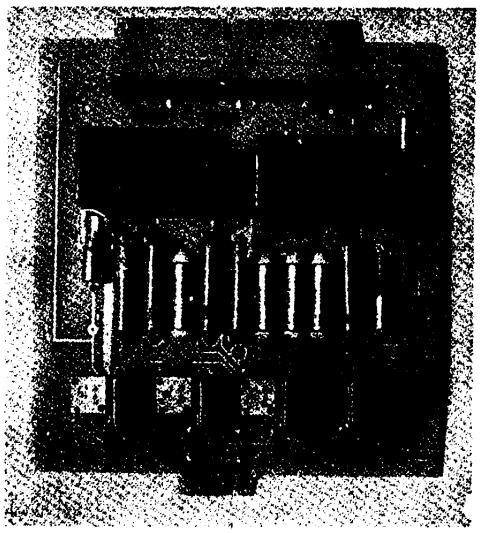


Figure 1. Analog Memory Unit

Automatic correction of the error originating as the result of the joint effect of zero drift and temperature-related zero drift and the displacement and offset current is employed in the unit. Correction is combined in terms of time with the access mode, as the result of which accessing of the analog signal is accomplished with an accuracy of not less than 0.0005 percent.

Reed relays are used as switching elements for the purpose of reducing the error resulting from switching. The minimum access time thereby equals $5 \cdot 10^{-3}$ s.

The error arising as the result of leakage of the charge from the memory capacitor's plates and the polarization of the dielectric is reduced to a minimum by selecting the type of capacitor and by appropriate circuitry solutions. The rate of distortion of an analog quantity during storage is not greater than 0.001 percent per minute.

The input voltage range of the unit is from -10 V to +10 V. The unit has a simple pulse sequence for controlling the accessing, storage and correction processes. The overall dimensions of the unit's printed circuit board are 150 X 150 mm and the supply voltage is +15, -15, +5 V.

8831
CSO: 1863/95

UDC 621.382

PHYSICOTECHNOLOGICAL PROBLEMS OF COMPUTER ENGINEERING

Kiev FIZIKO-TEKHNOLOGICHESKIYE VOPROSY VYCHISLITEL'NOY TEKHNIKI in Russian 1981 (signed to press 17 Jun 81) pp 3-4, 8-14, 24-25

[Preprint 81-33, "Physicotechnological Problems of Computer Engineering", by Ali Mamedovich Abbasov, Anatoliy Ivanovich Zolotopup, Ol'ga Vasil'yevna Dronova, Igor' Vyacheslavovich Zavalin, Yuriy Yakovlevich Kanevets, Viktor Alekseyevich Tarasov and Aleksandr Mikhaylovich Bogdanchenko, Ukrainian SSR Academy of Sciences, Institute of Cybernetics, 300 copies, 28 pages]

[Excerpts] 1. On One Method for Formalizing Drawing of LSI Circuit Topology

A central problem in automating design of integrated circuits [IC] is the synthesis of topological drawings (TCh) for large-scale IC's [LSI]. Inadequate formalization of this process is the main reason for the decline in efficiency of application of computer-aided design [CAD] systems for LSI topology [1].

Most methods for automating synthesis of LSI topological drawings are based on using sketches of topological drawings developed manually, which can be quite varied: rough (dimensionless) depiction of the topological drawings, their simplified graphic representation and symbolic representation. Simple and convenient for computer representation is a sketch of a topological drawing that is a conventional depiction of the elements and connections in the electrical circuit (ES) on an orthogonal topological grid [2 - 4]; it is sometimes called a symbolic representation or draft (SP) of the LSI circuit. With special rules for drawing the symbolic draft and certain metric and geometric descriptions of the elements in the layout drawing and grid, it is possible to construct a symbolic draft of an LSI circuit, isomorphic to the layout drawing [3, 4].

The main stages in design of an LSI circuit, such as minimization of the chip area, reduction of path intersections in the same technological layer and optimization of circuit characteristics, are solved precisely at the stage of drawing the symbolic draft. In the process, manual drawing of the symbolic draft does not permit meeting the criteria cited above to an adequate extent. Also, the probability of errors in it is not precluded; therefore, the symbolic draft itself has to be completely checked. Given below is the technique for formalizing the drawing up of a symbolic draft for the layout drawing of an LSI circuit.

In conclusion, let us note that the technique cited for formalizing the compilation of a symbolic draft for the layout drawing of an LSI circuit when it is applied in

the symbolic method [3, 4] for designing the layout drawing for an LSI circuit permits full automation of the layout drawing synthesis process. Programs that implement this technique are now being debugged on the BESM-6 computer and it is planned to include them in the SIMPAS computer-aided design system [4].

2. Formation of Low-Resistance High-Temperature Layers in Integrated Circuit Technology

The widespread introduction of IC's in the national economy urgently requires improving the electrical characteristics, raising the reliability and expanding the operating conditions for IC's both through developing new physical principles and through improving their manufacturing technology. A special role in solving these problems belongs to the development of multilayer metallization which meets the complicated requirements of IC technology.

In LSI circuits, particularly in those with a high scale of integration and speed, increased demands are imposed on the longitudinal resistance of the buses, which leads to the necessity of developing multilayer high-temperature metallization [6].

These problems can now be solved by applying thin films of infusible, chemically stable, low-resistance materials with metallic type of conductivity. Such materials include certain borides, for example WB_4 and LaB_6, tantalum carbide TaC, transition metal silicons WSi_2, $MoSi_2$, $TiSi_2$ and others. The metallic silicons WSi_2 and $TiSi_2$ are most promising because of their unique properties: rather low specific resistances R_s = /12.5 ... 25/ microohms.cm, the capability of obtaining barrier-free contact to silicon of n^+ and p^+ types of conductivity with low specific contact resistance R_c = /2 ... 8/ $.10^{-6}$ ohms.cm^2, high eutectic temperature with silicon T_{eut} is greater than or equal to 1200°C, good adhesive-cohesive properties with silicon, glass ceramic and quartz, and the high reliability and stability of parameters over prolonged operation [7 - 9].

A number of methods are available for forming silicide films on the surface of a silicon wafer: deposition of the film by the method of discrete evaporation of silicide powder, and by the method of sputtering of a silicide target in plasma of direct or alternating current and of spraying of silicide by an electron beam; formation of a silicide layer by high-temperature annealing from a metallic film spray-coated on silicon; formation of a silicide layer in the process of spraying metal on the substrate heated to a certain temperature (800-1000°C) and formation of a silicide layer by simultaneous spraying of silicon and metal from two sources by two electron beams.

Key:
1. R_s in ohms/□
2. h in micrometers

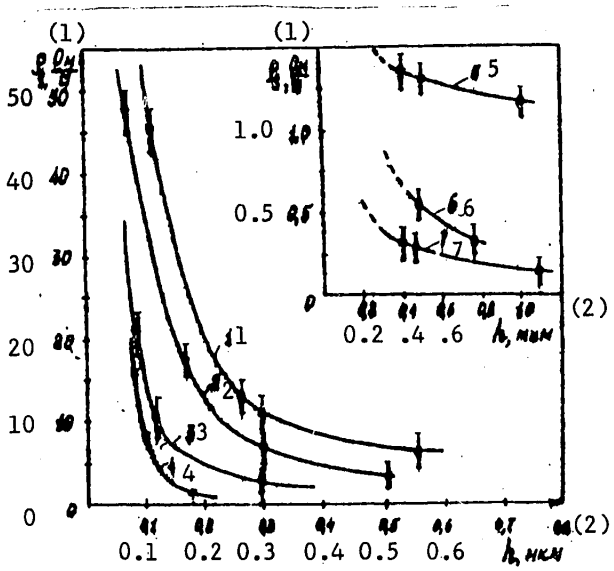


Fig. 1.

Shown in fig. 1 are the graphs of the specific resistance of films based on silicides WSi_2 and $TiSi_2$ as a function of the thickness obtained by the different methods under various conditions.

Curves 1 and 3 are for sputtering of WSi_2 from a target in a plasma of direct current when $P_{Ag} = 4.10^{-4}$ torr and $P_{Ag} = 5.10^{-3}$ torr, respectively; curve 2 is for sputtering of W from a target in a plasma of direct current when $P_{Ag} = 10^{-3}$ torr and $T_{substrate}$= 900°C; curve 4 is for sputtering of WSi_2 of powder by discrete vaporization when $P = 10^{-6}$ torr; curve 5 is for forming WSi_2 with sputtering of W and by electron beam when $P = 4.10^{-7}$ torr and $T_{substrate}$= 1100°C; curve 6 is for deposition of W and Ti from two sources by two electron beams; curve 7 is for forming $TiSi_2$ with deposition of Ti by electron beam when $P = 4.10^{-7}$torr and $T_{substrate}$= 1000°C.

Formation of film by the method of discrete vaporization of silicide powder permits performing deposition in a high vacuum on the order of $10^{-6} - 10^{-7}$torr, which enables obtaining layers of high electroconductivity (R_s = 0.5 - 0.6 ohm/□). However, this method has a number of substantial shortcomings. The high temperature for silicide vaporization leads to rapid destruction of the tungsten evaporator, which results in contamination of the film by the evaporator material. The nonuniformity of silicide powder supply from the vibrating feed bin hinders checking the growth of the thickness of the silicide layers and results in formation of defects in the form of embedded particles of silicide the size of 2 to 10 micrometers on the surface of the silicide layers.

The method of sputtering of a silicide target in a plasma of direct current enables obtaining, just as in the previous method, silicide layers on substrates of various materials (both silicon and dielectric). Because of the low rate of deposition and the high reproducibility of the process, this method enables obtaining different sizes of silicide layers with fine reproducible thickness and electrical parameters. But the shortcoming in thsi method is that, just as in deposition of metallic films,

it is difficult to obtain low-resistance layers because of the introduction of an inert gas and residual oxygen into the film. Using this method, we obtained films of WSi_2 with a thickness on the order of 5000 Å with a specific resistance on the order of 2-3 ohms/□ after annealing at a temperature of 1150°C for 20 minutes. This method also requires manufacturing silicide targets with high purity and a specific porosity to avoid destruction of the target in the sputtering process.

Deposition of films by electron beam from a target of molybdenum silicide, obtained by the method of powder metallurgy, did not permit formation of silicide layers with the required stoichiometry because of the destruction of the silicide in the process of vaporization and primary deposition of silicon on the substrate.

Formation of silicide layers by the method of deposition of metallic films and subsequent high-temperature annealing enables obtaining qualitative layers of silicide with the required stoichiometry. But this method does not permit obtaining layers of WSi_2 and $MoSi_2$ with a thickness of more than 0.4-0.6 micrometer, which provides a specific resistance for such films on the order of 0.6-0.8 ohm/□ .

Obtaining thicker silicde layers is possible when the metal is sputtered on a highly heated silicon substrate. In doing so, silicide is formed in the metal sputtering process. This method requires selecting the optimal metal sputtering rate and substrate temperature. The substrate temperature determines the silicide growth rate, however, it may vary within fixed limits. At a low substrate temperature (less than 700°C), the rate of formation of silicides of tungsten and molybdenum is very low; at a high temperature (over 1000°C), the atoms of the deposited metal penetrate deeply into the silicon substrate, which results in an excess of silicon in the layer being formed. Experiments have shown that an optimal substrate temperature must be selected for each metal. For example, for titanium, this temperature lies within the range of 800-900°C, and for tungsten, up to 1100°C at high rates of metal feeding (on the order of 40-50 Å/s). The optimal metal feed rate is selected after selecting the substrate temperature. Disparity between the metal feed rate and growth of the highest phase of the silicide $MeSi_2$ results in deterioration of the stoichiometry. Additional annealing can eliminate metal excesses in the silicide film.

The method of forming a silicide layer by simultaneous deposition of silicon and metal from two sources by two electron beams is promising. It enables forming a layer with the required stoichiometry on any substrate, but the complexity consists in selecting and ensuring the required relationship between rates of deposition of the silicon and the metal.

Key:
1. R_s, ohm/□
2. $t_{substrate}$, °C

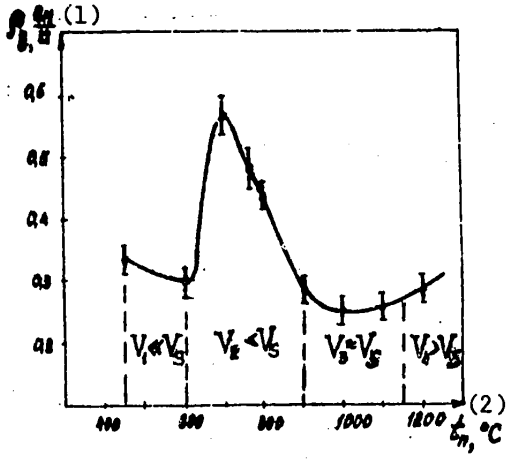


Fig. 2.

Fig. 2 shows the plot of the specific resistance of titanium film with a thickness of 1.05 micrometer deposited on a silicon substrate KEF-0.5 /III/ by the electron-beam method as a function of substrate temperature t_s. The sputtering was performed in a vacuum of 5.10^{-7} torr at a constant metal feed rate V_s of 33 Å/minute; V_1-V_4 are the rates of diffusion of the silicon into the film at the different temperatues.

When the substrate temperature is raised to 600°C, the specific resistance of the film is reduced insignificantly through the processes of recrystallization and improvement in the film structure. In the process, there is still no noticeable mutual diffusion of the silicon and metal. Electron-diffraction studies have revealed the polycrystalline structure of the metallic film.

When the substrate temperature is raised to 700°C, film resistance sharply rises two- to threefold through the intensive diffusion of the silicon into the metallic film. In the process, electron-diffraction studies have revealed the quasi-amorphism of the film structure.

With a further rise in substrate temperature to 900°C, specific resistance of the film declines through formation of the low-resistance silicide phase and, accordingly, the decline of free silicon in the metallic film. The primary presence of titanium disilicide $TiSi_2$ in the film is confirmed by electron-diffraction studies.

With a further rise in substrate temperature, film resistance changes insignificantly; this is due to the approximate equality in the rates of metal feeding V_s and of diffusion of the silicon through the silicide layer V_3.

It should be assumed that as substrate temperature increases above 1200°C, specific resistance will increase due to the quantity of silicon concentration in the silicide layer.

Thus, as a result of the studies made, the conclusion can be drawn that the most acceptable methods for forming high-temperature metallization are the methods of obtaining silicide layers by annealing of the matallic film deposited by an electron beam in a single vacuum cycle and the method of forming silicide in the process of metal sputtering on a hot silicon substrate and the combination of these methods in one cycle.

BIBLIOGRAPHY

1. Batalov, B. V.; Nazaryan, A. R. and Rudenko, A. A., "Trends and Prospects for Automating Design of Electronic Items," ELEKTRONNAYA PROMYSHLENNOST', No 4, pp 3-11, 1979.

2. Selyutin, V. A., "Mashinnoye konstruirovaniye elektronnykh ustroystv" [Computer Aided Design of Electronic Devices], 383 pages, Moscow, Sov. radio, 1977.

3. Gibson, D. and Nance, S., "Symbolic System for Circuit Layout and Checking," Prod. of ISAS, Phenix, USA, pp 436-440, 1978.

8545
CSO: 1863/90

UDC 681.327.67

BROAD APPLICATION MEMORY UNIT

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 81
pp 9-11

[Article by engineers N. I. Velichko, B. Ye. Vasil'yev, G. V. Vshivtsev, N. P. Gritsayenko, Yu. I. Statylko and V. Z. Yampol'skiy]

[Text] The modular principle of designing storage devices (ZU) that provide ease of increasing the memory, the capability of further development and high reliability of the entire system, finds broad application in computer design. The main requirements placed on the memory unit are simplicity of the control circuits and technological outfitting at all phases of manufacture and testing. Fulfillment of these requirements permits the memory unit to be used in different computers and production of it over a prolonged time in large volumes.

Two principles of internal storage design are possible. Memory units can have a functionally complete structure, i.e., they may contain their own control circuits and interface [1]. Increases of the memory capacity are achieved in this case by parallel connection of auxiliary memory units to the mainlines of the computer interface. This structure of design has considerable disadvantages: the memory unit cannot be used in computers having communication interface different from the memory units and it is complicated to monitor the storage medium.

In the other case the internal storage of the computer is fulfilled in the form of a set of memory units of the same type and functionally complete control and interface units. The storage capacity is increased by connecting additional memory units with the number of control and interface units remaining unchanged [2, 3].

The latter of the named design structures of the memory was adopted when developing the A211-15 and A211-16 ferrite memory modules, that have found application in different computer complexes of the SM EVM [International Small Computer System]. The BP-38 (BP) semiconductor memory unit, which is used extensively in various storage devices of the international small computer system, was developed for the second unit of the SM EVM.

Dynamic type integrated memory microcircuits with random access of type K565RU1, constructed on n-channel MOP-devices and which are a single-digit

storage device with capacity of 4,096 bits, are used as the storage elements in the semiconductor memory unit.

The main characteristics of the semiconductor memory unit are presented below. The characteristics of OZU-NTsOZD [1] and MSV 11-B memory modules of the DEC Company (United States) are given for comparison.

	BP-38 for SM-1M, SM-2, SM-2M and Other Computers	OZU-NTsOZD Module for Elektronika NTsOZD Computer	MSV11-B for LSI-11 Computer
Bit capacity	8K X 22	8K X 16	4K X 16
Access time, nanoseconds	300-400	550	
Access cycle, nanoseconds	600-800	750	--
Specific consumed power, mW/bit	0.1	0.09	0.19
Specific capacity, bits/cm^3	226	202	186
Type of memory		Semiconductor	
Capability of working with Hamming codes	Yes	No	

The specifications of the semiconductor memory unit are presented in the table as a function of its versions.

Parameter	Version of Semiconductor Memory Unit BP-38/1	BP-38/2	BP-38/3	BP-38/4
Time, nanoseconds:				
cycle	600		800	
access	300		400	
Regeneration period, ms	2			
Type of microcircuits	K565RU1A		K565RU1B	
Method of address and number transmission:				
parallel	Yes	No	Yes	No
serial	No	Yes	No	Yes
Power supply voltage, V	+5, -5, +12			

A functional diagram of the semiconductor memory unit is shown in Figure 1 and includes the following functional assemblies: address reception, number reception and retrieval, control signal reception, access signal shapes, semiconductor memory unit tuning, memory and encoder.

The address reception assembly is based on K131LN1 microcircuits and is designed to receive and distribute address signals. In semiconductor memory units with serial transmission of address and number, the signals of the latter are fed alternately over the same buses. In these semiconductor memory units, microcircuits D1 are not installed and the address is transmitted through the

number reception and retrieval assembly and matching resistors for distribution to the inputs of microcircuits D2. In all versions of the semiconductor memory unit, a 12-digit address code is fed from the output of the address reception assembly to the address inputs of the memory microcircuits, to which the signals of the six bottom digits of the address are fed in the regeneration mode.

The number reception and retrieval assembly is based on K589AP26 microcircuits, which are bus shapers with inversion. It is designed for reception of the number code of the write mode from two-way buses of the semiconductor memory unit and also of address signals in the write, read and regeneration modes for versions of the semiconductor memory unit with serial address and number transmission. A 22-digit number is fed from the output of the assembly to the information inputs of the memory microcircuits. In the read mode, a 22-digit number is fed from the outputs of the memory microcircuits through the number reception and retrieval assembly to the buses of the semiconductor memory unit.

A control signal reception assembly is provided for reception and matching of the following gating signals: CS1-CS4 crystal selection, CE1 and CE2 access authorization, WE write authorization, UV reception-retrieval control and "Reg" regeneration signal. The assembly is based on K131LA3 microcircuits.

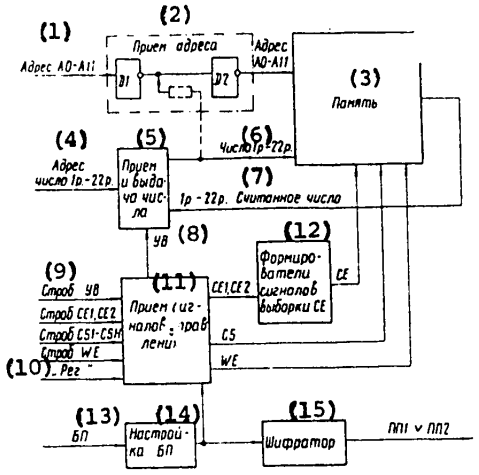


Figure 1

Key:

1. Address
2. Address reception
3. Memory
4. Number address 1-22
5. Number reception and retrieval
6. Number 1-22
7. Read number
8. Control device
9. Control device gate
10. Regeneration
11. Control signal reception
12. CE access signal shapers
13. Semiconductor memory unit
14. Adjustment of semiconductor memory unit
15. Encoder

The CE access signal shaper assembly is used to match the access input of the memory microcircuits having high MOP-level to the control signals of the TTL-circuits. The assembly consists of four shapers, each of which is designed for its own group of memory microcircuits. A diagram of the shapers is presented in Figure 2. It contains a switch D1, V1 n-p-n-transistor and V2 discharging p-n-p transistor, switch D2 and auxiliary transistor V3.

In the initial state (during the pause between two accesses), a high-level signal (logic "1") is fed to the inputs of switches D1 and D2, based on two inverters with K155LA11 open collector and in this case the cut-off voltage is fed to the base of the V1 transistor. the voltage at the output of the shaper will be equal to the saturation voltage of switch D2 (not more than 0.4 V). If a low-level voltage pulse is fed to the inputs of switches D1 and D2, transistors V1 and V3 are opened and the charging current of the load capacitor flows through resistor R4 and in this case transistor V2 and switch D2 are closed. Transistor V3 increases the total amplification factor for stage current in transistor V1 and reduces the voltage drop on resistor R1 by reducing the base current of transistor V1.

When the voltage at the input of switches D1 and D2 is compared to the level of a logic "1," transistors V1 and V3 are closed and transistor V2 is opened and in this case the main discharge current of the load capacitor flows through resistor R3 and transistor V2. When the voltage on the load capacitor becomes equal to 1 V, transistor V2 is closed and discharge then proceeds through resistor R2 and opens switch D2. As a result the potential at the output of the shaper is set equal to the voltage drop on the saturated transistor of switch D2 (not more than 0.4 V). Resistors R3 and R4 are damping resistors that limit the current during charging and discharging of the load capacitor of the access input of the memory microcircuits. Resistor R2 limits the current through switch D2.

The encoder is designed to shape the conformation signals of receiving access to the selected semiconductor memory unit: PP1 or PP2, by means of which the storage device of one of two time diagrams can be formed. Thus the operation of a storage device with semiconductor memory unit of different speed (with K565RU1A or K565RU1B microcircuits) is provided. The encoder is adjusted by setting the diode to one of two adjusting points, depending on the type of memory microcircuits used in the semiconductor memory unit.

The adjusting assembly of the semiconductor memory unit is used for automatic selection of the memory unit corresponding to the access address in the storage devices of computer systems having internal communication interface of the IUS. One of the characteristic features of the latter is the fact that the general installation connections should be made identical in it for all interface points, which does not permit radio communications with each semiconductor storage unit. At the same time it was necessary to exclude tying in the semiconductor storage unit to a specific interface point and to make the unit universal. It is the adjusting assembly of the semiconductor memory unit that permits one to create a semiconductor memory unit access circuit to the storage device that meets this requirement. It is connecting links laid with printed-circuit conductors between specific contacts of the semiconductor

memory unit plug. The semiconductor memory unit is selected through its adjustment assembly by the corresponding signal of the number decoder of the semiconductor memory unit shaped in the control unit of the storage device.

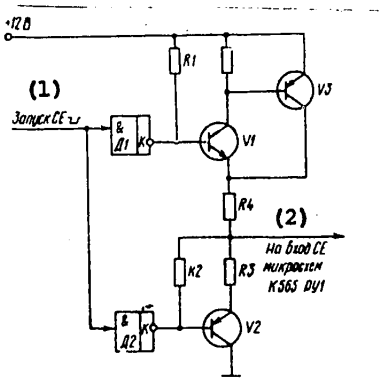


Figure 2

Key:
1. CE start
2. CE input of K565RU1 microcircuits

The memory unit--a storage matrix with capacity of 8,192 words X 22 bits--is designed to store information. A capacity of 8K bits is provided by combining two memory microcircuits in a single digit. One of them is selected with a corresponding combination of CS and CE signals.

An important condition for successful realization of a semiconductor memory unit based on dynamic memory microcircuits is precise calculation of the tolerances for the power supply and synchronization parameters. A no less important aspect is careful layout of the power supply circuits on the printed circuit card of the semiconductor memory unit and decoupling of them. As an example let us consider filtration of power supply circuits of +12 V. Each memory microcircuit may consume peak currents from 50 to 120 mA with fronts of 20-30 nanoseconds along the front and drop of the pulsed CE access signal. Local filtration of the power supply circuits is used to reduce the resulting voltage fluctuations, i.e., a capacitor with minimum length of communication to the corresponding contacts of the microcircuit to which the power supply lines are fed is located alongside each memory microcircuit. Moreover, each memory microcircuit consumes from 20 to 50 mA DC during access signal CE. The power supply feed system should ensure that these are direct currents with retention of voltage on the memory microcircuits. To do this, the power supply lines are made in the form of a network of printed-circuit conductors laid in the vertical and horizontal directions and having maximum possible width [4].

Selection of the type of decoupling capacitors is very important. On the one hand, they should have low series resistance and on the other they should have sufficiently high capacitance. Ceramic capacitors meet these requirements

most fully. Therefore, KM5 capacitors with capacitance of 0.033 μF are installed for decoupling through power supply circuits of ± 5 V and partially for those of +12 V. K53-4A capacitors with capacitance of 2.2 μF are provided alongside each memory microcircuit through the power supply circuit of +12 V.

Correct distribution of the address, data and control signal circuits is also significant. The main synchronizing signal is the CE access signal, which is fed to the access input of the memory microcircuits in a pulse with amplitude of +12 V. Rigid requirements on the length of the front, square-wave nature and high and low signal levels are placed on the parameters of the CE access signal. A CE access signal shaper based on digital components described above was developed to meet these requirements. The memory microcircuits must be arranged near the shaper so as to provide the necessary parameters of the CE access signal. The control signal, address and data lines should have minimum length.

With regard to the foregoing, a design of a semiconductor memory unit located on a printed-circuit card measuring 234 X 220 mm was made. The logic microcircuits are located in the first row from the plug. The next four rows occupy memory microcircuits (11 each in each row). The storage medium in each row is divided into two parts, between which are two K131LN1 logic microcircuits to distribute the address and a CE access signal shaper for the memory microcircuits of this row, due to which the length of any communications line does not exceed 14 cm. This design of a semiconductor memory unit made it possible to lay the data lines perpendicular to the address and control signal lines, which reduces crosstalk.

High production outfitting during production is typical for the described semiconductor memory unit. Input verification of the memory microcircuits is accomplished on the Elekon F-ZU functional testing installation. The memory microcircuits are checked in "Beg 1 (0)," "Paired read 1(0)" and "Marsh" tests. It is further proposed that a programmable bench with expanded set of tests be used for these purposes. A PNZU-22M storage device tuning console is used to check semiconductor memory units. The check can be made in the automatic mode according to the test program, which contains the following tests: "1," "0," "Number code equal to address" (direct and inverse), "Run 1(0)," "Heavy code" (direct and inverse) and "Alternating 1/0 by addresses." Moreover, the following dynamic tests are made: "Mar h," "Multiple address access," "Travelling 1(0) by addresses" and "Paired reading 1(0)." All tests can also be performed on the regenerative frequency. The enumerated tests are designed for functional checking of semiconductor memory units with different versions of information distribution in the memory. This set of tests is recommended to check the storage medium of devices and complexes containing and given semiconductor memory unit.

The semiconductor memory unit is now being produced serially by several plants.

BIBLIOGRAPHY

1. Titov, Yu. I., V. A. Shakhnov and V. N. Shmigel'skiy, "Semiconductor Internal Storage Module for Microcomputers," "Mikroelektronika i poluprovodnikovyye pribory" [Microelectronics and Semiconductor Devices], collection of articles, No 4, Moscow, Sovetskoye radio, 1979.

2. Velichko, N. I., G. V. Vshivtsev, N. I. Kholokholov and V. Z. Yampol'skiy, "Design and Manufacture of the Internal Store of the International Small Computer System," "Konstruirovaniye i proizvodstvo zapominayushchikh ustroystv", materialy kratkosrochnogo seminara" [Design and Production of Storage Devices, Proceedings of a brief seminar], Leningrad, LDNTP, 1980.

3. Ognev, I. V. and K. F. Sarychev, "Investigating Modular Semiconductor Internal Stores," "Trudy Moskovskogo ordena Lenina energeticheksogo institut, Tematicheskiy sbornik, Avtomatizatsiya proyektirovaniya i upravleniya" [Proceedings of the Moscow Order of Lenin Power Engineering Institute, topical collection, Design and Control Automation], No 3 (80), Moscow, MEI.

4. Keilbotta, "Characteristics of Designing Systems with Dynamic Storage Devices," ELEKTRONIKA, No 3, 1978.

6521
CSO: 1863/69

SOFTWARE

UDC 681.326

ADAPTING MACHINE GRAPHICS PROGRAM PACKS TO GRAPHIC INFORMATION DISPLAY DEVICES

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 81
pp 1-2

[Article by engineers S. N. Grinfel'd, M. N. Sorokin, M. I. Kislyy and V. Yu. Skobarev]

[Text] The development of computer equipment is now characterized by ever wider use of graphic display devices. The use of graphic displays and graph plotters of various types permits information to be obtained from a computer in a form convenient for perception and subsequent analysis. There is a large variety of display devices mainly having different instruction systems. Image programming by using these instruction systems is a very laborious process; therefore, special languages and machine graphics program packs are being developed in our country and abroad that permit the programmer to describe the image in a higher level language than the graphic display or graph plotter instruction system.

When developing the software (MO) for graphic devices (GU), developers are faced with a very important problem--to achieve independence of the machine graphics program pack from the computers and displays used. The use of general-purpose programming languages for graphic programming permits one to solve to a certain degree the problem of providing independence of the graphic software from the computer being used. The general-purpose programming language most widely used at present in machine graphics is FORTRAN. Thus, for example, the input languages of well-known graphic program packs GRAFOR, PADEC and DISGRAF [1-3] are the set of FORTRAN language operators CALL. Providing the independence of the machine graphics software from the instruction system of the graphic information display devices is very timely, although specific results have already been achieved in solving the given problem.

The purpose of this article is to analyze the existing situation and to work out an effective method of solving the problem.

The graphic device software usually has two levels: functional and basic. The functional level includes programs that realize operations which are independent of the graphic device. The basic level consists of programs that perform operations determined by the specifics of the instruction system for control of a specific graphic device. Thus, in order that the software of a

given graphic device can be used with another display, the basic level program must be reworked or finished while completely retaining the functional level program. In developing the graphic device software, one must decide which programs to include in the functional level and which in the basic level. Let us consider how this problem is solved in Soviet machine graphics program packs.

The segment plotting programs, i.e., the programs that form the control information for the graphic device by coordinates of the beginning and end of the segment, can be assigned to the basic level in GRAFOR--the graphic program complex in FORTRAN language [1]. The problem in the graphics software system (SMOG) can be solved in similar fashion [4]. Here the basic (buffer) part of the SMOG receives control information on the motion of the raised (lowered) graph plotter pen to a given point on a sheet of paper. The buffer is actually a complex of programs consisting of the master and interpolating program (for interpolation of the straight line segment) and information processing programs for each graphic device serviced by the system.

Programmed generation of symbols is performed at the basic level in the computer and GRAFIK graph plotter software system for graphic devices having no symbol generators, for example, DGU-2, while the letter and number generation programs are replaced by instructions that generate the signal for plotting these letters and numbers for devices of type DGU-4 containing a machine symbol generator. The programs of the basic graph dialogue program pack (level I) for the BESM-6 DISGRAF [3], the same as in the GRAFIK system for the DGU-2, have frames at the output that carry information about the segments which the graph plotter should plot. The basic program pack (level III) that programs the graphic images in ALGOL language for the M-222 computer complex--the automatic graph-drawing machine ITEKAN-2M [6] generates information at the level of graphic components "straight line," "arc" and "symbol line." The basic program pack PADB that implements operations determined by the specifics of the instruction system of the automatic drawing machine has been developed in the graph description language OGRA-EC and the PAD-EC program pack [2]. Information of the "segment," "broken line," "arc of circle" or "circle," "curve," "text" and "marking symbol" type is the input information of the PADB pack.

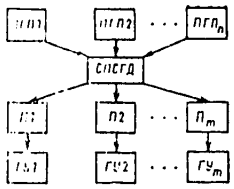


Diagram of Graphic Information Conversion When Using SPSGD:
PGP_i--i-th graphic program pack; P_j--j-th postprocessor;
GU_j--j-th graphic device

Analysis shows that the existing basic parts of machine graphics program packs were developed for specific graphic devices. The basic part of these packs

must be modified in order to use them for other graphic devices, which is a rather laborious process. Moreover, qualified specialists and detailed information on integration of the basic and functional parts of the pack are required to modify the basic part of the graphic packs. The literature published on the graphic pack frequently does not include all the information required to modify the basic part of the pack, since the user is not always able to develop a new basic part of the pack independently. If he does take on this work, the need for frequent consultations with the developers of the graphic pack does not contribute to rapid development of the new basic part since the users and developers of graphic program packs are frequently located in different cities of the country.

It was pointed out in [5], devoted to the computer software and GRAFIK graph plotter system, that expenditures to develop the basic parts of the system for graphic devices having no principle differences from DGU-2, DGU-4, YeS-7051, YeS-7052, YeS-7053 and ATLAS, with "the participation of the primary developers in their formulation," may comprise 15-20 percent of the total expenditures for the initial development of program modules for the DGU-2. And what if the future user of the GRAFIK system is unable to bring the developer in to develop the basic part that he requires? It is not always easy for the user to determine the clear boundary between its functional and basic parts when working on the graphic pack. Moreover, both of the parts must be completed in some realizations. Thus, for example, information on symbols is generated in the functional part of the system in SMOG. If the graphic device is equipped with a symbol generator, the user must either reject the use of a hardware symbol generator (the counting time, computer memory capacity, size of the control program and accordingly the time required to plot graphic documents increase in this case) or he must correct the functional part of the pack, which is rather cumbersome and requires special knowledge and skills.

The problems enumerated above occur for the user of the graphic program pack who solves the problem of tying it in to the graphic information output device. A solution of these problems would be development of a standard intermediate graphic data structure (SPSGD), which should be formed by the graphic program pack, i.e., which is the end result of their work. A program for converting the information in the form of the SPSGD to the control program for a given device (postprocessor) should be developed for each graphic device. Formation of output information from all the graphic program packs being developed in SPSGD and the presence of postprocessors for all graphic devices produced permit one to solve the problem of ensuring the independence of graphic program packs from the graphic devices being used (see figure).

The requirements placed on the SPSGD are met to a considerable degree by the intermediate processor-postprocessor language CLDATA (Cutter location data--data on tool motion [7]), designed to standardize the development of postprocessors for machine tools with ChPU [Numerical program control] and to ensure integration of postprocessors with different automated control program preparation systems (processors).

The intermediate processor-postprocessor language has been adopted by CEMA, is recommended by ISO and is used extensively in development of software with

output to machine tools with ChPU. The conformity on the content of CLDATA recordings to the ISO data format permits a considerable reduction of expenditures to develop postprocessors for graphic devices having the data format recommended by the ISO for machine tools with ChPU [8]. These devices may include, for example, the YeS-7054 (CSSR), the Aristograph and Aristomat of the Aristo Company [West Germany], the KAS-21 of the Coradi Company (Switzerland) and so on. It is suggested in [9] that the data format of ISO be used for devices with ChPU developed with regard to the characteristic features of graphic information display for all autonomous graphic devices.

The use of intermediate CLDATA language to display input information when forming the control programs of graphic devices also seems promising to us in light of the broad capability of using graphic devices to check the control programs of machine tools with ChPU. Thus, enterprises having a postprocessor with CLDATA language for graphic devices can make a check drawing without additional development of special programs with receipt of graphical documentat tion prior to developing control programs for machine tools with ChPU.

The given analysis leads to the following conclusions.

1. The use of CLDATA language as the SPSGD permits the user having a postprocessor from this language for a specific graphic device to work with any graphi program pack or even with several similar packs simultaneously.

2. Use of CLDATA language providesfor tying the grahic program pack to a specific graphic device without additional expenditures.

3. The language is described in detail in the literature, which permits the user himself to easily develop a postprocessor for the graphic device available to him. The participation or at least many consultations of the developers of the given pack is necessary for modifying the basic part of existing graphi program packs.

4. The intermediate CLDATA language was recommended by ISO and CEMA for programming systems of machine tools with ChPU, but at the same time it contains the required set of recordings for graphic devices and permits the capability of both programmed and hardware generation of symbols, which is not realized in all graphic program packs.

5. The format of the CLDATA language recordings corresponds to the format recommended by ISO for programming machine tools with ChPU. A number of graphic devices now has the data format recommended by ISO for programming machine tools with ChPU and the number of these devices will increase every year.

6. CLDATA is used extensively as an intermediate processor-postprocessor language when programming machine tools with ChPU. Thus, control information for graphic devices and machine tools with ChPU will be written in a unified language. This will make it possible to debug the control programs for machine tools with ChPU in graphic devices.

The basic part of the widely used PAD-EC program pack that ensures formation of graphic information in CLDATA language has been developed at VNITIpribor [All-Union Scientific Research Technological Institute of Instrument Making], NPO [Scientific Production Association] Temp (Moscow) and a postprocessor from CLDATA language for the Aristo coordinate graph has been developed.

The use of the CLDATA intermediate processor-postprocessor language as the standard intermediate structure of graphic data permits users to reduce the time and labor expenditures on adaptation of machine graphics applied program packs to a graphic device and to achieve a considerable saving.

BIBLIOGRAPHY

1. Bayakovskiy, Yu. M., T. S. Lebedeva and A. I. Mamayeva, "GRAFOR--Graphic Program Complex in FORTRAN Language," No 2, Moscow, Preprint of IPM AN SSSR, 1973.

2. Zozulevich, D. M., G. B. Borisova and L. G. Maksimova, "Pakety programm avtomaticheskogo chercheniya dlya yedinoy sistemy EVM" [Automatic Plotting Program Packs for the Unified Computer System], Minsk, ITK AN BSSR, 1978.

3. "Machine Graphics and Its Application," in UPRAVLENIYE I INFORMATSIYA, No 24, Vladivostok, Dal'nevostochnyy nauchnyy tsentr AN SSSR, 1972.

4. Gladkikh, B. A., Yu. L. Kostyuk and V. A. Pozolotin, "SMOG--sistema matematicheskogo obespecheniya grafopostroitelya" [SMOG--Graph Plotter Software System], Tomsk, Tomskiy gosudarstvennyy universitet, 1974.

5. "GRAFIK--sistema matematicheskogo obespecheniya EVM i grafopostroiteley" [GRAFIK--Computer and Graph Plotter Software System], Kishinev, Shtiintsa, 1975.

6. Yegorov, V. A., A. I. Fedotov and L. I. Shub, "Matematicheskoye obespecheniye chertezhno-graficheskogo avtomata ITEKAN-2M na EVM M-222" [Software of the ITEKAN-2M Automatic Graph-Drawing Machine Based on the M-222 Computer], Minsk, ITK AN BSSR, 1977.

7. Deryabin, A. L., I. A. Vul'fson and L. M. Kovnatskiy, "Promezhutochnyy yazyk protsessor-postprotsessor: Rekomendatsii" [Intermediate Processor-Postprocessor Language--Recommendations], Moscow, ENIMS, 1976.

8. Draft of International Standard ISO/DIS 1056. Numerical Control of Machines--Punched Tape Block Formats," Coding of Preparatory Functions and Miscellaneous Functions," Moscow, International Organization for Standardization, 1974.

9. Petrov, Yu. A. and L. V. Semenov, "Selecting the Data Format for Autonomous Graphic Devices," VOPROSY RADIOELEKTRONIKI, SERIYA EVT, No 4, 1975.

6521
CSO: 1863/69

UDC 658.51.011.56

CENTRAL-LEVEL-DATA MANIPULATION LANGUAGE IN HETEROGENEOUS DATA BASE INTEGRATION SYSTEMS

Kiev YAZYK MANIPULIROVANIYA DANNYMI TSENTRAL'NOGO UROVNYA V SISTEMAKH INTEGRATSII NEODNORODNYKH BAZ DANNYKH in Russian 1981 (signed to press 17 Jun 81) pp 2-8, 55

[Annotation, introduction, sec 2 and conclusion from preprint "Central-Level-Data Manipulation Language in Inhomogeneous Data Base Integration Systems", by Leonid Andreyevich Kalinichenko, Inessa Aleksandrovna Chaban and Aleksandr Sergeyevich Nazarov, Ukrainian SSR Academy of Sciences Institute of Cybernetics Preprint No 81-21, 300 copies, 58 pages]

[Text] In this study a characterization is given of the input language of the central-level data processor in the SIZIF inhomogeneous data base integration system, which makes possible the independence of applied programs from data base control systems (SUBD's) and their simultaneous interaction with many data bases organized by means of various SUBD's. The central level of the subsystem for the interpretation of operations on data in the SIZIF system is based on a general representation of data which is independent of SUBD's. The general central-level-data manipulation language contains the following statements: relational algebra; cyclic relation - module - virtual data base processing; parallel programming and distributed processing; relation conversion; and logic, arithmetic and control statements.

This study is intended for a wide range of programmer-mathematicians.

1. Introduction

The accumulation of various data bases in data base control systems (SUBD's) of different types has created the problem of the simultaneous and combined use by an applied program of several data bases as a combined whole, which are incompatible in terms of software and data. The solution to this problem is one of the main objectives of the inhomogeneous data base integration system project being developed at the Institute of Electronic Control Machines. The following are being developed within the scope of this project:

An expandable conceptual model of data making it possible to represent effectively in it random virtual models of data (net, hierarchical and relational, utilizing structured and unstructured data).

Methods, algorithms and software for the representation of various models of data in the conceptual model.

A language for programming operations on high-level data bases.

The architecture and algorithms of a program complex making possible the combined use by applied programs of inhomogeneous data bases stored in individual computers, multimachine computing complexes and networks employing ASVT-M [modular computer hardware system], YeS [Unified Series] and SM [international system of small computers] computer facilities.

The central component of the inhomogeneous data base integration system is the program processor, implementing functions of the interpretation of statements of the general data manipulation language (YaMD), which is independent of the YaMD of specific operative SUBD's. This processor, called a logical processor below, implements the following:

Interpretation of the statements of the general data manipulation language.

Interaction with processes of applied programs (receiving from processes macroprograms--sequences of statements of the general data manipulation language defining operations on integrated data bases required by these processes--and the output of results to applied programs).

Interfacing with program converters of data models of specific SUBD's into the conceptual data model.

Storage of central-level intermediate information formed in the process of interpretation of a macroprogram.

Control of the execution of a parallel macroprogram as applied to the conditions of a multicomputer complex or a computer network.

In the present study a formal definition is contained of the general language for the manipulation of data in integrated data bases which makes up the input language of a logical processor implemented by means of an M-4030 computer.

2. Functions of the Logical Processor in an Inhomogeneous Data Base Integration System

In relation to applied programs the inhomogeneous data base integration system represents a data base control system with an inclusive programming language, as which in the version of the system implemented PASCAL is used. The inclusive language is expanded by means of new types of data, statements and functions making possible operation on a virtual data base (VBD)--a homogeneous representation of integratable data bases which is independent of specific data base control systems. These statements and functions utilize the constructions of a first-order predicate logic language which can be converted by a compiler into programs in the input language of the logical processor. Relational algebra statements form the basis of this input language. The main operations for the interpretation of operations on conceptual-level data by means of specific data models are performed by drivers--dynamic converters of internal data models into the conceptual model. Each data base organized by means of some sort of data base control system is represented at the conceptual level as a group of virtual data base relations (modules). A virtual data base relation each cortege of which is united with unstructured data--an

associative cortege--forms a data module representing a group of data complexes. Associative corteges represent ordered groups of corteges of random unary and binary relations specified in sets of values of the properties of entities (domains). The logical processor interacts with drivers by means of an instruction language independent of the type of data base control system, whereby each instruction indicates the execution of some sort of operation on the virtual data base relation.

The operation unit to be communicated by the applied program's process to the logical processor is the macroprogram--a group of statements each of which causes the execution by the logical processor of specific control operations or operations on the virtual data base relation (module) or on a working relation. The macroprogram prior to output to the logical processor is set up by means of an interface concentrated in the same program section with the applied program, and actually the logical processor uses precisely this copy of it.

The macroprogram is transferred from the applied program to the logical processor in parallel form as a group of asynchronously executed branches and their data connectives. The logical processor can receive simultaneously for execution both macroprograms from the processes of applied programs concentrated with it in one and the same computer and branches of macroprograms from remote logical processors.

Normal relations are the main form of data representation at the level of the logical processor. The domains of relations have fixed scalar types and fixed representations received in the logical processor. The required transformations of types in interaction with applied programs or data base control systems are functions of individual interfaces or drivers. The logical processor has an internal memory for storing intermediate normal operating and intraprogram relations existing only during the execution of an applied program.

Virtual data base relations (modules) or working relations are the key objects of the operation of statements of the input language of the logical processor. As the result of the performance of an operation on a virtual data base relation (module) a working relation can be formed which in turn can become the object of the operation of subsequent statements of the macroprogram. The statements of the logical processor are so constructed that even if the object of their operation is a hierarchical relation or associative structures of a virtual data base module the result is represented in the form of a normal relation.

In the distributed variant of the system when a macroprogram is run its various branches are implemented by means of various logical processors, which transfer to one another the results of the execution of branches--normal relations. It is assumed that the interconnections of logical processors (through virtual channels) form a complete graph.

It should be mentioned that the end result of the execution of a macroprogram can be data structures which are directly transferrable to an applied program, such as corteges, associative corteges, complexes, arithmetic or logical values. If the end result is formed by a branch to be executed remotely it is transferred from one logical processor to another and only then to the applied program.

The logical processor performs the following key functions:

It receives macroprograms from interfaces of applied programs interacting with an integrated data base.

It organizes the execution of branches of macroprograms to be run on the computer--the residence of the logical processor.

It interprets individual statements of a macroprogram, including control, relational algebra, cyclic processing, relation modification and transformation, parallel programming and remote processing statements and logic statements.

It organizes the issuing of instructions to drivers of various data base control systems functioning in the computer--the residence of the logical processor (these instructions are formed in the interpretation of control and relational algebra statements, relation modification and transformation statements and logic and arithmetic statements carried out on virtual data base relations and modules)--and organizes interaction with drivers in the process of executing instructions.

It organizes the execution of a macroprogram within the framework of a distributed data base.

It controls internal resources, including the distribution of the logical processor's memory for storing intermediate working relations.

It organizes the output of the results of the execution of a macroprogram, via an interface, to the applied program's process.

4. Conclusion

In this study a definition has been given of the central-level-data manipulation language in an inhomogeneous data base integration system, including relational algebra statements, virtual data bank relation (module) cyclic processing statements, statements for parallel programming with distributed processing, relation transformation statements, logic statements, arithmetic statements and control statements. The facilities of the general data manipulation language are sufficient for the purpose of implementing data manipulation operations both in the concentrated and distributed variants of inhomogeneous data base integration systems and make it possible to carry out the required operations on virtual data base relations (modules)--representations of data structures in real data bases. The set of general data manipulation language facilities determines the functions of the central level of data manipulation in inhomogeneous data base integration systems and the structure of individual program processors.

8831
CSO: 1863/123

UDC 681.3.06:519.768.2

COLLECTIVE-USE COMPUTER CENTER SOFTWARE, USE OF NATURAL LANGUAGES

Kiev MATEMATICHESKOYE OBESPECHENIYE VTsKP: PRIMENENIYE YESTESTVENNYKH YAZYKOV, 1 in Russian 1981 (signed to press 22 May 81) pp 2, 17

[Annotation and table of contents from preprint "Collective-Use Computer Center Software: Use of Natural Languages, 1", edited by Doctor of Technical Sciences Professor A.I. Nikitin, Ukrainian SSR Academy of Sciences Institute of Cybernetics Preprint No 81-25, 300 copies, 19 pages]

[Text] This preprint is devoted to collective-use computer center software. In the articles contained in it are discussed facilities oriented toward use in collective-use computer centers and designed to improve the effectiveness of interaction between the user and computer, i.e., the creation of language facilities for human communication with a computer and the training of collective-use computer center users.

CONTENTS Page

8831
CSO: 1863/123

UDC 519.3.62-50

ANALYSIS OF SPACE OF RANK ESTIMATES AND SYNTHESIS OF STRUCTURAL ANALYTICAL MODELS FOR AUTOMATING EXPERT DECISION MAKING

Kiev ANALIZ PROSTRANSTVA RANGOVYKH OTSENOK I SINTEZ STRUKTURNO-ANALITICHESKIKH MODELEY DLYA AVTOMATIZATSII PRINYATIYA EKSPERTNYKH RESHENIY in Russian 1981 (signed to press 23 Jul 81) p 2

[Annotation from preprint "Analysis of a Space of Rank Estimates and Synthesis of Structural Analytical Models for Automating Expert Decision Making", by Kirill Yevgen'yevich Volkovitskiy, Yevgeniy Mikhaylovich Krylov and Igor' Borisovich Sirodzha, Ukrainian SSR Academy of Sciences Institute of Cybernetics Preprint No 81-43, 300 copies]

[Text] The new results, which are both of theoretical and practical importance, of a mathematical combinatorial analysis of a multidimensional space of expert rank estimates are discussed. A classification of coalitions of expert opinons on the basis of their diametric opposition is presented. A procedure is suggested for automating expert decision making on the basis of a structural analytical method of classification processing of data. A description of the system implementation of this procedure is given in the form of the KOD EO package of applied programs for the YeS [Unified Series] computer operating system. The results of the experimental use of this package in simulation and practical problems are discussed.

For specialists working on questions of automating scientific and technical forecasting, processing expert estimates and pattern recognition.

8831
CSO: 1863/123

UDC 681.3.06.51

CREATION, APPLICATION OF AUTOMATED DIALOGUE TRAINING SYSTEMS

Kiev VOPROSY SOZDANIYA I PRIMENENIYA AVTOMATIZIROVANNYKH DIALOGOVYKH OBUCHAYUSHCHIKH SISTEM in Russian 1981 (signed to press 3 Mar 81) p 47

[Abstract from preprint "Questions Relating to the Creation and Application of Automated Dialogue Training Systems", by Yevgeniy Anatol'yevich Alekseyenko, Vadim Pavlovich Smirnov, Tat'yana Ivanovna Strizhak, Vladimir Ivanovich Branovitskiy, Lyudmila Nikolayevna Getsko, Svetlana Pavlovna Kudryavtseva, Valentina Vladimirovna Seraya, Boris Alekseyevich Platonov, Kostadinka Nikolayeva Kirova, Aleksandr Andreyevich Sakhno, Yevgeniy Petrovich Strizhak, Aleksey Yevgen'yevich Strizhak and Tat'yana Nikolayevna Topchiy, Ukrainian SSR Academy of Sciences Institute of Cybernetics Preprint No 81-4, 300 copies, 49 pages]

[Text] The key requirements for dialogue systems are formulated. On the basis of this some statements are given on their further development. Information is given on the PROLOG instrument system, designed for solving problems of artificial intelligence. Major trends in the use of PROLOG are indicated. Work performed at the Ukrainian SSR Institute of Cybernetics is singled out.

Considerable attention is paid to questions relating to the use of the SPOK dialogue instrument system in various subject areas. Questions of integrating the SPOK package of applied programs with packages of applied programs for various purposes are discussed.

8831
CSO: 1863/123

UDC 62-50

MULTICRITERION OPTIMIZATION PROBLEMS

Kiev VOPROSY ISSLEDOVANIYA ZADACH MNOGOKRITERIAL'NOY OPTIMIZATSII in Russian 1981 (signed to press 31 Dec 80) pp 2, 52

[Annotation and table of contents from preprint "Questions Relating to Studying Multicriterion Optimization Problems", edited by L.V. Tverdova, Ukrainian SSR Academy of Sciences Institute of Cybernetics Preprint No 81-22, 300 copies]

[Text] Questions relating to studying problems of multicriterion optimization in the determinate and stochastic formulations are discussed. The problem of studying irregular systems is formulated in a class of discrete programming problems and is then reduced to a separable discrete programming model.

A description is given of a method of solving a multicriterion separable discrete programming problem based on the method of constraints. An approach is suggested to organizing a dialogue system of programs for solving multicriterion problems in the interaction mode. A description is given of models of multicriterion stochastic optimization problems, for which the definition of an effective solution is introduced and an analogue of Karlin's lemma is formulated.

These data are intended for specialists working in the field of vector optimization.

CONTENTS Page

8831
CSO: 1863/123

UDC 681.3.06

DEVELOPMENT AND INTRODUCTION OF PACKAGES OF APPLIED PROGRAMS

Kiev VOPROSY RAZRABOTKI I VNEDRENIYA PAKETOV PRIKLADNYKH PROGRAMM in Russian 1981 (signed to press 19 Mar 81) p 2

[Annotation from preprint "Questions Relating to the Development and Introduction of Packages of Applied Programs", by V.M. Yurkov, V.Ya. Burdyuk, V.G. Deyneka and A.I. Koronkevich, Ukrainian SSR Academy of Sciences Institute of Cybernetics Preprint No 81-19, 300 copies]

[Text] Studies devoted to questions of the development and introduction of packages of applied programs are presented in this preprint. In particular, the results are discussed of the development of several packages of applied programs and program complexes, such as system study of an enterprise, solution of some combinatorial optimization problems and the analysis of oriented graphs. The first package will be of considerable help to a systems analyst involved in studying enterprises. The second package represents a system of algorithms and programs for solving problems regarding the appointments of a traveling salesman and many traveling salesmen when their number has an upper limit. The third program complex is convenient to use for analyzing abstract systems as the model of whose intrasystem link structure it is convenient to use an oriented graph.

Intended for systems analysts, developers and users of computer software.

8831
CSO: 1863/123

SELECTED ITEMS FROM JOURNAL 'ALGORITHMS AND PROGRAMS', SEPTEMBER 1981: EL'BRUS

Moscow ALGORITMY I PROGRAMMY in Russian No 9, Sep 81 pp 89-90

[Following is a listing of selected entries from ALGORITMY I PROGRAMMY, a bibliographic publication of GPNTB]

[Excerpts]

4006. Zelenskiy, V. B. "Realization of medical analysis in a compilator with the algorithmic language SIMULA-67 for for the multiprocessor computer complex "El'brus-1". In the book: "Metody upravleniya" (Control Methods/Rostov/na/Donu/Leningrad State University, Rostov/na/Donu, pp 29-30. Bibliography: 6 titles. An internal concept of the lexicon is described, one which permits a syntactic analyzer to reduce the number of selections of alternatives and rapidly issue a diagnosis of the error. To obtain adjustment tasks it is proposed to introduce dynamic control of those tasks from the text of the compiling program.

4007. Zotov, S. M., and Somenikhin, S. V. "Interaction of Processors and the Multiprocessor Computer Complex 'El'brus'." Moscow, 1981, 20 p. (Institute of Precision Mechanics and Computer Technology, Academy of Sciences USSR Preprint No 1), Bibliography, 7 items.

4008. Ivanov, A. P., and Shevtakov, V. S. Control of the Memory of the Multiprocessor Vychislitel'nogo kompleksa 'El'brus-1'." Moscow, 1981, (Institute of Precision Mechanics and Computer Technology, USSR Academy of Sciences No 3). Bibliography, 15. General comments are made on the structure of the memory, as is an algorithm for the distribution of physical memory; a method of guaranteed production of memory for a number of operating system procedures; components of a memory control system are selected.

4009. Sukhomlin, V. A. "Operating Principles of the Multiprogram computer complex 'El'brus,'" Educational Aid. Moscow, 1981, 120 p. Before the Title: MGU. Bibliography: 7 items.

4010. Shevarov, V. S. "Tables of Evacuated Pages in the Multiprocessor Complex 'El'brus-1.' Moscow, 1981, 19 p. (Institute of Precision Mechanics and Computer Technology, USSR Academy of Sciences Preprint No 2). Bibliography: 9 items. Continuation of the boook: A. N. Ivanov and V. S. Shevyakov, "Memory Control in the Multiprocessor Computer Complex 'El'brus-1'"); for annotation see bibliography No 4008.

4011. Shevyakov, V. C. "Tables of Empty Pages in the Multiprocessor Computer Complex 'El'brus-1'." Moscow, 1981, 19 p. (Institute of Precision Mechanics and Computer Technology, USSR Academy of Sciences Preprint No 2). Bibliography: 9 items. Continuation of the book of A. P. Ivanov and V. S. Shevyakov: "Control of the Memory in the Multiprocessor Computer Complex 'El'-brus-1'"; for annotation see bibliographic record No 4008.

2174
CSO: 1863/108

MORE SELECTED ITEMS FROM JOURNAL 'ALGORITHMS AND PROGRAMS', SEPTEMBER 1981

Moscow ALGORITMY I PROGRAMMY in Russian No 9, Sep 81 pp 1-122

[Following is a listing of selected entries from ALGORITMY I PROGRAMMY, a bibliographic publication of GPNTB]

[Excerpts]

3697. Nosova, G. N.; and Chereyshev, P. V. "Algorithm i programma rascheta dlya nekotorykh kharakteristik rasprostraneniya korotkikh radiovoln" ("Design algorithm and Program for Some Characteristics of Short-Radio Waves.") Institute of Territorial Magnetism, the Ionosphere and Radio-Wave Propagagation. Bibliography: 7 items. A design program is presented in the languages ALGOL and FORTRAN for any time of day and any level of solar activity of the frequency range, the method of propagation of each working frequency, the time of propagation, the angle of altitude and intensity of the field of the radio wave at the point of reception.

3707. Aleksandrov, V, V., Alekseyev, A. I., and Gorskiy, N. D. "Sistema obrabotki raznotipnikh data SITO. 2. Instruktsiya dlya pol'zovatelya: Materialy po MO" [System for Processing Various SITO Data. 2. Instructions for the User: Materials for the User. Materials on Software"], Leningrad, 1981, 91 pages. Leningrad Scientific Research Computer Center. Bibliography: 4 items. The system for solving various tasks of classification (including selection of an informational system of characteristics, the recognition of examples in the initial statistical processing of experimental data (construction of a correlational distogram and a factorial analysis) represents a set of ALGOL programs.

3732. "Data Bank for Storage of a System of Network Models." Moscow, 1981, 36 p. (Programs for Solving Problems of Road Construction on on an EVM/SOYUZDORNII [Union Road Construction Scientific Research Institute]). Description of the CSMA software and data bank for storing the parameters of network models. The task is assigned for accomplishment of the BANKHEAD program for disposition of the data base file.

3747. Gayfulin, S. A., Karpov, V. Ya., and Mishenko, T. V. "Sistema OLYMPUS: Instruktsiya" (The OLYMPUS System: Instructions"), Moscow, 1981 62 p. Institute of Problems of Mechanics, USSR Academy of Sciences. Bibliography: 5 items. A version of the OLYMPUS system is described, one adapted for the BESM-6 computer, for the development, debugging and operation of programs in the FORTRAN language and the solution of tasks of the evolutionary type.

3767. Prigoryan, F. A., and Ambaryan, A. Sh. "Estimation of the Technical and Economic Level of Articles." VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 14, pp 108-112. Bibliography: 4 items. Greater precision of solution is obtained by selecting a standard subgroup of articles by the criterion of the zero eigenvalue of the matrices. A FORTRAN program is described for estimating by the cathode-beam oscillographic method is described.

3775. Korbatov, P. A., and Lunin, V. P. "Program for Calculating the Distribution of Magnetization Within a Permanent Magnet Over Its External Field." ELEKTRONNAYA TEKHNIKA I. ELEKTRONNIKA SVCh, 1981, No 3 (327), p 63. Bibliography: 1 item. The program is written in FORTRAN and the time of calculation of magnetization is in accordance with the volume of the magnet divided by N elementary volumes $(N/2)^2$ s.

3849. Ignatochkin, A. Ye., and Matiyek, Ye. A. "Basic Concepts of Retrieval for the Library NSR--RECENT REFERENCES IN TsAYaD GKAE SSSR (USSR State Committee for Use of Atomic Anergy--not further identified). Moscow, 1981, 52 p. (Institute of Atomic Energy Preprint No 3584/16). Bibliography. 4 items.

3855. Shukuryan, Yu. G., and Yeshazaryan, V. V. "Mu--the Language of Simulating Microprogram Processors on the Level of Register Transmissions With Temporary Parameters." VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 14, pp 59-70. Bibliography: 10 items. A language is described which has a modular structure reflecting the structural connections of the blocks of processors, which permits effectively introducing changes and refinements in the descriptions of models.

3891. Vinogradov, V, I., Karavicheva, T. L., and Prokhvetilov, M. A. "Rezidentnoye programmnoye obespechenie malykh modul'nykh sistem real'nogo vremeni na osnove KAMAC and EVM klassa PDP-II" ["Resident Software of Small Real-Time Modular Systems Based on Camac and Computers of Class PDP-ii"]. Moscow, 1981, 28 p. (Nuclear Research Institute, USSR Academy of Sciences Preprint No P-0192). Description of the developed MONIKA CAMAC for modular real-time systems based on the M-400 and Elektronika-60 computers and a package of SPEKTR-1 programs for processing a unidimensional amplitude spectrum, accumulated in the buffer of the MONIKA monitor.

3893. Oganyan, G. A., Gonchoyan, V. G. Grachyan, G. G., and Martirosyan, K. Ye. "Use of a System of SM-3 Coputer Software in Computers of the 'NAIRI-4' Series." VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 14,, pp 3-6. Bibliography: 2 items. Methods of assuring program compatibility of computers of the 'NAIRI-4' series with the M-400 and ELEKTRONIKA-60 computers, an apparatus-microprogram EMULATOR assuring that compatibility and a structural diagram of passage of SM-3 instructions through the EMULATOR are described.

3905. Buttseva, G. L., Mircheva, D., Naphed'yeva, L. S., et al. "Organizatsiya vvoda-vyvoda chislovykh massivov v sisteme obrabotki spektrov (SOS)" ["Organization of Input-Output Digital Files in a Spectrum Processing System (SOS)"]. Dubna, 1981. 12 p. (Joint Nuclear Research Institute Report No P-10-81-56). Bibliography: 9 items. The SOS, created within the framework of the Message Center Dubna on the basis of the BESM-6 computer, is a component part of the software of a single system for the processing of spectrometric information and serves for the processing of information received on other computers. The system assures the input of information

about various carriers: punched cards and magnetic tapes of the types YeS-5012, CDC-608 and BESM-6 over cable lines of communication. Questions of the conversion of information into the structure of numbers of the BESM-6, its recordings, compression and the formulations of files in the form of files in the SOS system.

3924. Grigoryan, R. Kh., and Astvatsaturyan, L. A. "Algorithm for Synthesis of Microprograms of Centralized Control of a Set of Processes." VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 14, p 83-88. Bibliography: 3 items. A procedure and an algorithm for synthesis of a graphic-diagram of microprograms of a centralized real-time equation in YeS Assembler language has a length of 1151 instructions. The counting time of the control example is about 53 s (without translation and editing).

3929. Kalechin, V. Ye., Lobodin, N. I., and Shukin, A. Ya. "The Elektronika-60 Cross-System in a YeS Computer." In book: "Metody translyatsii" (Translation Methods). Rostov-na-Donu State University, Rostov-na-Donu, 1981, pp 52-59. Bibliography: 8 items. The paper describes a programming cross-system for the "Elektronika-60," realized in the YeS Assembler language, its purposes, composition, distinctive features of the input language and the main components of the cross-assembler emulator, adjustor and set of service programs. The temporary characteristic of the cross-assembler in the emulator ware given. For the cross-assembler versions to work more than 54 Kbytes of main memory, on the construction of a model of the memory of the "Elektronika-60" computer 64 K bytes are necessary. The speed of translation in work with libraries is about 600 operators of a language per minute for a YeS-1022 computer.

3931. Lazaryan, E. A, and Shukuryan, Yu. G. "System of Generation and Analysis of Tests for Diagnosis of Third-Generation Computer Units." VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 14, pp 29-36. Bibliography: 10 items. The paper describes an automated system in the form of a complex of programs on YeS computers of automatic construction of verifying tests, diagnostic tables and tables of states for determination of error in interchangeable computer units.

3933. Marzepa, Ye. Yu. "Cross-assembler for the Intel-8080 on the YeS-1010." Dubna, 1981, 7 p. (Joint Nuclear Research Institute Report No 11-81-51). Bibliography: 6 items. Cross-assembler in the ASS2 language produces a translation of programs of the microprocessors Intel 8085A on the YeS-1010 and serves for coupling the YeS-1010 with the CDC-6900.

3943. Geolepyan, G. G. "Algorithm for Disposition of the Cards on Computer Panels." VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1980, No 14, pp 48-50. Bibliography: 3 items. The paper describes a program in the Assembler language for YeS computers. For a panel with about 70 elements the working time is about 30 minutes.

3975. Kapanov, S. P., and Shemyakin, I. V. "Analysis of the Organizational Control of Transport Processes at Autotransport Enterprises." VOPROSY RADIOELEKTRONIKI. SERIYA ASU, 1980, No 2, pp 53-58. Bibliography: 4 items. The procedure of organizing a flexible automated package of a simulating model capable of being adjusted to simulation of various working conditions of transport flows.

3976. "Simulation and Investigation of an Arbitrary Type of Geological Construction on YeS computers." In book: "Sovershenstvovaniye programmy i skhemy postroyeniya opornykh geologicheskikh setey na territoriyakh gorodov." Materialy Vsesoyuznoy nauchno-tekhnicheskoy konferentsii/Ch 2 (Improvement of the Program and Scheme for Construction of Reference Geological Networks on the Territories of Cities. Materials of the All-Union Scientific Technical Conference. Part 2). Novosibirsk, 1980, pp 49-55. Bibliography: 5 items. A multiplicative algorithm for the generation of pseudo-random numbers on a YeS computer requires 15-20 words of machine memory. The generation time for access with a volume of 10,000 numbers is about 3-4 sec.

4003. Zobov, A. A., and Chuprynin, A. F. "System of Preparation of Controlling Programs for Machine Tools With Numerical Control on an 'Elektronika-60' micro-computer." ELEKTRONNAYA TEKHNIKA. SERIYA 1. ELEKTRONIKA SVCh, L(*L, No 3 (327), p 62. Bibliography: 1 item. A system has been compiled for geometric calculations of the formation and issuance of a control program for processing parts for the electronika-79M electro-erosion complex. The time of calculation and issuance of the control program for a control part, the contour of which contains about 30 elements, is 3.5 min.

4014. "Work With Terminal on a Seiver-172 Computer, Instructions on Operations in Interactive Conditions." Vorob'yev, V. I., Kolesnikova, O. S., Troyan, A. I., and Fedorochenko, L. I. Leningrad, 1981, 43 pages. Scientific Research Computer Center. Bibliography: 8 items. Working procedure with the NOSI system in interactive conditions for terminals of the teletype sort; information about file organization; tables and alphabetic index of terminal instructions.

4021. Zasenko, V. A., Ivkin, V. G., and Mozin, I. V. "System for Control of Large Electrophysical Plants. Survey OG-40." Leningrad. 41 pages. Scientific Research Institute of Electrophysical Apparatus. Bibliography: 24 titles. The following are examined; systems for control of charged-particle accelerators on type Sigma-2 in FOCAL and BASIC languages into control systems of experimental thermonuclear installations of the Tolkamak type on PDP and HP computers.

4022. Karpov, Yu. G., and Tolstyakov, A. V. "Programming Parallel Processes in an Automated System for Control of Technological Processes." TRUDY/Leningrad Polytechnic Institute, 1980, No 372. PROYEKTIROVANIYE I POSTROYENIYE SISTEM UPRAVLENIY C PRIMENENIYEM EVM, pp 52-55. Bibliography: 5 items. The paper discusses: development of an operating system nucleus on the basis of a PDP-11; the reaction time on a higher level in the range of 10 ms and in the following range from 50 to 100 ms. In the method of distribution of memory of the processes the folume of the operating system is about 300 words.

4023. "Problem-oriented Complex of Processing Social Information on the Basis of a Mini-computer (Tasks and Algorithms)." Bakayev, A. A., Petukhov, V. S., Revenko, V. L., et al. Kiev, 1980, 44 pages. (Institute of Cybernetics, Ukrainian SSR Academy of Sciences Preprint No 80-70). Bibliography: 4 items. Three problem tasks of automation of the main production functions of services of motor-vehicle-passenger vessels are described, realized on the basis of the PDP-BE mini-computer.

2174
CSO: 1863/108

SELECTED ITEMS FROM JOURNAL 'ALGORITHMS AND PROGRAMS', OCTOBER 1981

Moscow ALGORITMY I PROGRAMMY in Russian No 10, Oct 81 pp 1-120

[Following is a listing of selected entries from ALGORITMY I PROGRAMMY, a bibliographic publication of GPNTB]

[Excerpts]

4063. "Distribution of information and computer work in subscriber networks." Kanonykhin, V. H., and Mikhaylov, V. V. ELEKTRONNAYA TEKHNIKA. SERIYA 9. ELEKTRONIKA I SISTEMY UPRAVLENIYA, 1981, No 1 (38), pp 50-52. Bibliography: 2 items.

4117. "The Question of Automating the Process of Describing Radio Echoes of Meteopoles." Parshuto, T. P. In book: "Radiolokatsionnaya Meteorologiya" [Radar Meteorology]. Materials of the Radar Meteorological Center of the Socialist Countries, Main Geophysical Laboratory, Leningrad, 1981, pp 41-48. Bibliography: 9 items. A program in the language ALGOL-GDR is described for solution of the problem of nonlocal analysis of radio echo with use of an operator from the process of analysis and increase of reliability of analysis of a meteorological situation.

4118. "Calculation of spectral characteristics on large North Atlantic Water Areas." Pokhil, A. E. TRUDY GIDROMETEOROLOGICHESKIY NAUCHNO-ISSLEDOVATEL'SKIY TSENTR SSSR, 1981, No 241. MORSKIYE GIDROLOGICHESKIYE RASCHETY I PROGNOZY, pp 77-78. Bibliography: 6 items. An algorithm is presented for calculation of swell on the water area over an area of 20 x 10^6 km^2 with an error not exceeding 20 percent, and a nomogram for calculating the passage of time on a BESM-6 computer during calculation of fields of swelling of any dimensions in any calculated period over its length.

4152. "Method of compact representation of an interval Boolean funnction and its estimation." Voronin, D. F. VOPROSY RADIOELEKTRONIKI, SERIYA EVT, 1981, No 1, pp 80-90. Bibliography: 3 items. The program of an optimum algorithm in the language PL/1 for the cover of an interval Boolean function is presented. There are 90 intervals, the main memory is about 2 Kbytes; the time of realization of the program in the DOS YeS-1020 is about 100-400 ms and in the OS YeS-1040 is about 15-50 ms.

4155. "Multimicroprocessor architecture of computer systems with direct interpretation of high-level languages." Boyanov, K. L., and Kisimov, V. S. UPRAVLYAYUSHCHIIYE SISTEMY I MASHINY, 1981, No 1, pp 32-36. Two processors have been designed on the basis of the proposed architecture. The former consists of six Motorola 6800 microprocessors, the latter of 11 Intel 3000. YaVUNI (a high-level language based on an

arithmetic with direct interpretation) is described on the basis of arithmetic with a fixed period, representing a version of the PL/1 language. On the basis of calculation of polynomials, search in the lists and multiplication of matrices, a comparison has been made of designed processors and the YeS computer and IBM 360 and 370 processors. Comparison showed that for the selected examples the former is about 1.5 times greater than the YeS-1020 and the latter about 1.3 times greater than the IBM 370 model 155.

4160. "Problems in automating problem solution." Glapun, V. P., Vashenko, N. D., Biba, I. G., et al. PROBLEMY BIONIKI. Republican Interdepartmental Scientific-Technical Collection. Khar'kov Institute of Radioeletronics, 1981, No 26, pp 89-94. Bibliography: 5 items. The APROS system for the solution of practical problems in the planning of actions (in particular, tasks in planning the behavior of robots) and the performance of experimental investigations of processes in problem solution. The system is described in the PL/1 language, and the input language is the task-description language SITPLAN.

4169. "Modeling stand for problem-oriented simulation system." Massarskiy, L. V., and Shub, L. L. ELEKTRONNAYA TEKHNIKA, No 9. ELEKTRONIKA I SISTEMY UPRAVLENIYA, 1981, No 1 (38), pp 30-35, Bibliography: 2 items. A package of applied proglems is described in the languages PL/1 Assembler and GPSS IMOUP YeS and a control system produced by a simulation complex of interaction of an ASU with a production model of an object of control.

4177. "Automated system of preparation of control programs for electric-spark machining with numerical programmed control." Kozlov, N. G., Peretyaka, Yu. P., and Rodionov, I. S. ELEKTRONNAYA TEKHNIKA,SER 7, TEKHNOLOGIYA, ORGANIZATSIYA PROIZVODSTVA I OBORUDOVANIYA, 1981, No 2 (105), pp 60-63, Bibliography: 8 items. The system was constructed according to the preprocessor-processor-postprocessor principle, realized in FORTRAN-4 for the design of parts whose contour is described by a set of functions, preliminarily introduced into the control program according to definite rules and approximate tabular-task curves by a spline approximation method.

4192. "Method of variable parameter of penalty to solve tasks of nonlinear programming with set precision." Rapaport, L. B. In book: "Metody issledovaniya slozhnykh sistem" [Methods of Investigating Complex Systems]. Proceedings of Graduate and Young Specialists. All-Union Scientific Research Institute of Systems Research. Moscow, 1981, pp 50-58. Bibliography: 6 items.

4202. "Relaxation of systems in tasks of multidimensional numerical analysis of semiconductor instruments." Abramov, I. I., and Mulyarchik, S. G. IZVESTIYA VUZOV: RADIOELEKTRONIKA, 1981, No 6, pp 59-67. Bibliography: 23 items. A new method is described, one based on a FORTRAN-program of two-dimensional numerical analysis of dipolar RELAX-2 resistors and a memory volume of about 200 Kbytes. The Seidman-Chu method has been realized in a COTDABSE program.

4209. "ATLAS-B on a BESM-6 computer." Gal'dikas, A. K. TRUDY/KAZAN'SKAYA GORNAYA ASTRONOMSKAYA OBSERVATORIYA, 1980, No 10, pp 96-97. Bibliography: 2 items. An ATLAS-B program for calculation of models of stellar atmospheres has been compiled in FORTRAN-4 for the CDC-6400. Changes connected with its copying for the BESM-6 are described. The calculation time, with deviation from the thermodynamic equilibrium and during use of 78 points of frequency for 10 iterations with respect to temperature taken into consideration, is 2 hrs 30 min on the BESM-6.

4231. "Analytical calculation of the optimal working point of the matrix on ferrite cores." Kuz'min, V. P., Levshin, V. I., and Surin, R. V. VOPROSY RADIOELEKTRONIKI. SERIYA EVT, 1981, No 1, pp 38-46. Bilbiography: 7 items. A FORTRAN program has been compiled to calculate the region of stable work at coordinates of tlows of excitation for three temperature points: -20, +20 and +60°C.

4256. "Preliminary processing of the results of diffractometric experiments on objects with large elementary cell parameters." Shul'meyster, V. M. APPARATURA I METODY RENTGENOLOGICHNOGO ANALIZA. Collection of Articles. Leningrad "Burevestnik" Scientific-Production Association, 1981, no 25, pp 147-153. Bibliography: 7 items. The paper describes the program complexes REFLEX M (with a memory volume of 24K words) for processing the results of experiments on an automatic coordinate diffractometer--DARK 2.0, and RFARM in FORTRAN for statistical analysis and presentation of the results of diffraction experiments per unit of scale (memory volume of about 32K words).

4261. "Determination of the optimal variant of grading of articles with defects." Shevtsov, V. N., and Kozhin, A. V. ELEKTRAONAYA TEKHNIKA. SERIYA 8. Quality Control, Standardization, Metrology, Tests, 1981, No 2 (88), pp 7-10. Algorithm in the language FORTRAN-4K for the grading of articles minimizing the mean manufacturing expenditures per article.

4263. "Investigation of algorithms of adaptation for an automatic system for control of technological processes (ASUTP)." Zadorozhnyy, S. S., Prilipko, V. I., and Shevyrev, Yu. Ye. ELEKTRONNAYA TEKHNIKA, SERIYA 9. Economics and Control Systems, 1981, No 2 (39), pp 33-34. Bibliography: 5 items. For adaptation of ASUTP models a Kachmazh algorithm is described, and also a program in the Macroassembler language for the ELEKTRONIKA-100/I minicomputer with use of numbers with a floating point. The program has a memory volume of about 4K.

4270. "Predicting production requirements on the basis of a dynamic model." Shurgin, Kh. R. ELEKTRONNAYA TEKHNIKA. SERIYA 9. Economics and System Controol, 1981, No 1 (38), pp 7-10. Bibliography: 12 items. The paper describes a dynamic model, an identification algorithm, the prediction and distribution of production among enterprises of a branch. A complex of programs is composed in the FORTRAN language, one which includes programs for providing information, calculating parameters and the structure of a model, and prediction of requirements.

4289. "Yazyk opisaniya funktsional'noy arkhitektury vychislitel'nykh sistem" [Language for dessribing the functional architecture of computer systems]. Lel'chuk, T. I., and Marchuk, A. G. Computer Center, Siberian Department, USSR Academy of Sciences Preprint No 285, Novosibirsk, 1981, 10 pages. Bibliography: 7 items. The language is based on a parallel asynchronout model of computations and is a concretization of the Modular Asynchronous System to be Developed (MARS). Syntactic elements of the APL, SETL and Basic language are used.

4312. "Interaction with a computer in tasks of planning electronic circuits." Kucherov, V. Ya., Sokolova, L. F., and Yurevich, S. A. ELEKTRONNAYA TEKHNIKA, SERIYA 9. Economics and Control Systems, 1981, No 2 (39), pp 22-24. Bibliography: 3 items. A set of complexes of interaction with a computer is described, one assuring effective connection of a systems engineer for evaluation of the results of designs of electronic circuits and decision making. For interactive conditions a complex of service programs has been developed in the Assembler language DOS YeS-4030.

4340. "Automation of selection of an optimal data processing circuit." Korinevskiy, L. V., Kul'ba, V. V., Nul', I. A., and Pekhov, V. P. ELEKTRONNAYA TEKHNIKA. SERIYA 9. Economics and Control Systems, 1981, No 1 (38), pp 23-25. The paper presents a method of formalized description and construction of an optimal mathematical model of a data processing system with the detection and correction of errors by means of a complex of programs for YeS computers.

4341. "Combining the 'Elektronika-100/I' with YeS computers." Anishkevich, N. N., Zhelezko, B. A., and Pikhun, V. N. ELEKTRONNAYA TEKHNIKA. SERIYA 9. Economics and Control Systems, 1981, No 1 (38), pp 22-23. Bibliography: 5 items. The paper describes construction of a multimachine hierarchic system of scientific investigations based on the combining of computers within the framework of YeS disk operating system computers while preserving initiative on the part of the mini-computers.

4370. "Modification of a translator from the BIYaZ language to the "OKA" data bank language." Petrov, A. Ye. ELEKTRONNAYA TEKHNIKA. SERIYA 9. Economics and Control Systems, 1981, No 1 (38), pp 18-21. Bibliography: 4 items. The paper describes the development of a second version of a translator from the BIYaZ language for work with the information fund using sensible relations between elements of information machines machines without turning to logical and physical data storage structures.

4381. "Engineering subsystem for automation of circuitry planning of microelectronic apparatus." Gridin, V. N., and Nukin, C. N. VOPROSY RADIOELEKTRONIKI. SERIYA EVT. 1981, No 1, pp 31-37. Bibliography: 6 items. The paper describes a subsystem for circuitry and planning of microelectronic apparatus within the framework of the general system from complexes of programs for YeS computers. A single input language is described.

4385. "Automation of varicap acquisition." Lubyanyy, V. Z., Lebedenko, A. P., and Gorshenko, G. F. ELEKTRONNAYA TEKHNIKA. SERIYA 7. Technology, Organization of Production and Equipment, 1981, No 2 (105), pp 6-11. Bibliography: 6 items. The paper presents an algorithm for making up complete sets of varicaps matched in capacity for the YeS-1020, analysis of existing systems for selecting complete sets, a description of a system with the application of minicomputers and a robot-manipulator and the way to improve its qualitative indicators.

4421. "Complex of algorithms for detection of astronomical objects and dtermination of their coordinates." Kaganov, S. M., Levchenko, V. D., Matyagin, V. S., et al. In book: "Avtomatizatsiya astronomicheskikh nablyudeniy [Automation of Astronomical Observations], Astrophysical Institute, Kazakh SSR Academy of Sciences. Alma-Ata, 1981, pp 41-56. Bibliography: 9 items. The paper describes main algorithms realized in the form of programs for a universal computer. To optimize the proprocedure of filtering images from the noise the Neimann-Pierson criterion was used, an estimate made of the parameters of mobile objects to select images of them and images of stars by the method of maximum probability.

4422. "Peculiarities of the processing of seismic body waves capable of D-transformation." Kondrat'yev, O. K., and Orlov, V. P. PRIKLADNAYA GEOFIZIKI. All-Union Scientific Research Institute of Geophysics,1981, No 100, pp 11-22. Bibliography: 5 items. An algorithm is described for the D-transformation of x-components: the method of transmitted body waves in the depiction of a deep section on the BESM-4 computer. In the reduction of heterogeneous media it is advisable to introduce an algorithm for automatic regulation of the base of summation.

4423. "Photogrammetric dterminations of the release of allowed soils." Ivanova, L. I., Novikov, M. F., Derek, Z. D., and Takovskiy, L. F. INZHENERNAYA GEODEZIYA: MEZHVEDOMSKYY NAUCHNO-TEKHNICHESKIY SBORNIK, 1981, No 24, pp 26-28. Bibliography: 2 items. A program has been completed for the M-222 computer for determining the coordination of points of angles of a network of squares and determining volumes based on bassistic course photographs.

4425. "Complex of automated factographic information retrieval systems has been created by deposits and geological maps (method of creating and experimentally sampling a model)." Unksova, M. V. Systems have been described for automating the sampling, storage and analysis of large volumes of information on the Minsk-32 and BESM-4 computers.

4442. "Language and translator of test task for micro-computer module diagnosis." Arzhenovskaya, O. M., Makhalin, B. N., Reshetov, M. B., and Chaykina, O. I. ELEKTRONNAYA TEKHNIKA. SERIYA 7. Technology, Organization of Production and Technology, 1981, No 2 (105), pp 56-59. Bibliography: 2 items. A test task language which is a modification of the MEMTEST language is described, as is a translator on the ELEKTRONICS-60 computer, coded in the language MOVING ASSEMBLER, consisting of 26 subprograms with a total volume of 5400 words, including a 15,000-word table of vectors and other service files.

4444. "Some questions of the organization of information and mathematical software of automated solution of tasks according to plan." Dolozhkina, N. P., Lavrent'yev, V. V., and Pechelin, A. A. In book: "Ubespechivayushiye podsistemy planovykh raschetof (ASPR) Gosplana RSFSR [Subsystems for Planning Calculations (ASPR) Under the Gosplan RSFSR], Collection of Scientific Works, Central Scientific Research Economic Institute, Scientific Research Institute of Automated Control Systems, Moscow, 1980, pp 42-51. Bibliography: 4 items. The peper described the organization of the storage, retrieval and correction of information on the example of a fragment of the subsystem "Material and Equipment Supply" ASPR on the Wang 2200 mini-computer in interactive conditions. The main memory has a volume of about 32 Kbytes.

4446. "Automated system for processing space observations." Burmakov, Yu. A., Staykov, P. P., Minkovskiy, K.,S., et al. A system is described for the complex IBM 370/145 and Command 20 and it is concluded that space observations increase the reliability of generation of refracted waves on account of collection of the energy of waves in space.

4451. "Compton effect on a particle with the spin 3/2 without polarization focus." Guenn, N. I. In book: "Kovariantnyye metody teoreticheskoy fiziki. Fizika elementarnykh chastits i teoriya otnositel'nosti" [CovaRIant Methods of Theoretical Physics. Physics of Elementary Particles and Theor of Relativity]. Collection of Scientific Works. Institute of Physics, Belorussian SSR Academy of Sciences, Minsk, 1981, pp 113-119. Bibliography: 11 items.

4453. "Procedure and results of processing by means of the examination-measurement system 'BPS-75-ELEKTRONIKA-100-I' of calibrated measurements of wide-gap space chambers." Averin, S. A., Veselova, G. V., and Navasardyan, T. V. Moscow, 1981, 27 p. Space Research Insitutut USSR Academy of Sciences Reprint No 630. Bibliography: 9 items. The paper presents a procedure for measurement of film information from the space chambers of a gamma-telescope. The results of processing photographs obtained

during graducation of space chambers on the DESY accelerator are presented. The procedure for imitating the volume of information from the space chambers by means of the digitizer of the HP-9820 calculator, vidicons and PZS matrices is described.

4454. "Interface for programmable instruments in experiment automation systems." Gorelikov, N. N.,, Domaratskiy, A. N., Domaratskiy, S. N., et al. Institute of Oceanology, USSR Academy of Sciences, Moscow, Nauka, 1981, 262 pages. Bibliography: 9 items. Interfaces assuring orderly exchange of information between autonomous measuring instruments, peripherals and computers are described. The IECBUS interface, which the HP-1B interfaces are made the basis of, the IDELA (Interface DEsign Language) and algorithms of exchange between instruments along the IECBUS main line are described.

4455. "Some results of calculations of circulation of waters of the world ocean on a single-degree network." Sarkisyan, A. S., Demin, T. Z., and Brzekhovskikh, A. L. TRUDY. Gidrometeorologicheskiy Nauchno-Issledovatel'skiy Tsentr SSSR. 1981, No 241, Moscow. "Morskiye gidrologicheskiye raschety i prognozy"[Marine Hydrological Computations and Predictions], pp 65-67. Bibliography: 3 items. Computations were made on an HP-3000 computer on a grid with a spacing of h - 1° per herison on 31 horisons at depths of 0 t- 6000 m.

3457. "Numerical experiment with imitation multuproduct model of international trade." Zamkov, A. V. In book: "Trudy siminara aspirantov i molodovoykh spetsialistov" Trudy of the Seminar of Graduate Students and Young Specialists]. All-Union Scientific Research Institute of Systems Research). Moscow, 1981, pp 22-30. Bibliography: 7 items. Calculations of world prices for exchangeable commodities on a PDP-11/70 computer are described.

2174
CSO: 1863/108

APPLICATIONS

UDC 658.514.012.011.56:631.31
44.29.29.16.11;60.47

AUTOMATED SUPERVISORY CONTROL SYSTEM IN 11TH FIVE-YEAR PLAN

Moscow ENERGETIKA I ELEKTRIFIKATSIYA: SERIYA "SREDSTVA I SISTEMY UPRAVLENIYA V ENERGETIKE" in Russian No 1, Jan 82 (manuscript received 10 Nov 81) pp 1-6

[Article by V. G. Ornov and V. A. Semenov]

[Text] In the Tenth Five-Year Plan work continued on the creation of ASU and the wide use of computer technology in power engineering.

There was considerable development of automated supervisory control systems, which are based on multimachine information-computer complexes. These complexes assure:

--further improvement of the planning of regimes of energy systems and energy associations;

--the organization of minicomputers to solve problems of operating and automated control;

--the organization of regimes of intermachine and interlocal exchange of information and regimes of teleprocessing.

Problems of planning the regimes are solved on the general-purpose computers YeS-1033, YeS-1040, YeS-1055 and M-4000 in all unified supervisory controls and in more than 60 energy systems.

Further improvement of the algorithms and programs for planning regimes on the basis of an operational DOS YeS system and still wider use of interactive systems was continued. The interactive systems are used to solve problems in planning solutions on the USSR Unified Power System central supervisory controls, the unified supervisory controls and 11 energy systems.

A new area of application of general-purpose computers is beimg actively developed --operational control.

One- and two-machine complexes are working with a mini-computer intended for operative monitoring and control of the regimes of energy systems and energy associations.

At the start of the 11th Five-Year Plan the number of telemeterings arriving at load dispatching centers and introduced into mini-computers increased greatly. In individual branch supervisor controls the telemeterings have reached 380, and in energy systems 250-300 telemeterings. Side by side with telemeterings of the active power,

telemeterings of the reactive power and voltage are finding ever wider application. In individual cases telemeterings of the coal of the major intersystem of electrical transmission lines and transits are used.

In a number of energy systems and branch supervisory control systems through integration of active power measurements the electric energy values are formed with high enough precision.

Mini-computer reliability increased substantially, their full operating time in some cases reaches 1000-2000 hours, and that of a two-machine complex 6000-8000 hours.

With each year the number of tasks of operational control solvable by means of mini-computers increases. Side by side with the basic complex of tasks accomplishable on all objects (the collection, processing, display and documentation of information, retrospective analysis, monitoring of the current regime parameters, formation of the current balance of power by energy system and association and their parts, etc), in the branch supervisory control of the North-West and the Urals, Latglavnepro, Irkutskergnepro, Mosenepro, Chelyabenepro, etc, a number of original tasks of operational control have been developed and are being used. They include:

--operative forecast of loading;

--automatic estimates of the coefficients of statism of regions by frequency;

--automatic identification and replacement of incorrect telemeterings;

--monitoring of disconnections and limitations of loading by users;

--monitoring the adjustment of accident prevention systems of automatic machinery;

--operational adjustment of losses in main networks;

--estimates of the state of the main network;

--estimates of the amounts of flows in electric transmission lines on the basis of telemeterings of active and reactive power;

--estimate of the balance of the region in reactive power;

--formation of the daily news data on the basis of the telemeterings;

--histograms of the monitorable regime parameters;

--monitoring and calculation of the technical and economic indicators of the work of energy systems and energy associations, etc.

Experience is being accumulated in solving problems in the regime of a councillor to a supervisor, including:

--frequency control in the USSR Unified Power System and foreign transfers;
--operative calculation of the optimum regime for active power;
--optimization of power losses in the main network of the power systems, etc.

Together with solving tasks of operative control, mini-computers installed at load-dispatching centers of energy systems and oblast supervisory controls are used all the more in automated control systems. Two groups of functions should be noted in that connection:

--automatic regulation of frequency and active power of oblast supervisor controls of the North-West, the Urals, Siberia and the South, and the USSR Unified Power System Central Supervisory Control.

--automatic coordination of the action of local systems and automatic safety equipment--the USSR Unified Power System Supervisory Control and the branch supervisory control of the Urals.

Work is being expanded on organization of intermachine and interlevel objects. In the USSR Unified Power System Supervisory Control and in most oblast supervisory controls, exchange of information has been organized between mini- and general purpose computers, exchange accomplished through standard (adapters or multiplexors) or special contact devices.

Work is being done on interlevel information exchange between mini-computers. Those systems are realized on the upper level of control (central and oblast supervisory controls) by means of a programmable multiplexor based on a complex of type RPT microcomputers.

Low-velocity interlevel exchange between mini-computers in a number of oblast supervisory control and energy systems is organized by means of telemetry of the UTK [not further identified] type.

In part of organizing the regime of teleprocessing using general-purpose computers only the first steps have been taken: simplex data transmission systems have been tested through teleprocessing systems. The organization of these systems is held back mainly due to a lack of the necessary software.

In the 11th Five-Year Plan work is being continued on the development of the automated supervisory control system on all levels of supervisory control.

By 1985 it is planned to equip with mini-computers a number of energy systems, and also to replace obsolete models. The YeS-1011 (or the central supervisory control of the USSR Unified Power System and a number of oblast supervisory controls), the SM-1 and the SM-4 have been designated as new mini-computers.

Since these can have large main memories, higher speed and a developed standard software, it appears possible to solve on them tasks of operational control more complex in an algorithmic respect.

It is proposed in 1983-1984 to complete the creation of a low-velocity network of interlevel exchanges on the central-oblast supervisory control levels with complete replacement of traditional telemetric devices. In that case by means of RPT reprogrammable microprocessor multiplexors exchange of operating information (including the number of telemeterings and TS [nor further identified]), between the oblast and central supervisory controols, reception in the oblast supervisory controls of telemeterinas and TS from the telemetry transmitters installed in energy systems and at energy objects. Simultaneously with that starts the introduction of similar devices in an energy system (the UVTK-501, the AIST, multiplexors based on the micro-computer SM-1800, etc).

A further increase of computer resources and functional possibilities of general-purpose computers begins to appear through:

--the use of the more powerful computers YeS-1040, YeS-1045 and YeS-1055;

--expansion of the volume of the main memory of the used computers to 512-2000 kbytes;

--the use of magnetic disk storages with volumes of 29, 100 and 200 Mbytes;

--mass application of means of teleprocessing and ina interactive systems and means of multi-computer organization.

By the end of the five-year plan it is expected to complete the transition of the special-purpose computer systems to the YeS operating system, with the use as organizing systems of SURE and SUIBD [not further identified] complexes and VINIE-VTs GTU [not further identified] being developed.

Further development and improvement of the automated supervisory control system tasks are envisaged.

In the area of regime planning, two complexes are being developed: the computer and data-processing system-electro to solve electrical engineering problems and the computer and data-processing-energo to solve power engineering problems. The complexes are characterized by the use of an information base, the wide use of interactive modes, automation of information exchange by means of a medium-velocity network of exchange between levels.

The range of tasks of operational control being accomplished both on mini- and on general-purpose computers connected with them is being considerably expanded. The volume of monitorable regime parameters will be substantially increased (to about 500-1000 telemeterings on the oblast supervisory control level). In combination with programs for estimates of the state this will permit creating models to solve tasks of operational control:

--operational prediction of load;

--operational estimation of regime reliability;

--operational intra-day and intra-hour optimization of the regime in active power.

The model for operational estimation of reliability in the first stage must permit the supervisor or technologist to make operational calculations of the allowability of a regime during allowance of requests, estimation of the balance of power, regime variations not provided for by the plan, etc. That model must be further supplemented by a model of automatic accident provention equipment and assure cyclic regime estimation with respect to reliability with automatic formation of recommendations to the supervisor on the regime optimal from the point of view of reliability.

The model for operative optimization of a regime in active power must cyclically (from several times a day to several times an hour) calculate the optimum regime of a region in active power with prescribed anticipation and automatically transmit the planning tasks to the corresponding level of control. At the present time in the oblast suvervisory control of the North-West an ERGEN [not further identified] program developed for that purpose with the VNIIE VTs GTU [not further identified], is being operated experimentally.

In the area of automatic control it is planned to further develop digital automatic regulation of frequency and active power systems, create a hierarchic system of frequency and overcurrent regulation (central-branch supervisory control are the regions of regulation), and also the joining programs of operative optimization with the automatic regulation of frequency and active power.

In the 11th Five-Year Plan intensive automation of the lower levels of control is planned. The wide introduction of automated supervisory control systems of enterprises and regions of electric networks is proposed, in particular the creation of OIK [not further identified] based on micro- and mini-computers. The application of micro-computers for operative and automated control is being developed at substations and electric power plants, in automatic accident prevention equipment and relay protection. From 1982-1983 on, series production of various micro-processor means of display is expected: graphic and pseudographic displays (STGI-M, IPGTs, SODI-4), collective means of display (SOTI, matrix information boards), etc.

Address for questions: 103074, Moscow, Kitayskiy proyezd, 7, TsDU YeES SSSR

2174
CSO: 1863/106

UDC 681.39:801.3

SURVEY OF WORK ON SYNTACTICAL COMPONENT OF MACHINE TRANSLATION SYSTEMS

Moscow PEREVOD NAUCHNO-TEKHNICHESKOY LITERATURY, SERIYA 2: MASHINNYY PEREVOD I AVTOMATIZATSIYA INFORMATSIONNYKH PROTSESSOV in Russian No 5, 1981 (signed to press 2 Nov 81) pp 1-2, 22-24, 131

[Preface, appendix, and table of contents of book "Translation of Scientific-Technical Literature, Series 2: Machine Translation and Automation of Information Processes" by candidates of philological sciences Nina Nikolayevna Leont'yeva, Zoya Mikhaylovna Shalyapina, Yevgeniy Yevgen'yevich Lovtskiy and Ol'ga Arsen'yevna Gulyga, and Mira Borisovna Bergel'son, Aleksandr Stepanovich Yezhov, Irina Mikhaylovna Kudryashova, Yelena Yur'yevna Martem'yanova, Yelena Grigor'yevna Sokolova and Mariya Sergeyevna Sukhanova, Vsesoyuznyy tsentr perevodov, 1000 copies, 132 pages]

[Excerpt] Preface

The syntactical component refers to that part of machine translation systems which is responsible for construction of a certain syntactical structure or syntactical notation for each phrase of the text during analysis and for expanding the syntactical notation into a linearly organized sequence of lexemes with their morphological characteristics during synthesis.

This survey reviews only those systems in which the syntactical component is present as a separate component defined by the type of syntactical notation and the rules of construction of syntactical notation for sentences in natural language and/or the rules of generation of natural language sentences on the basis of the syntactical notation, that is, the rules of analysis and/or synthesis. Translation in such systems is done by phrases employing a series of conversions of the syntactical notation itself.

The book does not consider systems in which syntactical analysis is represented in "eroded" form. These are, for example, the so-called commercial or industrial machine translation systems (a survey entitled "Operating Machine Translation and Automatic Vocabulary Systems" [9] was devoted to them), in which syntactical information is used as context conditions for authorizing homonymy and the choice of the translation equivalent. It also refers to systems in which the leading role is played by the semantic component which constructs the semantic notation, while syntactical information is involved only as auxiliary filters during semantic analysis.

Experience with the design and development of machine translation systems shows that the development of the syntactical component is very labor-intensive (it takes 3-10 years). For precisely this reason it is important to have evaluation criteria from the standpoint of its adequacy for translation and its semantic power and to be able to evaluate the expected effect from the work of the syntactical component. Section 2 of Chapter 1 gives a brief description of the main constituent parts of the syntactical component of various systems.

In practically all machine translation systems the syntactical component either includes "semantic elements" or interacts in a significant way with the semantic component. Section 2 of Chapter 1 raises the question of the relationship between the syntactical and semantic components. A separate survey work will be devoted to consideration of the semantic component in machine translation systems. In this survey we are dealing with the construction of the semantic component of several systems only to the extent that it is necessary to explain the syntactical model adopted. Section 3 lists several characteristic "tight spots" in systems with syntactical components. Section 4 presents the ideas of leading investigators on the prospects for development of machine translation (in particular the syntactical component) in the near future.

Appendix 1. List of Machine Translation Systems with Syntactical Components

No.	System Name Used in Book	Country, Organization, Director	Start, Stage of Development	Purpose of System
	Systems Under Development at the VTsP [All Union Translation Center]			
1.	AMPAR-2	USSR, VTsP, Yu. N. Marchuk	1980, initial stage	English-Russian MT [machine translation]
2.	SPAR	USSR, VTsP, Ye. Ye. Lovtskiy	1975, development halted	English Analysis
3.	FRAP	USSR, VTsP, N. N. Leont'yeva	1976, turned over for experimental use	French-Russian MT
4.	FLOS	USSR, VTsp, Yu. S. Martem'yanov	1975, contract design stage	Russian Synthesis
	Other Systems Developed in the USSR			
5.	FR-II	USSR, Institute of Problems of Mechanics, O. S. Kulagina	1967, experiments	French-Russian MT
6.	LGU System	USSR, Leningrad State University, G. S. Tseypin	1960, work halted	English-Russian MT
7.	ARAP	USSR, First Moscow State Pedagogical Institute of Foreign Languages, Z. M. Shalyapina	1969, work halted	English-Russian MT

[List continued, next page]

[List continued]

No.	System Name Used in Book	Country, Organization, Director	Start, Stage of Development	Purpose of System
		Other Systems Developed in the USSR		
8.	YARAP	USSR, Institute of Orientology, Z. M. Shalyapina	1978, contract design stage	Japanese-Russian MT
9.	INF-EL	USSR, INFORMELEKTRO, Yu. D. Apresyan	1974, turned over for experimental use	French-Russian MT
		Systems Being Built Abroad		
10.	GETA	France, Grenoble, B. Vauquois	1961, experimental use	Russian-French MT
11.	KY	Czechoslovakia, Charles University, P. Sgall	1961, experiments	English Analysis, Czech Analysis
12.	SUSY	West Germany, Saarbruecken, Saar University, G. Eggers and H. D. Maas	1967, teaching experiments	Russian-German and English-German MT
13.	TAUM	Canada, Montreal University, R. Kitteridge	1971, industrial use	English-French MT
14.	TsIYa	East Germany, TsIYa, Ju. Kunze	1971, individual experiments	German Analysis
		Machine Translation Systems in Japan		
15.		Kyoto University, M. Nagao	1978, initial stage	Japanese-English MT
16.		Osaka Prefecture, University, F. Nishida	1978, initial stage	English-Japanese MT
17.		Kawasaki, Fujitsu Company Laboratory, H. Ushida	1978, initial stage	Japanese-English MT

Table of Contents

11,176
CSO: 1863/103

PARALLEL COMPUTING

PARALLEL COMPUTER AND PROGRAMMING SYSTEMS

Novosibirsk PARALLEL'NYYE VYCHISLITEL'NYYE I PROGRAMMNYYE SISTEMY in Russian 1981 (signed to press 3 Sep 81) pp 2, 4, 163-167

[Annotation, Preface and abstracts from the collection "Parallel Computer and Programming Systems", edited by Vadim Yevgen'yevich Kotov, Computer Center, Siberian Department, USSR Academy of Sciences, Vychislitel'nyy tsentr SO AN SSSR, 500 copies, 168 pages]

[Text] The collection is published within the framework of the series "Systems and Theoretical Programming," published by the Computer Center, Siberian Department, USSR Academy of Sciences, and devoted to problems of parallel programming theory, automation of developing multiprocessor computer systems and their software.

Preface

The collection is a topical selection of scientific papers devoted to problems of developing multiprocessor computer complexes (MVK) and the software for them. Most papers were written within the framework of the scientific research topic MARS [Intersectorial Automated Republic System]. The papers of V. A. Val'kovskiy, L. A. Cherkasova, V. A. Val'kovskiy and V. L. Kondratskiy and Ye. V. Trishina are devoted to various aspects of parallel programming theory. The papers of A. G. Marchuk, T. I. Lel'chuk, G. I. Alekseyev, S. P. Myl'nikov and also the paper of V. E. Malyshkin suggest some approaches and language facilities for describing the configuration and also simulation modelling of multiprocessor computer complexes. The papers of N. N. Dudorov, D. A. Kasperovich and L. V. Gorodnyaya touch on a number of problems that occurred during development of the basic language of the MARS project. The Novosibirsk Branch, ITM i VT [Institute of Precision Mechanics and Computer Engineering], USSR Academy of Sciences, is represented in the collection by the articles of I. N. Skopin that suggest one approach to organization of parallel symbolic processing and of the articles of a group of authors (A. F. Bondarenko et al) that describe the organization of an operating system for a multiprocessor computer complex from special processors of the El'brus-1 system. A lexical analyzer that carries out undetermined analysis of the input word is described in T. M. Yakhno's paper. A new element in the flow of scientific papers of the Computer Center, Siberian Department, USSR Academy of Sciences, is access to the topic of parallel numerical methods represented by V. A. Vasilenko's paper.

UDC 681.142.2

CALCULATIONS WITH ASYNCHRONOUS INPUT OF INDEPENDENT VARIABLES

[Abstract of article by Val'kovskiy, V. A.]

[Text] The problem of organizing synchronous parallel calculations with asynchronous input of independent variables is considered. The solution is given with some simple premises in the case of parallel realization of arithmetic expressions and cycles on files.

UDC 519.47

RATIO OF PARALLELLISM AND KA-DENSITY IN ACYCLIC NETWORKS

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

[Text] Conditions in which the system of parallel processes is complete expansion of an acyclic network are established for a subclass of acyclic networks. The relationship of the ratios of parallellism, K-density in an acyclic network and the processes comprising it is investigated. The concept of A-density, which is inherent only to systems and which is trivial in the case of processes, is introduced and its properties are discussed.

UDC 681.142.2

MAXIMUM PARALLELLING OF SIMPLE CYCLES

[Abstract of article by Val'kovskiy, V. A. and Kondratskiy, V. L.]

[Text] Estimates of the degree of parallellism of simple cycles that in some special cases yield a non-sorting maximum parallelling algorithm are presented and substantiated.

UDC 681.3.06.519.95

MODEL OF CALCULATIONS IN LANGUAGE OF CONFIGURATION DESCRIPTION

[Abstract of article by Marchuk, A. G.]

[Text] An unformalized model of calculations for the language of configuration description is suggested in the paper. The characteristic features of this model is parallellism and asynchronism of calculations, hierarchic nature of the modular structure and implicit control of data flows. General problems of interpretation are considered, including asynchronous generation and completion of processes and also their interaction. A definition of deadlock is given and a scheme for working with this and other exceptional situations is proposed.

UDC 681.3.06

WORKING WITH DATA IN LANGUAGE OF FUNCTIONAL CONFIGURATION DESCRIPTION

[Abstract of article by Lel'chuk, T. I. and Marchuk, A. G.]

[Text] The basic principles and designs of displaying data and working with it in the language of functional description of configuration, based on the parallel asynchronous model of calculations and being a concrete definition of the basic language of the MARS project, are outlined in the paper.

UDC 681.142.2

REALIZATION OF ASYNCHRONOUS CONTROL IN LANGUAGE OF CONFIGURATION DESCRIPTION OF MARS PROJECT

[Abstract of article by Alekseyev, G. I., Lele'chuk, T. I. and Myl'nikov, S. P.]

[Text] A machine-independent model for achieving asynchronous control in the language of functional configuration description of the MARS project is presented in the paper in the form of a set of structures and their processing proecdures.

UDC 681.3.06.519.95

SIMULATION MODELLING OF DIGITAL SYSTEMS BASED ON COMPUTER MODELS

[Abstract of Article by Malyshkin, V. E.]

[Text] A method of automating the design of simulation models of digital systems, based on formalized description of a class of these systems in terms of computer models, is considered. The concept of the circuitry of the simulation model and of the simulation model itself is defined. Three types of modelling are determined, the requirements on the simulation modelling language are discussed and the basic features of the system that realizes the suggested method are discussed briefly.

UDC 681.3.06

REALIZATION OF ONE MODEL OF PARALLEL OPERATIONS ON STRUCTURAL DATA

[Abstract of article by Dudorov, N. N. and Kasperovick, D. A.]

[Text] Problems of realizing dialogue language of working with structural data, which is a version of a sublanguage of expressions of the Basic language of the MARS system, are considered. The syntax and semantics of the language, representation of its facilities in some abstract language and program realization in Pascal are described.

UDC 519.688

INTRODUCTION OF PARALLELLISM INTO SYMBOLIC CALCULATIONS

[Abstract of article by Skopin, I. N.]

[Text] The possibilities of recruiting parallellism of calculations to solution of symbolic processing problems are considered. Low-level parallellism oriented toward increasing the efficiency of direct associative retrieval in line, is investigated. The need to combine this parallellism with high-level parallellism, which is related to the use of the structure of the material to be processed, is shown in the paper.

UDC 519.688

PARALLEL LEXICAL ANALYZER IN BUMP PROJECT

[Abstract of article by Yakhno, T. M.]

[Text] Organization of a parallel lexical analyzer made within the BUMP project and operating with indeterminate grammar, is described.

UDC 519.6

PARALLEL CALCULATIONS IN PROBLEM OF SMOOTH FULFILLMENT OF NETWORK FUNCTION

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

[Text] The possibilities of parallelling calculations in solving a multidimensional problem of plotting a spline function of arbitrary exponent in a parallellepiped grid are discussed in the paper.

UDC 681.142

SOLVABILITY OF FUNCTIONAL EQUIVALENTS FOR MONADIC FLOW DIAGRAMS WITH ONE-TIME ENTRY OF FUNCTIONAL SYMBOLS

[Abstract of article by Trishina, Ye. V.]

[Text] The solvability of the equivalence problem for free data flow diagrams, which are one of the formalisms that describe parallel calculations,

is investigated in the article. First, solvability is proved for a subclass of these diagrams interesting in the theoretical sense and more extensive in some meaning than those considered earlier. Second, a method is developed that is apparently also applicable to other interesting subclasses of free diagrams and that is based on comparison of the logic-thermal history of only a pair of the last cyclic identifiers of these diagrams.

UDC 681.3.06

CALCULATING NETWORKS FOR DESCRIBING A BASIC LANGUAGE

[Abstract of article by Gorodnyaya, L. V.]

[Text] A model of parallel calculations, which is a generalization of Petri networks, is described. It is shown how it can be used to describe the asynchronous order of using operations in formulas of the basic language.

UDC 681.142.2

REALIZATION OF OPERATING SYSTEM FOR MULTIPROCESSOR COMPLEX OF SPECIAL PROCESSORS OF EL'BRUS-1 MULTIPROCESSOR COMPUTER COMPLEX

[Abstract of article by Bondarenko, A. F., Nakonechnyy, V. N., Ostashov, N. F., Pas'ko, V. N. and Tsang, F. R.]

[Text] The characteristic features of realizing an operating system for a multiprocessor complex, consisting of the special processors of the El'brus-1 multiprocessor computer complex, are discussed in the given paper. The realized operating system permits one to significantly accelerate solution of large problems and to utilize equipment more efficiently.

6521
CSO: 1863/67

REALIZATION OF OPERATING SYSTEM FOR MULTIPROCESSOR COMPLEX OF SUPERPROCESSORS OF EL'BRUS-1 MULTIPROCESSOR COMPUTER COMPLEX

Novosibirsk PARALLEL'NYYE VYCHISLITEL'NYYE I PROGRAMMNYYE SISTEMY in Russian 1981 (signed to press 3 Sep 81) pp 152-162

[Article by A. F. Bondarenko, V. N. Nakonechnyy, N. F. Ostashov, V. I. Pas'ko and F. R. Tsang from the collection "Parallel Computer and Programming Systems", edited by Vadim Yevgen'yevich Kotov, Computer Center, Siberian Department, USSR Academy of Sciences, Vychislitel'nyy tsentr SO AN SSSR, 500 copies, 168 pages]

[Text] Hardware Capabilities of El'brus-1 Multiprocessor Computer Complex

The hardware of the El'brus-1 multiprocessor computer complex offers the user the capability of constructing different configurations of computer systems.

All the functional assemblies of the complex are realized in the form of autonomous modules having standard interface for integration of them into the system. The integrating assemblies of the hardware are commutators and internal storage modules. Up to 10 central processors (TsP) and up to four input-output processors (PVV) can be connected to the common field of the internal storage (OP) by commutators. Two types of central processors, differing by the instruction system and having standard interface with the commutators, are possible in the complex. One of the types of central processors, called a special processor (SP), is compatible by the instruction system with the BESM-6 computer. We will subsequently be interested in the multiprocessor configuration, consisting of several special processors of the El'brus-1 multiprocessor computer complex, which we shall subsequently call processors for simplicity.

During operation of a multiprocessor complex, the processors and input-output processors have the capability of interacting with each other both through the internal storage and through the interrupt system. The required hardware support, which includes processor configuration and internal storage registers, interrupt output and reception registers, emergency interrupt registers and the capability of synchronization access to internal storage, is realized in each processor to support the operation of the complex.

All exchanges with external devices are made by the input-output processors.

OS SP Operating System

The operating system for the multiprocessor complex is realized on the basis of the OS SP [Special processor operating system] [1], which is written in high-level Yarmo-2 machine-oriented language [2]. The OS SP has a modular-hierarchical structure and provides fulfillment of the following functions:

multiprogram operating mode;

autonomous entry and storage of entered flow of tasks;

storage of output information and autonomous output of it to real devices;

dynamic distribution of resources;

automatic distribution of external devices;

gathering and processing of statistical information on tasks to be admitted;

interaction with operator.

The distinguishing feature of the OS SP is that it stores and transfers the software stored on the DISPAK operating system of the BESM-6 computer due to the functional compatibility of both operating systems.

Any work of the OS SP proceeds within the framework of some process. Processes are divided into systems and user. Examples of systems processes are autonomous entry, problem planner, automatic identification of volumes of plug-in carriers, problem terminator, autonomous output and so on. The tasks and programs of the operating system directly caused by the task are fulfilled within the framework of user processes. Access to programs of the operating system on the part of the task can be voluntary through extracodes or forced through the internal interrupt mechanism. In any case the set of programs of the operating system that realize given actions should be regarded as program expansion of the hardware capabilities and fulfillment of the given set of programs should be regarded as a continuation of the task.

Each process is described by the process information field (IPP) containing the values of all registers of the process, resources required by the process, the address of entry to the process and so on. Switching from process to process is a rather laborious operation requiring concealment and readjustment of all registers of the processor.

The following problems were solved in realizing the operating system for a multiprocessor computer complex:

interaction of processes and synchronization in access to common facilities;

parallel execution of procedures;

offering the user facilities for simultaneous fulfillment of his task on several processors;

initiallization of the system;

"viability" of the complex.

Control of Processes

Realization of an operating system that ensures the operation of a multiprocessor complex required that special attention be allocated to problems of synchronization, working with common facilities and development of effective, parallel-executed procedures for these purposes.

The distribution of a common internal storage among processors is dynamic in a multiprocessor system. Exchanges are made by the multiprocessor configuration of the input-output processors operating on a common field of external devices under the control of a unified program. All processors are symmetrical with respect to each other and service a unified mixture of tasks. Each process can be performed on any processor. At the same time several processes can be performed simultaneously in the name of any of the tasks (and also in the name of the operating system).

The following types of status of processes are possible: active, ready and wait. An active process is one which is executed on a processor, a ready process is one awaiting selection to a processor and a wait process is one awaiting release of a resource or some event. All ready and wait processes are located in the corresponding units. The systems procedure SWITCH FROM PROCESS TO PROCESS changes the status of the process. If there are no ready processes, a test process which tests the system and in case of some changes of status of the system initiates the action of corresponding processes, is loaded into the processor.

The hardware of each processor determines the two independent virtual address spaces--systems memory in which the operating system program is fulfilled and the mathematical memory available to the task. The readdressing mechanism is program-controllable and permits arbitrary conformity to be established between systems and mathematical sheets on the one hand and real physical sheets of the internal storage on the other.

The area of the systems memory of each processor, corresponding to the codes of the resident part of the operating system and to common global data, is transformed to a common physical memory. A unified copy of the operating system is achieved by this. Local data of the procedures of the resident part of the operating system belonging to the processor are concentrated in the appropriate systems regions, which is readdressed for each processor to its own physical local region. Thus, resident procedures of a multiprocessor operating system are capable of being executed in parallel on different processors.

Mechanization of Synchronization

The event and semaphore synchronization circuits used in the OS SP are converted to a multiprocessor operating system with retention of their functions in the system. Only the procedures themselves were changed. The information structures that realize these circuits are units whose heads are the events and semaphores themselves. Since all processors in a multiprocessor system operate on the field of a common internal storage and since processes are executed in parallel and work with common facilities, one must additionally synchronize for access to the common facilities of internal storage (to tables, queues, lists, global variables and so on). The common facilities of the internal storage for a multiprocessor operating system become resources.

The events mechanism is used to organize interaction of processes. An event can be in two states: OCCURRED and DID NOT OCCUR. When executing WAIT operation on an event, the current process is taken from the processor and included in the queue to the event if the event was in the DID NOT OCCUR state. A process from the queue of ready processes is loaded into the processor. If the operation DECLARE is executed, all the processes from the queue to the given event are included in the queue of ready processes and the event is set to the OCCURRED state. The event can be interrogated and reset.

Exclusion of simultaneous access of processors to common facilities is achieved by using two pairs of operations on semaphores: WAIT WITH HOLD and DECLARE and WAIT BRIEFLY and DECLARE BRIEFLY. The given operations are similar to P and V operations on Diekstra's binary semaphores [3]. The first pair of operations is used to hold the resource when removal of the process from the processor for an indefinite time is possible when working on it. The last pair of operations is used to hold the resource for a short time and we will call the semaphore related to a given resource a brief semaphore.

A semaphore may be in two states: OCCUPIED and UNOCCUPIED. The status of the semaphore is checked when executing a WAIT WITH HOLD operation. If it is UNOCCUPIED, the semaphore is held; the number of the process that held the semaphore is assigned to the semaphore and the process begins to operate in the critical interval. Upon emerging from the critical interval, the current process performs the operation DECLARE, after which the process first in the queue to the semaphore becomes ready. If the status of the semaphore is OCCUPIED, the current process is removed from the processor and is included in the queue to the given semaphore. After the semaphore held by its process has been freed, the wait process is selected to the processor and enters the critical interval.

A brief semaphore, like an ordinary sempahore, may be in two states: OCCUPIED and UNOCCUPIED. If a WAIT BRIEFLY operation is being executed, the status of the semaphore is checked. If it is UNOCCUPIED, the brief semaphore is set to OCCUPIED by a special privileged instruction and the number of the process that held the semaphore is assigned to the brief semaphore and the process continues to work in the critical interval. Upon emerging from the critical interval, the current process executes the operation DECLARE BRIEFLY, which sets the status of the brief semaphore to UNOCCUPIED. If the status is

OCCUPIED, the current process is not removed from the processor and enters the critical interval only after the status of the brief sempahore has been changed to UNOCCUPIED. Brief synchronization is used only for working on resources held for a short time that does not exceed the operating time of the procedure SWITCH FROM PROCESS TO PROCESS.

A separate semaphore is allocated for each general-purpose resource and working with this resource is stipulated by a critical interval. In some situations a continuous critical interval should be set for working with several resources. For example, this situation occurs upon access to a sheet located in the exchange when the continuous critical interval is set to work with a table of sheets of the internal storage and the queue of processes awaiting completion of the exchange.

Capabilities Offered to the User

The operating system for multiprocessor configuration offers to the user facilities for developing processes within a task and a mechanism of synchronization between them. The user has the capability of dividing the problem into low-dependent parts, formulating them with processes and simultaneously executing them on different processors. If the low-dependent parts are selected according to the time of execution by significant parts (exceeding the time of switching from process to process), then the solution of the problem can be accelerated considerably.

Each process is offered its own mathematical memory up to 32 K words and thus the task as a whole is offered a memory exceeding 32 K words of the internal storage. The sheets of the physical memory can be divided among different processes, which is achieved by readdressing the mathematical memory to the physical memory. Interaction of processes and synchronization in access to common data of the task are accomplished by means of events and semaphores arranged on common physical sheets.

The user is offered the following capabilities to create and organize interaction of processes of the operating system task:

form a new process;

initiallize an event;

interrogate an event;

wait for an event;

declare an event;

establish agreement for common data and programs.

The user is offered the following capabilities for working on the semaphore to synchronize access to common data:

hold the semaphore;

release the semaphore.

The processes of one task can share physical sheets containing both the program code and data.

Parallel use of programs is realized for processes of different tasks in the form of code files, writing protection to which is provided by hardware. A specific mathematical memory is allocated to the code file within the framework of each task. Utilizing the mechanism of readdressing mathematical sheets to common physical sheets, one can see that one copy of a given program for all tasks working with this code file will be stored in the internal storage. A single restriction is placed on the program that it provide multientry capacity. The code file mechanism ensures a considerable saving of internal storage; therefore, it is desirable to develop frequently used programs (translators, monitors, editors and so on) as multientry.

Initiallization of a System

The multiprocessor nature of a complex required changes and supplements in initiallization of the system.

Initiallization is accomplished in two phases. The variables and tables of the operating system are formed, systems processes are created and the start of the dynamic initiallization process is prepared in the static initiallization phase. After static initiallization has been completed, the programming code of the operating system is placed by the operator on the systems disk.

Operator is understood in the given paper not only as the operator in the traditional meaning, but as both the engineer and administrator that service the computer complex.

The operating system is itself loaded by means of a special service program which the input-output processor initiated by the operator places from the drum to the internal storage by means of hot loading. The service program receives a description of the configuration which can be given either on punch cards or in a specific location of the external memory as the input data. The number and numbers of the central processor and input-output processor, the volume and numbers of internal storage modules, the number and types of external devices and other parameters of the operating system are indicated in description of the configuration. The service program places the resident operating system to the corresponding position of the internal storage and initiates the dynamic initiallization process.

The tables of the operating system whose size depends on the real configuration are formulated, the segments of the external memory are checked and rejected and the corresponding tables are constructed in the dynamic initiallization phase. After astronomical time, the date and number of the shift of operators has been entered, the operating system is ready to work. The processor on which dynamic initiallization of the operating system occurred can be selected arbitrarily.

New processes are introduced into the operating system by the operator by assigning a special directive which, based on the current status of the configuration of the complex and the operating system, prepares the required information structures for the new processor. Executive of the directive on one of the operating processors ensures hardware accessibility of the processor to be entered to the internal storage, input-output processor and central processor of current configuration, loads the local region for the processor to be introduced to some physical region and establishes the conformity of the systems memory of the processor to be introduced in it. Direct initiation of the processor to be introduced into the operating system is accomplished by a special ENTER IN OPERATING SYSTEM program started by the operator from the engineer's console of the processor to be introduced, which establishes the status of the hardware of this processor according to the information structures prepared by the operating system.

Reconfiguration of the Complex

The configuration of a multiprocessor complex is rather complicated and it contains several special processors and input-output processors operating on a common internal storage field and a large number of external devices, access to which can be gained through one or several input-output processors. The configuration of the complex can be changed dynamically during operation of the operating system in it. Dynamic reconfiguration is carried out by the operator's directives and automatically by the operating system upon breakdowns of processors, internal storage and input-output processors.

The configuration can be dynamically changed completely by the operator's directives, by connecting or disconnecting external devices, input-output processors and internal storage modules, which increases the viability and stability of the complex. It must be noted that connection or disconnection of a system processor only increases or reduces the capacity of the complex.

If several processors are operating, an emergency of any one of them can be detected automatically on an operating processor by emergency interruption. The processor monitor signal occurring in each processor at specific frequency is extinguished with the same frequency by the operating system and failure to extinguish the monitor signal in it during an emergency leads to transmission of emergency interruption to the other processors. The first operating processor that received the emergency interruption excites a special systems emergency process. The emergency process excludes the emergency processor from the configuration and determines the state in which the system was at the moment of the emergency. If a user program was being fulfilled on an emergency processor, the emergency process forms an emergency printout for a given task, freeze the resources occupied by it and completes the task on its own computer. If a program in operating system mode was being fulfilled on the emergency processor, the emergency process prints out a complete diagnosis of the emergency and the possible methods of coming out of it. Based on this information, the operator makes a decision for further continuation of the operating system or on restarting it. If the breakdown of the processor was accidental, connection of it to a system is similar to how a new processor was initiated.

Thus, an operating system for a multiprocessor complex consisting of special processors of the El'brus-1 MVK, compared to a complex of single-processor systems, has the following advantages:

solution of large tasks is accelerated considerably due to their parallelling;

the efficiency of equipment utilization is enhanced by balanced loading of the processors and external equipment;

a saving of internal storage is achieved due to the use of code files;

the stability of the system is enhanced with respect to equipment failures.

BIBLIOGRAPHY

1. Tsang, F. R., "The Operating System of Special Processors of the El'brus-1 Multiprocessor Complex," Preprint No 15, Moscow, 1980.

2. Gololobov, V. I., B. G. Cheblakov and I. D. Chinin, "Machine-Oriented High-Level Language for BESM-6 Computer," in "Razvitiye programmnogo obespecheniya dlya EVM BESM-6" [Developing the Software for BESM-6 Computers], Moscow, 1975.

3. Diekstra, E., "Interaction of Serial Processes," in "Yazyki programmirovaniya" [Programming Languages], edited by F. Zhenyuk, Moscow, Mir, 1972.

6521
CSO: 1863/67

UDC 519.95

PARALLEL PROCESSING IN ESTONIA

Tallinn PARALLEL'NAYA OBRABOTKA INFORMATSII I PARALLEL'NYYE ALGORITMY in Russian 1981 (signed to press 7 Jul 81) pp 2-7, 297

/Annotation, foreword and table of contents from book "Parallel Information Processing and Parallel Algorithms", edited by Viktor Alad'yev, Izdatel'stvo "Valgus", 800 copies, 298 pages/

/Text/ This collection contains papers devoted to parallel processing of information, parallel algorithms and modeling in homogeneous structures, which form the theoretical basis of computer technology of parallel operations. This collection should be of great interest to a wide circle of specialists in computer technology, software, information processing and cybernetics who are interested in topics related to parallel processing of information. 23 figures, 164 title bibliography.

Foreword

Computer technology penetrates more and more deeply into the nation's economy aiding in the solution to its important problems. The Estonian SSR is one of the leading republics in the nation in the use of computer technology. Several dozen design-technological and research institutes of the republic are working on problems involving the use of contemporary computer technology in the economy.

The sphere of application of automated information processing systems has been broadening rapidly, requirements for productivity of computer technology utilized are increasing. Any increase in the speed of operation of a computer is associated with huge expenses, which cannot avoid influencing the cost effectiveness of the development and utilization of information processing systems. Today's needs demand the creation of an information processing system which produces economic savings directly and this means that we must search for new principles of construction for computer systems (VS's).

Such a principle for constructing VS's was first suggested and theoretically justified in the 60's by Professor E. Yevreinov and was further developed in the subsequent work of the scientific school he founded. Time has demonstrated that this was the right scientific approach, since, even within the

framework of the sequential principle of information processing, the necessity has arisen to remove the constraint of the VS's operating speed, the implementation of which has led to the computer collective. Thus, the VS in this sense, is made up of individual computers, autonaomously solving problems, but capable of combining their computational resources.

At present, the greatest successes in the practical implementation of models of computer collectives have been attained in the assembly of homogeneous computer systems (OVS's), representing a concatenation of similar computers linked together and adapted for systems operation. Here, one distinguishes between distributed and centralized OVS's. A centralized homogeneous computer system plays a major role in providing the necessary computational resources for complexes for integrated processing of accounting/economic and statistical information in collective use computer centers (VTsKP's).

The organization of computers into a system increases the efficiency of computer technology utilization and, in a number of cases, makes it possible to create an information processing system which leads directly to economic savings. In the VGPTI/TsSU SSR (All-union State Design Technological Institute for the Mechanization of Accounting and Computers, USSR Central Statistical Administration), under the leadership of Lenin prize winner, professor E. Yevreinov, intensive work was undertaken to create centralized, as well as distributed OVS's for the economy.

The Estonian branch of the VGTTI TsSU SSR, within the framework of its general program, is conducting work on the creation of software (PO) for OVS's based on the YeS EVM (Unified Systems Computer). This work has important significance. First of all, in the process of software development for homogeneous computer systems and the use of software, the fundamental principles and approaches to the creation of the homogeneous systems themselves become clear, their effectiveness gets evaluated and a methodology for solving problems with OVS's gets developed. Secondly, the gradual saturation of the economy by third generation computers leads to a situation where there are a number of organizations and computers centers of the nation having two or more YeS EVM's, and means for interfacing them. This makes it possible to create information processing systems which lead to large economic savings and also to increase the reliability of this processing itself.

In connection with this, in 1980 the Estonian affiliate expanded its work on parallel information processing and parallel algorithms, which had begun in March, 1979. In the process of developing this topic, the affiliate maintains close ties with a number of scientific centers in our nation (Moscow, Minsk, Voronezh, Kiev, Novosibirsk), as well as abroad (Bulgaria, CSSR, Hungary, GDR, FRG, United States, Japan), involving questions of mathematical theory of homogeneous structures and their application. Thus, the material offered in this collection which contains fundamental results on parallel information processing and applied aspects of the theory of homogeneous structures, has been created collectively. However, the editor takes responsibility for all shortcomings of this material. The material offered can be characterized briefly as follows.

The first paper describes a parallel system of information processing (PSOI) whose implementation is based on already existing hardware and basic software for models of the YeS EVM. The PSOI is implemented in the form of a parallel processing package (PPO), which broadens the capabilities of the YeS EVM operating system for controlling the functioning of homogeneous computer systems consisting of any number of YeS EVM models. The paper discusses prerequisites for the creation of a PSOI, the functional structure of the package, the basic device of intermachine communication in homogeneous computer systems (OVS's), systems operations of parallel processing in OVS's and the system for package interchange. In conclusion, the paper considers the task of parallel sorting in an OVS under control of a PSOI and the organization of a parallel search in an OVS. Theoretical evaluations are given of the time gained through parallel search in an information parallel mode, as a function of the organization and mode of use of the data. The information parallel mode is discussed in detail, as is the creation of highly efficient information processing systems based on this mode. The set of mass information processing tasks which are efficiently implemented in this mode are defined.

A popular account of the ideas of information paralell operation and the possibilities for using it to create highly effective information processing systems can be found in the Hungarian journal COMPUTER SCIENCE for June, 1981. This account is aimed at a wide circle of specialists in computer technology and programming.

This paper contains a detailed description of the structure and functioning of the PSOI which allows the creation of similar OVS-based processing systems consisting of non-YeS computer models. The present paper represents a significantly expanded version of a report given at the All-Union school-seminar "The Distributed Computer System and Parallel Computing", which took place in June, 1981 in the city of Voronezh.

The second paper discusses the problem of adopting parallel information processing technology for solving accounting problems. It is well known that, at present, problems of this class are not implemented effectively on computers. Analysis of the major problems in this class shows that more than half the solution time must be spent on operations of sorting and information search, which can be implemented in the parallel operation mode on an OVS, under control of a PSOI with great savings of time. This makes it possible to hope for significant increase in the efficiency of solution of accounting problems on the whole. The problem considered in the paper was offered for discussion at the All-Union Scientific-Practical Conference "Accounting Under Improved Economic Mechanisms" (October, 1981, city of Tbilisi).

The third paper discusses future prospects for the development of the theory of homogeneous structures (OS) with regard to using them in the computer technology of parallel operations. The OS is considered as the basis for a non-Neumann approach to computation and computer technology. The paper defines the most important trends in the theory of the OS as a formal model of homogeneous computational media, structures and systems. The paper represents an expanded version of material presented at the third Hungarian conference on computer science (January, 1981, city of Budapest).

The fourth paper is devoted to cybernetic modeling of biological development. The inclusion of this work in the present collection is not accidental. In the past decade, theoretical and mathematical biology has been characterized by much penetration of the methods from the theory of abstract automata and formal grammars. As a basis for modeling developmental processes on a cellular level, we have proposed the techniques from the theory of homogeneous structures, which are presently being widely adopted. In order to eliminate certain shortcomings inherent in the use of the OS for modeling, a number of biological phenomena, Lindenmayer has introduced his, now widely known, L-systems, which, at present, are being intensively studied (like the OS) form the point of view of parallel information processing and parallel programming, in spite of the fact that initially both systems were introduced for the purposes of biological modeling. The study of a whole series of models of development implemented on the basis of the OS and L-systems revealed in a number of cases an extremely close connection between the mechanisms underlying the processes of development and the process of processing and control in parallel operation computer systems. This fact makes it possible to build a bridge connecting theoretical and mathematical biology with computer sciences. This opens up broad possibilities for mutual enrichment and development. In our view, this connection will expand steadily and, with time, may lead to more benefit for computer technology than vice versa. This is why the topics of biological modeling using OS and L-systems, which are also the research techniques in parallel information processing, are of interest for a non-Neumann approach to computing. The paper begins by characterizing the basic approaches to discrete modeling of biological development. Then there is discussion of a number of models of development based on the OS and L-systems. The conclusion of the paper analyzes OS and L-systems as bases for cybernetic modeling of developmental processes in detail and discusses future prospects for further development of the techniques for modeling biological development. This work is a significantly expanded version of material written as a chapter titled "Regulation and Control" for the book "The Mathematical Biology of Development," published in 1982 by "Nauka."

The fifth paper investigates the types of parallelism in homogeneous computer systems consisting of micro-computers. A comparative analysis is performed of the efficiency of functional parallel operation and data paralleling. This analysis forms the basis for the conclusion that the data paralleling realized in the OVS mode is preferrable. Issues related to the realization of the basic software of the OVS, which supports data mode are discussed.

This collection should be of interest to a wide range of specialists in computer technology and software for parallel computer systems, specialists in information processing and also cyberneticists and mathematical biologists interested in topics in parallel information processing and cybernetic modeling of biological development.

A number of the issues considered in this collection were discussed at the Institute of Computer Technology (city of Sophia, 7-24 July, 1980) and the regional computer center of Prague University (city of Prague, 24 November-6 December, 1980). Thus, we are also grateful to all the participants from these research centers for their useful discussion.

In conclusion, we wish to express gratitude to V.I. Mazurenko, senior engineer of the division of design of the VTsKP (Collective Use Computer Center) for his substantial work in preparing this manuscript.

Please address all questions related to the material in this collection to: 200001, city of Tallinn, Maakri 15, EF VGPTI, telephone 42-34-64.

Contents

9285
CSO: 1863/68

OPTICAL CHARACTER READERS

GENERAL REVIEW OF OPTICAL CHARACTER READERS

Kiev OPTICHESKIYE CHITAYUSHCHIYE AVTOMATY in Russian 1980 (signed to press 22 Nov 79) pp 2-4, 206-208

[Annotation, preface, bibliography, and table of contents of book "Optical Character Readers", by Doctor of Technical Sciences Vladimir Antonovich Kovalevskiy, Candidate of Technical Sciences Georgiy L'vovich Gimel'farb and Candidate of Technical Sciences Anatoliy Fedorovich Voziyanov, Izdatel'stvo "Tekhnika", 4,000 copies, 208 pages]

[Text] Annotation

This book describes the methods of designing optical character readers for reading and inputting alphanumeric texts to computing, information retrieval, and automatic control systems. It sets forth the theory of image recognition relevant to automatic text reading and models the work of a character reader on a general-purpose electronic digital computer. Special attention is devoted to experience with development of the domestically produced ChARS correlation character reader. The authors review the distinctive features of the organization of document circulation under conditions of automatic reading.

The book is intended for engineering-technical employees who specialize in the field of automatic reading equipment and the hardware of automatic control and computing systems. It may also be useful to upper-division and graduate students in the appropriate specializations.

Preface

The challenges posed by the 25th CPSU Congress with respect to automation of various sectors of the national economy demand rapid development of computer technology. The document "Basic Directions of Development of the USSR National Economy for 1976-1980" points to the need to develop the production of general-purpose and control computing complexes, peripheral equipment, and data recording and transmission units for automated systems to control industrial processes and optimal control in sectors of the national economy.

High-speed character readers are used to increase the efficiency of functioning of automated and computing systems. These machines eliminate the unproductive manual labor of encoding data and significantly reduce the disproportion between the speed of feeding data to the computing system and the speed of its

processing. To judge by foreign estimates, in the late 1970's from 25 to 50 percent of all expenditures for data processing went for encoding and feeding the raw data. Character readers greatly reduce these expenditures and are thus one of the most promising types of input equipment.

Work on character readers in the USSR began in the late 1950's. By the early 1960's many Soviet and foreign organizations were actively developing optical character readers. Despite the great complexity of the problem and the theoretical and engineering difficulties that arose during the process of development and operation of the first models of character readers, definite progress has been made in recent years in building and using these machines. This progress depends significantly on the technological advances of contemporary computer equipment, precision mechanics, optical electronics, and laser engineering (in particular on the appearance of reliable and inexpensive digital and analog integrated circuits, high-speed small computers, microprocessors, and the like).

Many things in the field of automatic character reading are still disputed and problematical, so a summary and systematization of experience with planning and designing character readers should be of tangible use not only to beginning developers but also to those specialists who have made their own contribution to solving this problem. It is relevant to note here that the problems that arise in building character readers have only been touched on very slightly (and that has only been on a general level) in domestic literature on image recognition.

The bulk of this book is made up of results of work done over the space of more than 15 years at the Institute of Cybernetics of the Ukrainian SSR Academy of Sciences and the Special Design Bureau of the MMS [possibly Mathematics Council] of the Ukrainian SSR Academy of Sciences. During this work an experimental model of the ChARS correlation character reader was built. It successfully underwent testing and was accepted by the State Commission. During development of the ChARS modern methods of design based on computer modeling of the work of the character reader, in particular the recognition process, were used. The design of the ChARS contains a number of original assemblies that are protected by author's certificates.

We ask that comments and requests be sent to the following address: 252601, Kiev, 1, GSP, Kreshchatik, 5, Izdatel'stvo "Tekhnika."

Bibliography

1. "Avtomatizatsiya Vvoda Pis'mennykh Znakov v EVM" [Automation of Input of Written Characters to the Computer], 2nd edition, Vilnius, RINTIP, 1968.

2. "Avtomatizatsiya Vvoda Pis'mennykh Znakov v EVM" [Automation of Input of Written Characters to the Computer], Vol 1, Vol 2, Vilnius, RINTIP, 1969.

3. "Avtomatizatsiya Vvoda Pis'mennykh Znakov v TsVM" [Automation of Input of Written Characters to the Digital Computer], Vol 1, Kaunas , NIINTIiTEP, 1973.

4. "Avtomatizatsiya Vvoda Pis'mennykh Znakov v TsVM" [Automation of Input of Written Characters to the Digital Computer], Vol 1, Kaunas, Kaunas Polytechnic Institute, 1977.

5. Author's certificate 181169 (USSR).

6. Author's certificate 206901 (USSR).

7. Author's certificate 367434 (USSR).

8. Author's certificate 413503 (USSR).

9. Author's certificate 496574 (USSR).

10. Belobragina, L. S., and Yeliseyev, V. K. KIBERNETIKA, 1967, No 6.

11. Kalmykov, V. G. IZV . AN SSR. SER. TEKHN. KIBERNETIKA, 1973, No 3.

12. Kiyko, V. M., In "Raspoznavaniye Obrazov" [Image Recognition], Kiev, IK AN USSR, 1978.

13. Kovalevskiy, V. A., "Kibernetika i Vychislitel'naya Tekhnika. Resp. Mezhved. Nauch.-Tekhn. Sb." [Cybernetics and Computer Technology. Republic Interdept. Scientific-Technical Collection of Articles], 1969, Vyp 3.

14. Kovalevskiy, V. A., "Metody Optimal'nykh Resheniy v Raspoznavanii Izobrazheniy" [Optimal Decision Techniques in Image Recognition], Moscow, "Nauka," 1976.

15. Kovalevskiy, V. A., Sibirtsev, V. G., and Tretyak, O.D., KIBERNETIKA, 1974, No 5.

16. Barashko, A. S., Kovalevskiy, V. A., Mazyra, Yu. S., et al. "The ChARS Correlation Character Reader with Shift Register," in "Chitayushchiye Avtomaty" [Character Readers], Kiev, "Nauk. Dumka", 1965,

17. Leman, E., "Proverka Statisticheskikh Gipotez" [Testing Statistical Hypotheses], Moscow, "Nauka", 1964.

18. Shlezinger, M. I., and Svyatogor, L. A., in "Trudy III Vsesoyuznoy Koferentsii po Informatsionno-Poiskovym Sistemam" [Proceedings of the 3rd All-Union Conference on Information Retrieval Systems], Vol 3, Moscow, VINITI, 1967.

19. Shlezinger, M. I., KIBERNETIKA, 1976, No 4.

20. Hueckel, M. H., JOURN. ACM. 18, 1971, No 1.

21. Rosenfeld, A., and Kak, A. C., "Digital Picture Processing," New York, Academic Press, 1975.

Table of Contents

11,176
CSO: 1863/47

MAIN CHARACTERISTICS OF SOVIET CHARACTER READERS

Kiev OPTICHESKIYE CHITAYUSHCHIYE AVTOMATY in Russian 1980 (signed to press 22 Nov 79) pp 5-37

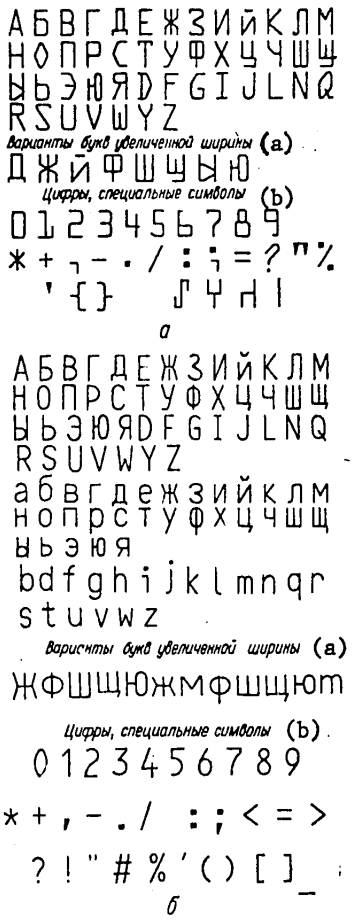
[Chapter 1 of book "Optical Character Readers", by Doctor of Technical Sciences Vladimir Antonovich Kovalevskiy, Candidate of Technical Sciences Georgiy L'vovich Gimel'farb and Candidate of Technical Sciences Anatoliy Fedorovich Voziyanov, Izdatel'stvo "Tekhnika", 4,000 copies, 208 pages]

[Excerpts] Many developers of character readers have proposed different kinds of stylized type faces. In the late 1960's the ISO [International Organization for Standardization] selected two stylized machine type faces from the many which existed at that time and recommended them as international standards, called ISO-A and ISO-B. The ISO-A type (also called OCR-A) was developed by the American Institute for Standards and is used for many foreign-made character readers. This type face has been adopted as the national standard in the United States, West Germany, and numerous other countries. ISO-B (also called OCR-B), which was proposed by the European Association of Computer Producers (ECMA), is more widespread in Western Europe. The designs of the characters of this type face are more familiar to people than those of ISO-A. Character readers that read ISO-B were initially developed by Western European companies or European branches of American companies. In recent years American character readers have also made provision for reading ISO-B type face.

Our country adopted GOST [State Standard] 16330-70 for optical reading type faces ROS-A (see Figure 1a below) and ROS-B (Figure 1b), which use the type standards of ISO-A and ISO-B supplemented by the Russian letters they do not contain. The results of studies of different methods of stylizing the characters were taken into account. This research was done at the Institute of Cybernetics of the Ukrainian SSR Academy of Sciences and the Special Design Bureau of Computer Technology in Vil'nyus.

Tables 1 [below] and 2 [not reproduced] give the basic domestically produced and some foreign models of character readers, classified by types of documents that they process. This is the classification most often used in the literature. All character readers are divided into four classes:

1. for documents of a few lines;



Key: (1) Widened Versions of Letters;
(2) Numerals and Special Symbols.

Figure 1. The ROS-A (a) and ROS-B (b) Stylized Type Faces.

---

2. For pages of text;

3. for a continuous roll of paper with line printing;

4. general-purpose machines that work with various types of documents.

Table 1.

Model (Year of Production)	Description of Initial Document: Class*	Size, mm	Number and Kind of Type Faces (Alphabet)**	Speed: Characters per Second	Speed: Documents per Minute
VINITI-2 (1971)	2	200 × 297	1NSh "Optima" (TsBS)	***	Up to 20
ChARS (1972)	2	210 × 297	1NSh "Optima" (TsBS)	200	Up to 60
Sever-3 (1969)	2	150 × 180-280 × 355	Several printing and typewriter nonstylized type faces (TsBbS)	35-100	Up to 60
YeS (1977)	2	210 × 297	1SSh ROS-B (TsBbS)	Up to 500	Up to 50
Blank-2 (1969)	1	105 × 105-210 × 297	1SSh ROS-A (TsS)	N/A	To 400
Blank-3 YeS6031 (1976)	1	105 × 105-210 × 297	1SSh ROS-A (TsS)	N/A	Up to 400
Blank-4 (1977)	1	110 × 75	1NSh Printing T-8 (TsS)	Up to 60	Up to 400
Ruta-701 (1968)	2	210 × 150-210 × 297	1NSh "Optima" (TsS), RZ (TsS)	Up to 180	Up to 20
R711	1	65 × 105-105 × 210	2SSh ROS-A, ROS-B, (TsBS), RZ (TsS)	Up to 1000	Up to 580

* According to the classification in subchapter 1.4.

** Numeral — number of type face; SSh — stylized type face; NSh — nonstylized type face; RZ — manuscript characters. In the alphabet of character readers for these types of type faces: Ts — numerals; B — capital letters; b — small letters; S — other symbols (punctuation marks and the like).

*** [Russian text obscured, probably "50"]

[Table continued, next page]

[Table continued]

	Description of Primary Blocks			Reliability of Recognition		Approximate Cost, rubles
	Block for Feeding and Moving Documents	Read Block	Recognition Block	Frequency of Air, %	Frequency of Failures To Recognize %	
VINITI-2 (1971)	rod with vacuum suction devices, roller conveyor	"running beam" system with CRT	correlation	0.02-0.4	0.1-0.3	N/A
ChARS (1972)	rod with vacuum suction devices, vacuum drum	photodiode line	correlation	0.01	0.1	140
Sever-3 (1969)	manual feed, roller conveyor	"running beam" system with CRT	correlation and analysis of structural features of characters	0.01-1	0.1-1	300
YeS (1977)	vacuum feed, belt conveyor	"running beam" system with CRT	correlation	0.001-0.01	0.005-0.05	150-200
Blank-2 (1969)	vacuum feed, roller conveyor	photodiode line	analysis of structural features of characters	0.001	0.01	30
Blank-3 YeS6031 (1976)	vacuum feed, roller conveyor	photodiode line	analysis of structural features of characters	0.001	0.01	30-40
Blank-4 (1977)	vacuum feed, belt conveyor	LI-601 dissector	analysis of structural features of characters	0.01	0.1	N/A
Ruta-701 (1968)	rod with vacuum suction devices, roller conveyor	"running beam" system with CRT	correlation (analysis of features for manuscript characters)	0.001, or 0.14 manuscript characters	0.02	65-90
R711	vacuum drum	photodiode line	analysis of structural features of characters	0.001-0.01	0.01-0.1	N/A

[Table continued, next page]

[Table continued]

* According to the classification in subchapter 1.1.

11,176
CSO: 1863/47

DESIGN, OPERATION OF RUTA-701, SEVER-3 CHARACTER READERS

Kiev OPTICHESKIYE CHITAYUSHCHIYE AVTOMATY in Russian 1980 (signed to press 22 Nov 79) pp 95-146

[Chapter 4 of book "Optical Character Readers", by Doctor of Technical Sciences Vladimir Antonovich Kovalevskiy, Candidate of Technical Sciences Georgiy L'vovich Gimel'farb and Candidate of Technical Sciences Anatoliy Fedorovich Voziyanov, Izdatel'stvo "Tekhnika", 4,000 copies, 208 pages]

[Excerpts] Chapter 4. Designs of Contemporary Character Readers

1. The Blank-2 Character Reader

The domestically produced Blank-2 character reader for reading forms with a few lines was developed in 1968-1969 as a further development of the Blank-P label reader. In addition to labels the Blank-2 reads a line of numbers and service characters in the stylized type face KOS-A on blank forms in four formats: 210 × 297, 105 × 297, 148 × 210, and 105 × 148 millimeters. The character reader is set manually for the format of the blanks and position of the line of text before reading begins.

The character reader has a speed of 350-400 documents per minute for continous reading of a package and 100-125 documents per minute if each document is fed following a request by an external computer to which the reader is connected.

The block for feeding and moving documents has an input pocket with a capacity of 1,000 forms and three output pockets that hold 750 forms apiece (one for documents with unrecognized characters and two for sorting documents according to signals from the external computer). The input pocket rises as the package is read so that the top sheet is presented to the feed assembly. A special electromechanical tracking system with optical electric sensors which monitor the position of the top of the package and correct feeding of the top sheet (to see that it does not become crumpled and that no more than one sheet at a time is taken) controls this rising motion. The top sheet is separated from the package by a revolving disk arm. Then a small vacuum roller transfers the document to a roller conveyor. The conveyor which moves the document is divided into two parts between which there is a vacuum drum. The drum holds the document while it is read, making it possible to repeat the reading of a line of text if

necessary. In addition to the vacuum suction the sheet is held in the drum by spring-activated rollers. When the sheet is being moved on the conveyor it is straightened out by its leading edge: the residual misalignment of the sheet in the drum does not exceed 0.3 millimeters for a length of 297 millimeters.

The read block of the character reader has two separate heads: for reading labels and for reading a line of text. They are located along the generating line of the drum; the text reading head can be moved manually to adjust it according to the position of the line on the sheet. This head contains an illuminator consisting of two mirror lights, a lens, and a line of 32 photodiodes with photocurrent amplifiers. The line of photodiodes is arranged across the line being read and is approximately twice the height of a character on the line: the image of a character projected on the line covers a height of 13-16 photodiodes. This makes it possible to perform the reading operation despite possible misalignments of the line being read with respect to the direction of movement of the document and vertical displacement of characters on the line. After amplification the signals of the photodiodes are quantized on two levels (black-white) and interpreted as binary variables (1-0 respectively).

The recognition block employs the structural logical method of recognition according to which there is a given boolean decision function from the binary structural features of the character being recognized for each character of the alphabet. The presence of a certain vertical or horizontal lines (hachures) is considered to be a feature. A total of 10 vertical lines and three horizontal lines located in five columns and three lines of the field of vision are analyzed (see Figure 13). The choice of these features is dictated by the characteristics of the design of the numbers and special characters of the ROS-A type face. In the figure the upper vertical lines are designated BB1-BB5, while the lower vertical lines are BH1-BH5 and the horizontal lines are Г1-Г3.

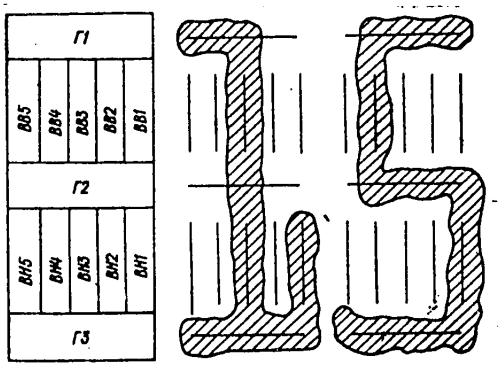


Figure 13. Arrangement of the Main Lines (Hachures) for the Numbers and Special Characters of the ROS-A Type Face Recognized by the Blank-2 Character Reader.

To compensate for possible incomplete printing of the lines, the read zone is divided on the vertical into 16 discretization elements (cells). Corresponding to each element are two adjacent photodiodes of the read line whose signals are logically summed, that is, the element is read as black if at least one of the photodiodes has at its output the corresponding signal. The shortest vertical line should consist of at least three black discretization elements, while the widest horizontal line should not be wider than two elements.

The read head scans characters from right to left. The process of measuring the features of the character begins when the first vertical line of the character is detected and continues for five scanning cycles (each cycle corresponds to scanning one of the columns shown in Figure 13 above). Each cycle tests whether there is a vertical line and how it is positioned relative to the first line found: higher, lower, or on the same level. Horizontal lines are detected when the length of the "black" signal for the corresponding discretization elements is greater than for the widest vertical line.

The boolean decision functions from the features discovered take into account several of the possible distortions of characters during printing and reading. Specifically, if we put a line over an expression to signify the feature of absence of the line and use a dot to indicate logical multiplication, the decision functions for the numbers 1 and 2 used in the Blank-2 character reader are written in the following form:

$$1 \rightarrow (\overline{BB5} \cdot \overline{BH5} \cdot BB3 \cdot BH3 \cdot \overline{BB1} \cdot BH1) \vee$$
$$\vee (\overline{BB4} \cdot BB3 \cdot \overline{BB1} \cdot BH1);$$
$$2 \rightarrow (\overline{BB5} \cdot BH5 \cdot \overline{BB4} \cdot \overline{BB3} \cdot \overline{BH3} \cdot \overline{BH1} \cdot \Gamma1 \cdot \Gamma2 \cdot \Gamma3) \vee$$
$$\vee (\overline{BB5} \cdot BH5 \cdot \overline{BB4} \cdot \overline{BB3} \cdot \overline{BH3} \cdot BB1 \cdot \overline{BH1} \cdot \Gamma1 \cdot \Gamma2) \vee$$
$$\vee (\overline{BB5} \cdot BH5 \cdot \overline{BB4} \cdot \overline{BB3} \cdot \overline{BH3} \cdot BB1 \cdot \overline{BH1} \cdot \Gamma3).$$

Several additional features are used to distinguish certain similar characters. In terms of hardware the circuits to identify vertical features are constructed on three-input logical AND circuits, each of which tests the existence of a vertical line of minimum length in one of the three possible adjacent discretization elements. This circuit includes two shift registers which make it possible to evaluate the position of the vertical line found in each scanning cycle relative to the first line detected for the character. The output signals of the AND circuits are accumulated in the first register during the cycle, after which they are transmitted with a shift to the second register. This shift in the first cycle is done so that the first (initial) trigger of the second register is set in state "1." The number of steps of this shift is stored, and in later cycles the shift is done on the same principle (by the beginning of the register), but not for more than the stored number of steps. The number of shift steps obtained in each cycle and the state of the first register trigger ("0" or "1") indicates the position of the vertical line relative to the first line detected in the character.

Controlled delay circuits which form a unitary output signal only when a "black" signal of a definite length is fed to their input are used to find the horizontal lines. The output signals of the delay circuits are copied into the shift register and in the last (fifth) scanning cycle are moved to the beginning of the register for the same number of steps as signals for the vertical features in this cycle. The horizontal features are then identified using three double-input OR circuits which are connected to pairs of adjacent triggers in the first six bit positions of the register. The 10 vertical and three horizontal features obtained are transferred to the trigger register of features, to which a decoder is connected. This decoder carries out the selected decision functions.

Where there is an unambiguous answer at the output of the decoder the recognition block forms the code of the character recognized. If the answer is not unambiguous (signals are received from two or more outputs of the decoder), it issues a signal of failure to recognize.

The control block of the Blank-2 character reader establishes the read regime based on commands from an external Minsk-32 or Minsk-23 computer to which the reader is connected. Specifically, the computer may issue commands to begin or stop input, for continuous input of an entire package of forms, for individual input of the next document upon request, for document sorting, and so on. The control block of the character reader independently monitors emergency situations and stops the feeding process when two or more sheets are taken from the package simultaneously, when it is not possible to grip the next sheet, when the receiving pockets are overflowing, when there are no more sheets in the feed pocket, and so on. When a signal of failure to recognize is given the document is thrown into a separate receiving pocket. A document also goes into this pocket if a malfunction signal is received from the external computer.

The control block is also capable of sorting documents into two pockets (by content) in an autonomous work regime.

Reliability of recognition. The factory specification for the error rate of the Blank-2 character reader is 0.001 percent, with a rate of 0.01 percent for failure to recognize. Experiments have shown that these factory ratings are attained only when the quality of printing meets the ISO standard (see Chapter 1). This quality can be achieved when the text is printed using electric typewriters that have inked ribbons that are used just one time. As experiments have shown, the only domestically produced inked ribbon that is suitable for this purpose is the MKL-1 ribbon on an acetobutyrate base. This ribbon was originally developed to print documents for magnetic character readers. With a carbon inked ribbon for one-time use the frequency of errors and unrecognized characters increases to 0.6-0.7 percent. A reusable silk ribbon raises the frequency of errors and failures to recognize to 3-4 percent in the initial stage of wear (first eight times through the typewriter). As the ribbon becomes heavily worn (45-55 times) this figure reaches 40 percent.

Documents to be fed to the Blank-2 character reader are printed on special paper which was described in Chapter 1.

Comparative analysis of the working characteristics of the Blank-2 character reader shows that in terms of speed and cost it competes successfully with some foreign-made character readers of the same class such as the Data Recognition 700 (United States) and the ICL 8201/1 and ICL 8401/1 (England), but is inferior to such models as the Univac 2703 and Honeywell 243 (United States). All these character readers were produced at approximately the same time (1969-1970). The Univac 2703, unlike the other models mentioned, reads numbers and special characters in three stylized type faces OCR-A, OCR-B, and Univac H-14.

If we consider current trends in automatic reading of documents with few lines, the Blank-2 has a number of shortcomings: obsolete basic elements; small alphabet of characters (only numbers and four special characters of the only type face ROS-A), the impossibility of reading manuscript characters, small capability for document sorting, and so on.

The experimental model of the Blank-2 character reader was accepted by the interdepartmental commission. At the present time, a new character reader for small forms, the Blank-3, has been built for YeS computers (the YeS-6031) on the basis of this development. The Blank-3 differs from the Blank-2 only in design (new basic elements of electronic circuits, modernized mechanisms for feeding and moving documents).

4. The Ruta-701 Character Reader

The domestically produced Ruta-701 character reader, which reads pages of text with dimensions from 148 × 210 to 297 × 210 millimeters was developed at the Special Design Bureau of Computer Technology in Vilnius in 1967-1968, and produced in a series of 20 units. The Ruta-701 was successfully used for a number of years in several organizations, among them the Scientific Research Institute of the USSR Central Statistical Administration, the Computing Center of Estonian Radio, and the All-Union Geological Institute. The character reader makes it possible to read numbers, two letters (E, X), and the symbol "/" in the typewritten nonstylized typeface "Optima" or the same alphabet of manuscript characters. Guide rectangles with two dots inside are printed typographically on the page for manuscript characters. The factory rated speed of the character readers is up to 200 characters a second or between 12 documents per minute (for a page length of 297 millimeters) and 20 documents per minute (for a length of 148 millimeters). The maximum length of a readable line on a document is 140 millimeters with a page width of 210 millimeters.

The block for feeding and moving documents is designed in the form of a roller conveyor that works in a start-stop or continuous regime. The capacity of the block's input pocket is 1,000 sheets. The next sheet is fed to the conveyor by a moving arm with vacuum suction that operates on the principle of the automatic feed in printing machines. A special photoelectric sensor that measures the transparency of the sheet being fed monitors whether the suctions have mistakenly taken two or more sheets at once. When the next sheet enters the field of vision of the read block, the document feed block switches to a start-stop regime. The sheet does not move while the line is read. Then it is moved until the next line appears in the field of vision. An electromagnetic coupling

included between the drive and the roller of the conveyor is used for start-stop work.

The read block in the Ruta-701 character reader is a "running beam" system on a protection CRT which can work in two modes: search and line scanning. To simplify and speed up the search for the line to be read a tag is used, a black rectangle printed in the margin of the page opposite the start of each line. The maximum length of a readable line is 140 millimeters, which is determined by the capabilities of the character reader's read block.

During scanning the rectangular area of the field of vision corresponding to one character is expanded into 24 × 20 discretization elements. The read signals, which are received in the line search regime, are used to control the block for feeding and moving documents. A compensation FEU [amplifier for photoelectric cell] directed at the screen of the tube is used to reduce the unevenness of the brightness of the scanning spot on the CRT screen. The feedback signal from this FEU is fed to the modulator of the CRT. Read signals from the working FEU directed to the surface of the sheet being scanned are quantized on two levels ("black"-"white") and transmitted to the recognition block. Special feedback to stabilize the level of "white" in the videosignal and adjust the threshold of quantization are introduced to reduce the effect of fluctuation in the reflective capability of the paper and the contrast of printed characters.

The recognition block of the Ruta-701 consists of two assemblies. The first realizes an elementary variation of the correlation method of recognizing typewritten characters. The second assembly performs structural logical recognition of typewritten and manuscript characters. The two assemblies can work together or isolated from one another. The correlation recognition assembly completes the resemblance between the character being identified and standards for each character of the alphabet. The criterion of similarity used in the character reader is an approximation to the simple linear criterion

$$g(k) = \sum_{i=1}^{24} \sum_{j=1}^{20} v_{ij} \log p(v_{ij} = 1 \mid k) + (1 - v_{ij}) \log p(v_{ij} = 0 \mid k),$$

which is easy to derive, assuming that the components of the signal v_{ij} are statistically independent, quantized on two levels ($v_{ij} = 1$ is the "black" signal $v_{ij} = 0$ is the "white" signal), and appear for character k of the alphabet with probabilities of $p(v_{ij} = 1|k)$ and $p(v_{ij} = 0|k) = 1-p(v_{ij} = 1|k)$. The components of the signal are measured for elements (i, j) of the 24 × 20 discretization network into which the field of vision is broken when scanning a character.

The approximation used in the Ruta-701 character reader is based on the fact that the probabilities $p(v_{ij} = 1|k)$ and $p(v_{ij} = 0|k)$ quantize on three levels which correspond to the interval [0; 0.25], [0.25; 0.75], [0.75; 1] of probability values and set each element (i, j) in correspondence to a component of the three-fold standard of the character:

$$e_{ij}^{(k)} = \begin{cases} 1 & \text{for } p(v_{ij} = 1 \mid k) \in [0;\ 0{,}25]; \\ 2 & \text{for } p(v_{ij} = 1 \mid k) \in [0{,}25;\ 0{,}75]; \\ 3 & \text{for } p(v_{ij} = 1 \mid k) \in [0{,}75;\ 1]. \end{cases}$$

When probabilities are quantized in this manner the similarity between the character being identified and the standard of the characters is evaluated by the quantity

$$g(k) = \sum_{i=1}^{24} \sum_{j=1}^{20} q(v_{ij}, e_{ij}^{(k)}),$$

where the elementary similarity $q(v_{ij}, e_{ij}^{(k)})$ between signal v_{ij} and the component of the standard with the coded value $e_{ij}^{(k)}$ is given in Table 7 below.

Table 7.

$q(v_{ij}, e_{ij}^{(k)})$		$e_{ij}^{(k)}$		
		1	2	3
v_{ij}	0	1	0,845	0
	1	0	0,845	1

The character being recognized is assigned to class k° if for this character the similarity is maximal $g(k^\circ) = \max_k g(k)$, and two conditions are met:

$$g(k^\circ) > \theta_1;$$

$$g(k^\circ) - \max_{k \neq k^\circ} g(k) > \theta_2,$$

where the set thresholds Θ_1 and Θ_2 can be adjusted during the work of the character reader.

If the conditions are not met, a failure to recognize signal is formed and the unrecognized character is scanned again several times. If after these repetitions the character remains unrecognized, line reading is stopped and an image of the character is projected on the screen of the CRT monitor on the console of the control block of the character reader so that the correct answer can be fed from the console keyboard manually. The method of centering the character being identified, that is, the mutual arrangement of the corresponding components of the signal and the standard, is not presented in detail in descriptions of the Ruta-701 character reader. To judge by the published structural diagram, automatic centering is done before scanning signals that compute similarity with standards are transmitted. The criterion for this kind of centering is how the black points of the character are arranged relative to the boundaries of the raster. If the centering conditions are not met, the character is scanned again (the number of possible repetitions is limited).

In hardware terms, the correlation recognition assembly is constructed of several binary counters. The sums of elementary similarities for points in the middle interval of probabilities [0.25; 0.75], that is, for points where $e_{ij}^{(k)} = 2$, do not depend on the signals v_{ij} and therefore are written into their counters in advance for each standard. Thus, computation of the similarity g(k) amounts to conventional "1" addition in the situations $v_{ij} = 0$ and $e_{ij}^{(k)} = 1$ or $v_{ij} = 1$ and $e_{ij}^{(k)} = 3$.

The standards of the characters of the alphabet are shaped on the computer which has a Ruta-701 read block. The discretized images of the characters of one class are automatically centered within the boundaries of the 24 × 20 raster, after which the frequencies of "1" for each cell of the raster are determined. These frequencies serve as estimates of probabilities $p(v_{ij} = 1|k)$, and then the the components of the standard $e_{ij}^{(k)}$) are computed.

To switch to reading 14 characters of a new type face it is necessary to replace the standards of the characters in the memory of the recognition assembly. The design of the assembly makes it possible to copy the standards written on punched cards in a few hours. Judging by publications, the problem of optimizing the selection of standards for characters has not been solved.

In the second recognition assembly of the Ruta-701, the structural logical assembly, the features which indicate the continuity or discontinuity of the lines at certain points of the character being recognized are determined. This recognition technique has been patented by character reader developers in England, the United States, France, and elsewhere.

The raster is divided into vertical zones for identification of features. The boundaries of the zones coincide with the columns in which the number of intersections of the vertical column of the raster with the lines of the sign changes. An intersection with a line is noted when the number of sequentially arranged adjacent black points in a column exceeds a set threshold, and two adjacent lines (that is, adjacent groups of such black points) are separated from one another by at least a given number of white points. To avoid random distortions of the signal, the places of transition from one number of intersections to the next are recorded only when the new number of intersections is consistently repeated a given number of times in adjacent columns of the raster.

The columns of the raster included in the identified zone are joined into one column by logical summing of the scanning signals ($v_{ij} = 0$ or 1) located in the same positions of these columns on the vertical. It is considered that a line in this zone is continuous if in the combined column between the indicated points of intersection there is no sequence of zero (white) positions longer than the given threshold. Otherwise the line is considered discontinuous.

Two types of features are introduced: for zones in which the number of intersections is two, and for zones in which the number of intersections is three. For features of the first type continuity or discontinuity of the line is checked between the points of intersection. For features of the second type

a separate check is made of the nature of the line between the first and second intersection starting from the top down in the raster column, and between the second and third.

Features of the first type are conventionally designated ΠA_n, ΠB_n, ΠC_n, ΠD_n (n = 1, 2, 3) and can have three values: continuity (n = 1), discontinuity (n = 2), and absence of a zone of the feature in the character (n = 3).

The zone that joins the raster columns for the feature ΠA_n extends from the initial column of the raster to the first column with two intersections (inclusively). The feature ΠB_n is formed in two cases:

1. if after the first group of columns detected with two intersections, no more such columns are found until the end of the raster;

2. if after the first group of columns with two intersections there are columns with one intersection, and then again a group with two intersections (that is, with a sequence of transfers 2-1-2).

In the first case the zone for feature ΠB_n is formed by the columns beginning with the last one that has two intersections and going to the end of the raster. In the second case the zone includes all the columns with one intersection and both enclosing columns with two intersections.

The feature ΠC_n is formed if the second case for ΠB_n repeats again, that is, for all repeated transfers..., 2-1-2, ...

Finally, the feature ΠD_n is formed in the last repetition of this situation; in this case the zone of the feature, as in the first case for ΠB_n, begins from the last column with two intersections and extends to the end of the raster.

Features of the second type ΠE_n, ΠF_n, ΠG_n, ΠH_n (n = 1, 2) assume only two values: continuity (n = 1) and discontinuity (n = 2). The zone for features ΠE_n, ΠF_n begins from the first column of the raster and ends at the first column with three intersections. The zone for features ΠG_n, ΠH_n extends from the last column with three intersections to the end of the raster. The features ΠE_n and ΠG_n are characterized by a line located between the first and second intersections in the column from the top; the features ΠE_n and ΠH_n are identified by a line between the second and third intersections.

Recognition by the resulting features takes place in two stages. In the first stage the characters are divided into two groups by a maximum number of intersections of the raster columns with lines of the characters — two or three. In the second stage the measured features of the character are substituted into logical decision functions that describe the characters of the alphabet of the particular group. The numeral 0 is an example of a character of the first group

$$(\Pi A1 \cdot \Pi B1 \cdot \Pi C3 \cdot \Pi D3) \vee (\Pi A1 \cdot \Pi B2 \cdot \Pi C3 \cdot \Pi D3) \vee$$
$$\vee (\Pi A1 \cdot \Pi B2 \cdot \Pi C1 \cdot \Pi D1);$$

the numeral 2 is an example of the character of the second group

$$(\Pi E2 \cdot \Pi F1 \cdot \Pi G1 \cdot \Pi H2) \vee (\Pi E2 \cdot \Pi F1 \cdot \Pi G2 \cdot \Pi H2) \vee$$
$$\vee (\Pi A2 \cdot \Pi E2 \cdot \Pi F1 \cdot \Pi G1 \cdot \Pi H2) \vee (\Pi A2 \cdot \Pi E2 \times$$
$$\times \Pi F1 \cdot \Pi G2 \cdot \Pi H2)$$

Figure 17 below shows examples of the characters 0 and 2 obtained from scanning real printed characters. For the numeral 0 the boundaries of the zones are the columns 7 and 16: in zone 1-7 feature ПА1 forms, while in zone 16-20 feature ПВ1 forms. For the numeral 2 the boundaries of the zones are the columns 3, 7, and 15: feature ПА2 forms in the zone 1-3, features ПЕ2 and ПF1 form in the zone 1-7, and features ПG1 and ПН2 form in the zone 15-20. In these examples the new number of intersections was recorded if it repeated at least two times, and the feature of discontinuity was formed when more than two zeroes were repeated in order in the combined column in the sequence of ones between the intersection points.

The control block of the Ruta-701 controls the interaction of all the other blocks of the character reader. Information that has been read is either transmitted directly to the Ruta-110 computer to which the reader is connected, or to punched cards or punched tape (in an autonomous work regime).

Reliability of recognition. The factory rated frequency of error for manuscript and typewritten characters is 0.01 percent, while the frequency of failure to recognize is 0.1 percent. Interdepartmental testing of the character reader involved multiple readings of 350 typewritten pages done on 20 standard Optima typewriters with simple cotton inked ribbons (a total of 202,420 characters) and 300 manuscript pages filled in by 14 trained persons at the Scientific Research Institutes of the USSR Central Statistical Administration (a total of 100,800 characters) and produced the following results:

Frequency of Errors:
- For Typewritten Characters 0.003%
- For Manuscript Characters 0.001%

Frequency of Failure To Recognize:
- For Typewritten Characters 0.015%
- For Manuscript Characters 0.004%

Frequency of Skips (During a Search in a Document):
- Character. 0.0002%
- Lines 0.0018%

It should be noted that careful preparation of personnel and training them to fill out manuscript documents correctly played a decisive role here. When manuscript documents filled out by 13 persons at the All-Union Geological Institute who did not have adequate preliminary training were read the sum frequency of error and unrecognized characters rose immediately to 2-3 percent.

Comparative analysis of the working characteristics of the Ruta-701 character reader shows that in 1968, the first year of its production, it was able to

read manuscript characters from pages of text much more cheaply than then-existing comparable foreign-made character readers such as the IBM 1288. But for other characteristics such as alphabet of characters, number of type spaces, and speed the Ruta-701 is inferior to all other well-known models. Specifically, the laser OCR-1 character reader built by the American Optical Business Machines Company, which came out in 1971, for roughly the same cost makes it possible to read the complete alphabet of typefaces for OCR-A or OCR-B (numerals, capital letters, and special symbols), the numerals of the typefaces Selfcheck 7B, IBM 1428, or NCR NOF, and manuscript numerals at a speed of up to 400 characters per second.

The recognition technique used in the correlation recognition block of the Ruta-701 does not permit a significant broadening of the alphabet of characters. This is because, first of all, this method fails in principle to consider the interrelationships that exist between signals in adjacent elements of the character. This leads to a low reliability of recognition of characters that have similar outlines (for example the Russian "sh" and "shch"). The second drawback of this recognition technique is that the centering of the characters is almost unrelated to subsequent recognition. This imposes too-rigid requirements on the quality of character printing and ultimately also reduces the reliability of recognition (the more efficient way used in many other correlation character readers is to center the characters by checking the possible positions of the character relative to the standard and identifying the similarity that is maximum for all of these positions).

The Ruta-701 remains in the history of domestic computer technology as the first series-produced automatic machine for reading pages of typewritten and manuscript character text.

5. The Sever-3 Character Reader

The domestically produced Sever-3 character reader permits reading printed and typewritten pages written in various Russian or Latin typefaces. The prototype of this character reader was produced in 1971.

The set of recognizable type faces is determined by the customer. Each type face can have up to 150 characters in its alphabet: printed and cursive small and capital letters, Arabic and Roman numerals, marks of punctuation, and special symbols. The vertical dimensions of the printed characters can vary from 1.35 to 2.5 millimeters (type sizes 8, 9, and 10), while typewritten characters range from 2.2 to 3.8 millimeters.

The text being read may be on one or both sides of a page and may consist of one, two, or three columns with headings, figures, and formulas.

Before reading a page of text or series of similar pages, instructions on the reading procedure are fed to the control block of the character reader by means of the console keyboard or punched tape. The instructions indicate the number of columns in the text, the number of pages, the kind of typeface, and the width of the columns and contain descriptions that make it possible to identify places not to be read (figures, formulas, and the like) and places for reading to stop automatically so that essential additional information can be fed from the

console of the character reader or from punched tape. Journals and books are torn apart into separate pages before automatic reading. One column on a sheet being read should not be wider than 180 millimeters. During reading the lines may be misaligned relative to the left edge of the page, but no more than the height of a small letter for a line length of 180 millimeters. It is also permissible for characters to "drop" out of the line, but not more than one-third of the height of a small letter.

Each successive page to be read is fed to the character reader manually. Pages with text on both sides are also turned manually. A page that has been fed goes to a roller conveyor with clamp and feed rollers and a guide rule. The rollers are set at a slight angle to the direction of movement of the sheet so that the sheet is pressed against the rule. During the reading process the rollers are raised by means of an electromagnet. This prevents the next page from being fed until this page has been read.

For line reading the sheet is moved in the field of vision of the read block in steps of 5.7 millimeters. The page automatically returns to the initial position for reading a new column or turning the page. When being returned and brought up to the read zone the sheet is moved at a speed of 0.3 meters per second. In the field of vision of the read block the sheet is held by means of a vacuum tray with two pairs of clamp rollers at the beginning and end of the tray. The lower rollers are the guide rollers and are driven by a step motor.

The passing of the beginning and end of the sheet in the field of vision of the read block is monitored by photoelectric cells which consist of an illuminator and a photodiode. The dimensions of the field of vision of the read block are 50 millimeters in length and 160 millimeters in width.

After the sheet has been read it is ejected into the receiving pocket by two rollers joined by an electromagnet. The work of all the mechanisms and assemblies of the block for feeding and moving documents in the Sever-3 character reader is coordinated in time with the length of reading pages.

The read block of the character reader is a "running beam" system on a CRT with high resolution. A rectangular point raster with dimensions of 28 × 90 millimeters (up to 800 × 2,600 raster points) is formed on the screen of the tube. The diameter of the scanning spot on the screen is 70-100 microns. The step of the raster may range from 35 to 270 microns. The raster is projected on the surface of the sheet being read with a 1.8 times magnification. To reduce the unevenness of illumination of the screen of the tube, part of the scanning beam of light is diverted by a semitransluscent mirror to a compensation FEU whose signal goes to the modulator of the tube. The light reflected from the surface of the sheet is received by six working FEU's connected in parallel to the total load and installed so that they reduce the unevenness of the output scanning signal caused by the position of the scanning spot on the sheet. Dynamic focusing of the CRT beam on the field of the raster is used to compensate for changes in the dimensions of the scanning spot. Geometrical distortions of the raster are reduced to one percent by means of special correcting circuits whose signals are "mixed" into the signals of the generators of the CRT scan.

The video signals received from the working FEU's are quantized on two levels (black-white). If the value of the video signal does not exceed 0.15 of the standard maximum level "black" the signal for the raster point is considered to be white. If the value of the video signal is greater than 0.70 of the same standard level the signal is considered black. For intermediate values of the video signal (between 0.15 and 0.70 of the standard level) an additional circular scan is engaged with the center at the raster point being quantized. The video signals for the resulting circular environment are averaged and the average signal is considered the threshold of quantization for this point. The lens of the read block can be automatically moved across the page and occupy one of three possible positions (according to the number of columns in the text) for scanning the entire area of the page.

The recognition block of the Sever-3 character reader uses a two-stage recognition algorithm. In the first stage the structural features are identified and measurements are made according to which the character is classified in one of several groups of characters of the alphabet (up to a total of 15 such groups). In the second stage the character is finally recognized by computing the minimum Hemming distance between the quantized signals for the character and the binary standards for characters of the alphabet from the particular group. The algorithm that is used takes account of the variable width of printed characters across the line and possible contact between characters in the line because of printing or reading error. For each successive character in the line the signals are read in a segment whose beginning is determined by the result of recognition of the preceding character (that is, by the width of the preceding recognized character) or by a clear space appearing in the field of vision after-recognition of the preceding character. The horizontal dimension of the segment read (width of a recognized character) is selected to correspond to the greatest width of a standard character or is limited to the following clear space if the distance to it from the beginning of the segment does not exceed the width of the widest standard.

In the first stage of recognition the standards are centered relative to the character being identified. Two types of structural features are used for this: primary and auxiliary. The primary feature describes what is called the basic line of the character. The basic line is the first (reading from left to right) vertical rectangular segment or convex (to the left) arc, with the length of the line equal to the height of the character. The auxiliary feature characterizes the presence of an outside element, that is, the first line from the left that is below the line level (as in the letter "p") or above it (as in the letter "d").

The primary feature Π_1 assumes three values:

$$\Pi_1 = \begin{cases} 0 \text{ if the primary line is absent;} \\ 1 \text{ if a rectangular segment is found;} \\ 2 \text{ if a convex (to the left) arc is found.} \end{cases}$$

The auxiliary feature represents the set of two measurements Π_2 and Π_3, each of which assumes three values:

$$\Pi_2 = \begin{cases} 0 \text{ if there is no outside element;} \\ 1 \text{ if an above-the-line element is found;} \\ 2 \text{ if a below-the-line element is found;} \end{cases}$$

$$\Pi_3 = \begin{cases} 0 \text{ if there is no outside element;} \\ 1 \text{ if the outside element is located to the right;} \\ 2 \text{ if the outside element is located to the left.} \end{cases}$$

At the same time as the features for the recognized character are being formulated measurements are made of its width L (the width of the segment read), the horizontal coordinate x_1 of the middle of the primary line relative to the beginning of the character, and the horizontal coordinate except two of the beginning of the outside element relative to that same beginning of the character (the width of the segment and coordinates are measured by number of columns of the scanning raster).

Each of the binary standards for characters of the alphabet $e^{(k)}$ is characterized by the same features and measurements: $\Pi_{1,k}, \Pi_{2,k}, \Pi_{3,k}, x_{1,k}, x_{2,k}, L_k$.

The first stage of recognition begins by checking the coincidence of primary features and the correspondence between dimensions of the character and the standard:

$$\Pi_1 = \Pi_{1,k};$$
$$L \geqslant L_k.$$

If this condition is not met for the given group of standards, the next group is selected. If the condition is met, the character is centered relative to each of the standards in the group. The method of centering depends on the values of the features found.

If there is no primary line ($\Pi_1 = \Pi_{1,\ k} = 0$), in the second stage of recognition the beginning of the standard $e^{(k)}$ is combined with the beginning of the character, after which the standard is "stretched out" over the segment of the line being identified. With "stretching" the given number of relative positions of the character and standard on the vertical and horizontal are checked and for each such position the Hemming distance between the character and the standard is computed. Centering is done to minimize this distance.

If a primary line is found ($\Pi_1 = \Pi_{1,\ k} \neq 0$), for centering the midpoints of the primary lines, the character and standard are matched (the known horizontal coordinates x_1 and $x_{1,\ k}$ are used for this purpose). With this kind of centering the standard $e^{(k)}$ covers a segment L_k wide of the character. This segment is "aligned" on the horizontal to the primary line of the character which has been found (the beginning of this segment is shifted on the horizontal by $\delta_k = x_1 - x_{1,\ k}$ relative to the beginning of the character). For the isolated segment of length L_k its own values are determined for the auxiliary features Π'_2, Π'_3. They

depend on earlier measurements Π_2, Π_3 for the outside element of the character being recognized:

a. $\Pi'_2 = \Pi_3 = 0$ if $\Pi_2 = 0$ or $\Pi_2 \neq 0$, but the existing outside element of the character does not fall within the isolated segment
$$x_2 \geqslant \delta_k + L_k;$$

b. $\Pi'_2 = \Pi_2$ and $\Pi'_3 = 1$ if $\Pi_2 \neq 0$ and the existing outside element of the character falls in the right half of the isolated segment
$$\delta_k + L_k > x_2 \geqslant \delta_k + L_k/2;$$

c. $\Pi'_2 = \Pi_2$ and $\Pi'_3 = 2$ if $\Pi_2 \neq 0$ and the outside element falls in the left half of the segment
$$x_2 < \delta_k + L_k/2.$$

The values of the auxiliary features Π'_2, Π'_3 gotten for the isolated segment of the character are compared with the corresponding values $\Pi_{2,k}$, $\Pi_{3,k}$ for the standard $e^{(k)}$, and if they coincide the recognition block moves to the second stage of recognition while the beginning of the standard is combined with the beginning of the isolated segment of the character. To lessen the influence of random distortions, the comparison in the second stage is done with both standards in which the primary line is straight and standards in which this line is curving. In hardware terms, the Hemming distance between the character and the standard is computed sequentially as the standard is read from internal memory of the recognition block, which includes a general-purpose single-address computer that performs 29 computing and control commands at a speed of 430,000 ops per second. The internal memory on magnetic cores contains 4,096 45-bit words. In addition, there is a small high-speed memory consisting of 24 trigger registers (10 and 13 bit positions) and a specialized assembly for fast computation of the Hemming distance between the character and the standard. This assembly consists of four 45-bit trigger registers and an adder, connected by special logical control circuits, and makes it possible to compute the Hemming distance immediately for 12 relative positions of the standard and the character. The character standards for different type faces are stored on magnetic tape and when necessary are copied into internal memory either automatically or on instructions from the operator.

The Sever-3 character reader has the capability of being instructed for a new type face, that is, the possibility of constructing standards and their structural features and storing this information on magnetic tape during the process of using the character reader.

Another recognition technique in which the characters are recognized by parts may be used to reduce computations and increase the speed of the character reader and recognition block. The part of the character is composed of several adjacent scanning columns. The full standards of the characters are constructed from parts ordered in the form of a tree, as shown in abstract form in Figure 18 below. For each unit of the tree the internal memory of the recognition block

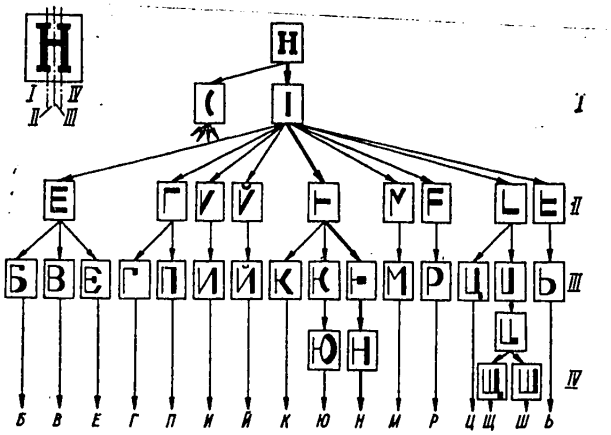


Figure 18. Tree to Shape the Full Standards of Characters of the Alphabet by Their Parts in the Sever-3 Character Reader.

---

stores a standard for the corresponding part of the character of the alphabet, the characteristics of this standard (structural features and width), and relations to the preceding and following units of the tree. The standards for parts of characters are divided into initial, intermediate, and final standards. The initial standards recognize the left part of the character, and the final standards complete recognition of the character. The code of the corresponding character of the alphabet is included in the characteristics of the final standards.

The procedure for recognition by parts largely resembles the procedure described earlier for two-stage recognition of characters as a whole, with the exception of the fact that in each step of recognition we are dealing not with the entire character but with a particular part of it.

To find the structural features of the next part of a character a definite number of columns of the scanning raster are analyzed. This number is selected based on the results of the preceding step of recognition or by a clear space in the field of vision.

After the left edge of the next character in the line is found, the group of initial standards whose features coincide with the features of the character is selected. A minimum of 24 Hemming distances obtained when this standard is "stretched" over the character are computed for each standard. The decision is made according to the minimum resulting distance. Then the next group of standards necessary to recognize the next intermediate part of the character is selected on the tree and the process continues until an answer is obtained for the final standard. At this point recognition is complete.

If the difference between the minimum Hemming distance and the one of the 24 computed distances that is closest to it is less than an assigned threshold, both answers are considered permissible and both groups of standards indicated by transfers on the tree are selected for recognition of the next part of the character. If the least distance exceeds the given threshold or the structural features of the nearest standard and the recognized parts of the character do not coincide, the answer obtained is rejected and the standard is removed from consideration. If the answers for all standards in the group selected are rejected, the recognition block returns to the preceding step of recognition on the tree. This step is repeated for all standards of the preceding group with the exception of those for which recognition answers were received the first time.

If a double answer is received for the final standard or if when returning on the tree the process again arrives at the stage of preliminary recognition but all permissible variations of features of the initial part of the characters have been exhausted, the line segment being recognized is scanned again.

After a given number of repeated scans a signal of failure to recognize is formed, the unrecognized character is projected on the CRT screen located on the control console of the character reader, and the character can be put in manually using the keyboard of the console.

Control of the Sever-3 character reader is decentralized. Autonomous control units are installed:

1. in the read block — to scan any area of the field of vision with horizontal or vertical point rasters;

2. in the recognition block — to organize the computation of the Hemming distance between standards and the character being recognized;

3. in data input/output units when working with magnetic tape or punched tape, and so on.

General control of the character reader which coordinates the work of all its blocks and assemblies is accomplished by the program control unit of the computer included in the composition of the character reader. The combination of hardware and software control makes it possible to realize complex algorithms for recognition and editing of information read and makes it easier to adapt the character reader quickly to solving new problems.

The information that has been read is transmitted to the external computer to which the character reader is connected or outputted to punched tape.

Reliability of recognition. The factory rating for frequency of errors for the Sever-3 character reader is one percent for an alphanumeric text and 0.01 percent for numeric typewritten text. These indicators should be achieved with fluctuations in the thickness of character lines from 0.1 to 0.6 millimeters in printed text and from 0.2 to 0.56 millimeters in typewritten text with a line contrast of at least 30 percent.

An experimental model of the character reader was tested on typewritten pages and printed sheets in different formats with different numbers of text columns (1-3) written on one and both sides of the paper.

The average reading speed (converted per sheet) was 69 characters per second for printed text, 38 characters per second for alphanumeric typewritten text, and 56 characters per second for numeric typewritten text. The average time required to change the set of standards when switching to reading a new type face did not average more than 20 seconds. During the reading of 40 printed book and journal pages (106,000 characters) the frequency of error was 0.6-0.7 percent with a frequency of failure to recognize of 0.1-0.2 percent. For alphanumeric typewritten text (13 pages, 21,000 characters) the frequency of error was 0.9 percent (with a frequency of failure to recognize of 0.04 percent). For typewritten numbers (64 pages, 119,000 characters), the frequency of error was 0.02 percent, and the frequency of failure to recognize was 0.002 percent.

Comparative analysis of the working characteristics of the Sever-3 character reader is made difficult by the fact that the well-known contemporary models are rarely designed for reading full sets of printing type faces.

Nonetheless, it should be noted that the speed of the Sever-3 machine is about an order lower than the speed of foreign-made character readers for reading pages of text and general-purpose character readers of equivalent cost. The prototype of the Sever-3 character reader has been used successfully for several years to printed texts to an information service system.

11,176
CSO: 1863/47

DESIGN, OPERATION OF CHARS CHARACTER READER

Kiev OPTICHESKIYE CHITAYUSHCHIYE AVTOMATY in Russian 1980 (signed to press 22 Nov 79) pp 146-190

[Chapter 5 of book "Optical Character Readers", by Doctor of Technical Sciences Vladimir Antonovich Kovalevskiy, Candidate of Technical Sciences Georgiy L'vovich Gimel'farb and Candidate of Technical Sciences Anatoliy Fedorovich Voziyanov, Izdatel'stvo "Tekhnika", 4,000 copies, 208 pages]

[Excerpt] Chapter 5. The Design of the ChARS Character Reader

1. Features of the ChARS character reader

The Institute of Cybernetics of the Ukrainian SSR Academy of Sciences has developed several modifications of character readers carrying the name ChARS (character reader with shift register) and designed to read multiline typewritten documents. In 1965 a model of a character reader for 10 numerals using the correlation method of recognition [16] with grid dimensions of 8 × 11 was built. The model worked at a low speed of 25 characters per second. The reading unit used a "running beam" type of scan on a cathode ray tube. The brightness of the elements of the image was quantized on four levels. The probability of error was not more than 0.01 percent. Based on this model a prototype character reader for the full alphabet of the Optima typewriter was built in 1969 [1, 2]. The grid in this reader was slightly enlarged (10 × 18). But unlike the earlier modification, a column of photodiodes was used to scan the image. The masks for this machine were constructed with due regard for the spatial discretization of the image [18]. The machine has a read mechanism that allows automatic scanning of an entire package of documents.

Tests of the prototype showed that with a 10 × 18 grid a probability of error lower than 0.1 percent could not be achieved, even reducing the alphabet to 48 characters instead of 53 (the Russian letters B, V, I, M, and N were eliminated). The average speed of the reader was 240 characters per second with a maximum speed of 500 characters per second.

Because the results obtained with this prototype were unsatisfactory, the 1969 ChARS was modernized. The new 1972 modification appeared, and is the one described in detail below.

The most important characteristic of a character reader is the requirement that it imposes on the document being read. The 1972 ChARS was designed to read typewritten pages printed on white writing paper in a format of 210 × 297 millimeters by an Optima typewriter. A black cotton inked ribbon of medium thickness for typewriters and calculators should be used for printing.

The alphabet of the machine contains 53 characters, including 10 numerals (0-9), the 29 capital letters of the Russian alphabet, five signs of arithmetic operations (+−×/=), three marks of punctuation (., ?), five service characters [()%§»], and a "space" character.

Up to 30 lines can be printed on a page, with up to 62 characters on each line, in other words a total of up to 1,860 characters per document. The lines are printed across the short side of the sheet. At the beginning of each line subject to reading a special character is put at a certain point in the margin of the page. This is a marker in the form of a horizontal line formed by four consecutively written "-" signs (——). The marker should begin not more than 13 millimeters from the left edge of the sheet and end at a distance of 20-25 millimeters from it. The machine does not read lines that are not marked by the marker. This makes it possible to put additional information on the document such as headings, notes, explanations, and the like, which can be printed arbitrarily or entered by hand. The minimum permissible distance between lines depends on the permissible misalignment of lines relative to the edge of the sheet and should be at least 8.5 millimeters (two intervals) if a line misalignment of up to ± millimeters is permitted on the length of a line. Spaces between words (letters) in the line with a maximum misalignment do not exceed 50 millimeters). The distance from the top edge of the sheet to the top marker should be at least 25 millimeters, and from the bottom edge of the sheet to the lowest marker at least 18 millimeters. The thickness of the lines of the characters is in the range 0.2-0.5 millimeters. The coefficient of reflection of a character line should correspond to the condition $[(\rho_\phi - \rho_\pi)/\rho_\pi] \geq 0.5$ where ρ_ϕ is the reflection factor of the background paper.

There should not be tears, contrasting fibers and impregnations, or very dirty places on the sheets of paper.

At the start of development the goal was set of achieving the following indicators of reliability of recognition given compliance with the above requirements for printing quality:

Type of Array	Frequency, %	
	Errors	Failure To Recognize
Numerical	0.005	0.01
Alphabetic	0.05	0.1
Mixed (all 53 characters) . . .	0.04	0.07

The average reading speed counting time losses searching for lines and replacing documents is 170 characters per second. The ChARS as well as the stand equipment and measuring instruments are arranged in an area of 25 square meters. The ChARS receives power from a three-phase 220/380 volt current at 50 hertz. Its power usage is not more than 4.5 kilowatt-amperes.

The character reader set includes the following units:

a. document reader, which consists of a block to feed and move documents with a control assembly and read head;

b. recognition unit, which includes the recognition block with its control assembly;

c. buffer memory unit, which coordinates the work of the character reader with the computer and punch and insures manual encoding of unrecognized characters.

As can be seen from these technical specifications, the ChARS differs from other domestically produced character readers such as the Ruta-701 and Blank-2 considered in Chapter 4 in the following ways.

Ordinary writing paper and ordinary multiple-use inked ribbon are used to prepare documents. The documents are typed on typewriters with standard nonstylized typeface and a fairly large alphabet (53 characters). No special requirements are made for printing quality: all that is necessary is to avoid the use of an inked ribbon that is too thick or too worn out.

Requirements for arrangement of the information on the document come down to maintaining a minimum distance between lines and the need to identify lines with markers.

In the first modifications of the ChARS a correlation recognition algorithm was used which had been derived from the method of permissible conversion (see subchapter 2.3) on the basis of a mathematical model of a set of images taking into account optical conversions, image carryover in the field of vision, and noise. The 1965 model of the ChARS was built following this method and demonstrated high recognition reliability for an alphabet consisting only of numbers. Clearly printed images of the numbers were chosen as initial standards for this model.

The same method was the basis for the next, 1969 modification of the ChARS. The dimensions of the grid of this modification of the machine (10 × 18) were chosen on the basis of positive results obtained from the earlier model.

Because the image in this machine is represented on a comparatively crude grid, a methodology was developed to construct masks and took account of distortions occurring during discretization. This methodology is described in [8], which demonstrates that the set of images occurring during discretization of a certain fixed image shifted relative to the raster within the limits of a step of discretization is a convex polyhedron whose apexes are the so-called nodal images. For example, four nodal images distinguished by a shift of exactly one

element of the grid are sufficient to describe each of the classes such as the Russian letters N, P, and Ts, whereas the description of the set of images for letters such as the Russian letters E, V, and the soft sign is a polyhedron with nine apexes. Optical conversions were also taken into account in constructing these sets.

The methodology involved constructing the difference masks necessary to distinguish similar classes, and isolated masks to characterize a class taken separately. To construct a difference mask the problem of dividing two convex polyhedrons by a hyperplane which maximizes the distance to the polyhedrons was solved. The isolated mask was selected so that the least correlation with the images belonging to the particular convex polyhedron was maximized. It should be noted that in order to simplify the technical realization of the algorithm, convex polyhedrons characterizing the set of images were constructed only for one fixed thickness of the lines of the character. This decision was made on the assumption that the convex sets constructed would also include images with line thicknesses differing from that for which they were constructed. It would evidently have been better to construct masks for different thicknesses and during the recognition process search for the maximum similarity not only by classes and different positions of the image, but also by different thicknesses.

As pointed out above, during testing of the 1969 ChARS unsatisfactory values were received for the parameters of recognition reliability. The basic reasons for this were the following.

The masks in the machine were constructed for one fixed thickness of lines. But with actual printing quality line thickness varies in a wide range.

The machine did not have adequate resolution capability. Even if the masks taking into account discretization had been constructed for the full range of variation of thicknesses, the raster adopted for the machine would still have been a crude one. The dimensions of elements of the grid (0.27 × 0.30 millimeters) exceeded the minimum thickness of lines of a character by 50 percent. This led to such serious distortions of images with thin lines that the images of similar classes could hardly be distinguished from one another after discretization.

So-called crude displacements of alien (competing) masks were not taken into account in constructing the masks. As research showed, because of the distortions caused by discretization, the maximum similarity in the correct and an alien mask may be attained for different crude displacements, that is displacements corresponding to carryover of images for an entire cell of the grid. In this case it may prove that similarity with an alien mask in an adjacent displacement is greater than similarity with the correct mask. Because the answer is taken for maximum similarity, in this case an error will be recorded. Therefore, when constructing the masks it is necessary to consider the different positions of the alien mask. The positions of masks which differ by a displacement of one cell are especially critical.

The algorithm used in the machine to divide lines into characters had low noise resistance because it was based on the assumption that false maximums of similarity at the intersections of two characters do not occur. Given real printing quality using conventional type faces this assumption is not justified.

The prototype was developed on the basis of testing a model which had different parameters, without preliminary computer modeling of the new modification. Before this model was built the correlation method of recognition was modeled and studies were made of its effectiveness for an alphabet of 10 numerals with a grid of 8 × 16 cells and brightness quantization on 16 levels. In addition, to improve the precision of centering half-step shifts of the image were done during modeling, that is, shifts equal to half a discretization step. When the parameters of the machine were (expanded alphabet, quantization on four levels, absence of half-step shifts, and the like), it was also necessary to make a detailed study of the recognition algorithm.

The method used to construct the mask does not permit an estimate of the probability of recognition error for any given masks. Although the masks constructed on this methodology insure minimum probability of error given the assumptions made, the value of this minimum was unknown.

The shortcomings of earlier modifications were taken into account in development of the 1972 ChARS and the following improvements were made. The grid was doubled in size by reducing the discretization step on the horizontal (20 × 18) with a cell size of 0.135 × 0.31 millimeters. But then it was necessary, for purposes of equipment economy, to reject the four levels of quantization and, consequently, use of the correlation method of recognition in the form considered in Chapter 2. To avoid a situation where the results of quantization of the image on two levels would depend strongly on changes in the contrast and darkening of the background, a quantization procedure with a variable threshold depending on the brightness of adjacent cells was employed.

A new methodology of constructing masks was developed, based on representing a set of images ditinguished by thickness of lines and position relative to the raster in the form of multidimensional distributions. The magnitude of the independent variable (argument) of probability of error was used as the optimization criterion.

11,176
CSO: 1863/47

EQUIPMENT COSTS, WAGES FOR CHARACTER READERS

Kiev OPTICHESKIYE CHITAYUSHCHIYE AVTOMATY in Russian 1980 (signed to press 22 Nov 79) p 191-205

[Appendix from Book "Optical Character Readers", by Doctor of Technical Sciences Vladimir Antonovich Kovalevskiy, Candidate of Technical Sciences Georgiy L'vovich Gimel'farb and Candidate of Technical Sciences Anatoliy Fedorovich Voziyanov, Izdatel'stvo "Tekhnika", 4,000 copies, 208 pages]

Table P1

Unit	Cost, rubles	Nominal Speed of Text Coding, Characters per Second
YeS 9015 Punched Card Data Entry Unit	8,000	5
YeS 9018 Punched Card Verifier	7,000	5
YeS 9001 Magnetic Tape Data Preparation Unit	20,000	5
SPD-9000 Magnetic Tape Data Preparation System with Keyboard Consoles	120,000 Plus cost of All Consoles (5,000 rubles apiece)	5
ChARS Character Reader	140,000	150

Table P2

Service Personnel	Monthly/Annual Wages, rubles
Operator	100/1,200
Senior Operator	120/1,440
Dispatcher-Operator	150/1,800
Technician	90/1,080
Mechanic	140/1,680
Engineer	120/1,440
Group Leader	160/1,920

11,176
CSO: 1863/47

CONFERENCES

INTERNATIONAL 'DIAGNOSTIC FACILITIES FOR DIGITAL SYSTEMS' CONFERENCE

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 4, No 1, Jan-Feb 82 pp 105-107

[Article by V.A. Gulyayev]

[Text] The international "Diagnostic Facilities for Digital Systems" conference, organized by the Czech committee of the Electrical Engineering Scientific and Engineering Society, the Czechoslovak IMEKO [expansion unknown] national committee and the Diagnostics in Electronics Central Trade Group, was held on 28-30 September 1981 in Brno (CSSR).

Diagnostic facilities for digital systems represent part of the program for improving the quality and reliability of digital electronics products. Questions relating to the area of the testing and reliability of digital systems from the viewpoint of their design, production and servicing were discussed in individual sections. Fifty-one reports from 14 countries, including the USA, France, FRG, Italy, GDR, Polish People's Republic and Hungarian People's Republic, were presented at the conference.

The following sections were at work at the conference: 1) designing of systems insensitive to failures; 2) simulation and evaluation of high-reliability systems; 3) software reliability; 4) test generation; 5) test simulation; 6) designing for easy testability; 7) self-testing systems; 8) system diagnosis; 9) self-verifying check circuits; 10) diagnostic instruments and systems.

At the morning plenary session Professor (E. Dzh. Mak. Klaski) (USA) delivered the paper "Survey of Methods of Designing for Testability," in which difficulties originating in testing were pointed out--the inadequacy of models, the low-percentage of the disclosure of malfunctions, great input of time, complexity and the considerable amount of documentation. An alternative is guaranteeing testability at the design stage. Three approaches to guaranteeing testability are discussed in the paper. Among them is the technique of installing and observing the state of circuits. A rather general approach is discussed, based on dividing a circuit into a combination circuit and one with a memory. A great number of specific examples are presented. Also discussed in the report are questions relating to guaranteeing the testability of programmed logic arrays and questions relating to the generation of input sets for testing by means of shift registers with feedback.

In a paper by Belorussian SSR Academy of Sciences Corresponding Member A.D. Zakrevskiy (USSR), "Diagnosis of Malfunctions of Regular Technological Structures," theoretical and practical questions were discussed relating to testing of a new class of large-scale integrated circuits--programmed logic arrays (PLM's). A distinctive feature of these structures is the presence of a special class of malfunctions, viz., of modifying functions performed by a combination circuit. A tabular representation of functions implemented with programmed logic arrays is used for the purpose of analyzing circuits and constructing tests.

At the evening session a paper by (I. Siray) (Hungarian People's Republic) was heard, "Survey of Methods of Generating Functional Level Tests," in which existing approaches to constructing tests at the functional level were discussed, including methods developed on the basis of the modular approach, Boolean differences, and development of a certain d-algorithm. The speaker presented an algorithm developed by him and based on the development of a d-algorithm and which takes into account repeated malfunctions, and he also compared two methods of simulating units with malfunctions--the parallel and concurrent.

In his paper "Evaluating the Reliability of Computing Systems" (Zh.-K. Lapri) (Toulouse, France) presented information on the percentage of errors of various types for individual design stages and on the life of elements of computing systems.

A classification was given of models for describing the state of systems and their behavior. The possibilities of using methods of Markov and semi-Markov processes and of simulation for the purpose of studying the reliability of computing systems were discussed. Various methods of simplifying analysis--consolidation of states and the like--were discussed. Information on the use of these methods for estimating the reliability of several classes of systems was presented.

In a paper titled "Methods of Reducing Diagnostic Data" V.P. Chipulis (USSR) presented a method of compressing source data obtained by simulation on a digital computer, by using so-called masks. Two variants of reducing the amount of source data were suggested: minimizing the amount of information (defined in a 0, 1, x alphabet) with the required search resolution, and reducing the amount of information with an acceptable reduction in degree of resolution.

The following papers were presented in section 1: (M. Kateyama) (Japan), "High-Reliability Digital Signal Processor with Insensitivity to Failures;" (P. Cardini) (Italy), "Mechanisms for Protection Against Failures in the (MyuTIM) Multiprocessor" and (F. Biardi) (Italy), "Protection and Limitation of Errors in an Information Transfer Medium: the Nucleus of the (MyuTIM) System;" and (L. Simoncini) (Italy), "Integrated Procedure for Designing Systems Insensitive to Failures."

The following papers were discussed in section 2: (P. Belardi) (Italy), "Comparison of Four Modular Redundant Circuits in a Computing System;" (L. Saloriutta) (Finland), "Hierarchical Model of the Productivity of a Multimicroprocessor Insensitive to Failures;" (P. Kaspi) (France), "Methods of Evaluating Systems Resistant to Failures;" A. Babak (Polish People's Republic), "Functional Reliability Model of the Hard Copy Log of a Computer Network;" and (M. Tutoveanu) (Rumania), "Improvement of the Readout of Information from a Magnetic Disk Storage by Means of Redundancy."

The following papers were discussed in section 3: (A. Levins'ki) (Polish People's Republic), "Method of Creating Arithmetic Microprograms;" (L. Saloriutta) (Finland), "Evaluation by Means of Petri Nets of a Symmetric Operating System Insensitive to Failures;" and B. Korel (Polish People's Republic), "Stream of Data in Testing of Programs."

The following reports were read in section 4: (Sh. Varsegi) (Hungarian People's Republic), "Functional d-Algorithm;" (Ya. Rada) (CSSR), "Adaptive Pseudorandom Test Generator for Logic Circuits;" and V.A. Gulyayeva (USSR), "Adaptive Method of Simulating Digital Equipment with Malfunctions."

The following papers were presented in section 5: (P. Marchal) (France), "Simulation of the Time for Detecting Malfunctions of the Integrated Circuit of a Processor;" (D. Raynerta) (GDR), "Two-Way Simulation--a New Approach to Test Generation;" (K. Valchak) (Polish People's Republic), "Deductive Simulation of Repeated Malfunctions in Logic Circuits;" (Ya. Piotrowski) (Polish People's Republic), "Graphic Language for a Functional Description of Logic Circuits." In section 6 a paper by (V. Koy) (FRG) was read, "Distribution of Test Points for Simple Generation of Tests."

Two papers were read in section 7: (G. Kravchik) (Polish People's Republic), "Algorithm for Steady Self-Testing of a Multiprocessor System" and (E. Mikhta) (Polish People's Republic), "Self-Testing Microprocessor Devices."

Section 8 was represented by the following papers: (Ya. Zeleny) (CSSR), "LMDS [expansion unknown]--a Microdiagnostic System for Localizing Malfunctions;" (A. Plugachek) (CSSR), "Structure and Properties of Tests of the LMDS System;" (P. Zhak) (CSSR), "Testing the Tesla TsNTs [expansion unknown] System;" and I. Smishek, "Use of Diagnostics in Graphic Systems."

The following papers were read in section 9: (V. Rabira) (CSSR), "Designing a Self-Verifying Check Circuit for 1-of-n Code;" (M. Kotochova) (CSSR), "Designing Self-Verifying Check Circuits for Some 1-of-n Codes;" and (P. Golan)(CSSR), "New Self-Verifying Check Circuit for 1-of-3 Code."

The following papers were presented in section 10: (P. Shtolle) (CSSR), "The ADT/ZKD [expansion unknown] Automatic Testing System;" (V. Shkvor) (CSSR), "Localization of Malfunctions by Means of the ADT/ZKD System;" (Ya. Revitski) (Hungarian People's Republic), "Classification of Integrated Circuits in TEZ's [Thermocouple Probes];" (B. Chaban) (Hungarian People's Republic), "Strategy for Testing TEZ's and Facilities for Designing Technical Equipment;" (K. Shviyeru) (Polish People's Republic), "The 'ANISS-20' Logical Analyzer;" and (A. Khlavichka) (Polish People's Republic), "Improving the Reliability of Error Detection by the Analysis of Control Characters."

During the conference opinons were exchanged on various questions relating to the design of diagnostic facilities. The organizing committee has published a collection of the conference's proceedings.

8831
CSO: 1863/95

OTIMIZATION OF CONTROL SYSTEMS

Vilnius OPTIMATIZATSIYA SISTEM KONTROLYA in Russian 1981 (signed to press 13 Jan 81) pp 4, 240-241

[Foreword and table of contents from collection "Optimization of Control Systems", edited by Professor A. Bikyalis (Bikelis), Lithuanian SSR Ministry of Higher and Specialized Secondary Education, 500 copies, 247 pages]

[Text] Foreword

The "Application of Probability Theory and Mathematical Statistics" republic conference dedicated to the 400th anniversary of Vilnius University was held at the start of 1979 at the mathematics department of Vilnius State University. The conference made it possible to make an evaluation of the state of applications of mathematical methods in the republic's enterprises, to exchange know-how and to hold a discussion on questions relating to problems, as well as to determine the most promising trends in the development of methods and applications of probability theory and mathematical statistics, taking into account the opportunities for the extensive employment of computers. The active participation of representatives of enterprises and design bureaus, who delivered half of the papers, made it possible to ascertain the requirements of industry in cooperation with mathematicians and to specify the framework of this cooperation. The majority of the papers delivered at the conference are printed in this collection.

CONTENTS Page

8831
CSO: 1863/123

PUBLICATIONS

UDC 551.509.313

METHODS OF NUMERICAL SIMULATION OF ATMOSPHERIC PROCESSES

Leningrad METODY CHISLENNOGO MODELIROVANIYA ATMOSFERNYKH PROTSESSOV in Russian 1981 (signed to press 20 Aug 81) pp 2-10

[Annotation, foreword and introduction from book "Methods of Numerical Simulation of Atmospheric Processes", by Vladimir Viktorovich Penenko, Gidrometeoizdat, 1350 copies, 352 pages]

[Text] This book contains a systematic presentation of methods of numerical simulation of the hydrothermodynamics of atmospheric processes. Major attention is devoted to the structural algorithmic aspects of this problem. Discrete models are constructed on the basis of the variational principle and the splitting-up method. Finite-difference and spectral-difference models are discussed, as well as methods of studying the sensitivity of discrete models to variations in input data and of identifying the parameters of models, assimilating and adjusting measurement data, etc.

This book is intended for specialists in the fields of computing and applied mathematics, meteorology and geophysics, as well as for students at universities and hydrometeorological VUZ's specializing in methods of numerical simulation of the atmosphere and ocean.

Foreword

This book is devoted to methods of numerical simulation. It is intended as a description of the structure of and of the principles of the structure of a complex of mathematical models and computing algorithms forming the basis of a package of applied programs for solving problems in atmospheric physics and physics of the ocean and environmental protection. Its main goal is a systematic discussion of the structural algorithmic aspects of this problem. Therefore general questions relating to the theory and physical fundamentals of mathematical simulation are touched upon only in part in it. The central place in the book's logical system is occupied by the fourth chapter, in which methods of studying the sensitivity of discrete models and their application are described, and the mathematics needed to implement these methods are discussed in the first three.

Know-how in solving applied problems gained at the USSR Academy of Sciences Siberian Division Computing Center was used in writing this book.

A considerable part of the algorithms presented here has been implemented on computers by A.Ye. Aloyan, N.N. Obraztsov and A.V. Protasov. They have also completed a long cycle of methodological studies and numerical experiments on solving specific problems of atmospheric physics and physics of the ocean.

The author considers it his pleasant duty to express his profound gratitude to his teacher, Academician G.I. Marchuk, who exerted a great influence on formation of the author's scientific interests.

At individual stages in this work considerable assistance in the form of advice and comments was rendered by N.N. Yanenko, N.I. Buleyev, L.T. Matveyev, Sh.A. Musaelyan, M.I. Yudin, L.S. Gandin, V.P. Il'in, A.N. Konovalov, V.P. Kochergin, G.P. Kurbatkin, V.P. Dymnikov, Ye.Ye. Kalenkovich, V.F. Kim, G.R. Kontarev, G.S. Rivin and especially A.Ye. Aloyan, N.N. Obraztsov, A.V. Protasov and Ye.A. Tsvetova, for which the author expresses his sincere gratitude to them all.

The author is deeply grateful to S.L. Belousov, S.M. Yermakov and L.V. Rukhovets, who read the book in manuscript and made a number of important comments, as well as to G.I. Ivanova, N.I. Kolker and Z.K. Urazalina for their great help in preparing the manuscript.

Introduction

The problem of mathematical simulation of the dynamics of the atmosphere and ocean has attracted the attention of scientists of various countries for a long time. This is due to the fact that studies of processes taking place in the atmosphere and ocean are closely allied to solving problems in the theory of climate and weather forecasting which are of direct practical importance. In recent years interest in this has increased more and more in connection with the problem of the interaction of man with his environment. Taking into account the complexity of arranging full-scale experiments under real conditions, the most natural approach to studying and evaluating the influence of man's activities on the atmosphere and ocean is the creation of mathematical models and methods of mathematical simulation making it possible by means of numerical experiments on high-efficiency computers to evaluate perturbations of key parameters and functionals characterizing the state and conditions of the atmosphere and ocean.

For solving this class of problems the following are first necessary:

Physically complete mathematical models of climate, general circulation of the atmosphere and ocean and local atmospheric and oceanic processes.

A theory for the transfer of aerosols and other impurities in the atmosphere and methods of evaluating the influence of transformation of these impurities on the composition of the atmosphere and on changes in hydrometeorological conditions on the local and global scales.

Methods of numerical simulation of meteorological and oceanic processes and principles of their use in estimating the influence of man's activities on hydrometeorological conditions.

Perturbation theory methods for estimating variations of major functionals in problems of atmospheric and oceanic physics, for studying the sensitivity of models to variations in input data and for estimating climatic anomalies.

Models of following the state of a climatic system and of methods of assimilating data from measuring complexes.

This book is devoted to the development of the last three of the trends enumerated above. Obviously success in solving the problems posed depends to a considerable extent on the physical models used as a basis and on their mathematical formulation. But since the main goal of this book is the development of the algorithmic aspects of the problem of numerical simulation, the theoretical fundamentals and the physical meaning of the formulation of hydrothermodynamics problems are practically nowhere discussed in it. These questions are represented sufficiently completely in studies by I.A. Kibel'; Ye.N. Lorents; S. Manabe and K. Brayen; G.I. Marchuk; L.T. Matveyev; A. Arakava; A.S. Monin; M.I. Yudin; in a collective monograph; etc. Ideawise the book is closest to the studies by G.I. Marchuk; therefore in the discussion the author relied on the definitions and terminology used in his monographs.

The variational-difference method of constructing energy-balanced discrete models of hydrothermodynamics of the atmosphere and ocean is discussed in the first chapter. Its main idea and applications to equations of mathematical physics are described very well in ch 6 of O.A. Ladyzhenskaya's book. In order to use this method, the mathematical model must be written by means of an integral identity corresponding to the initial system of equations and boundary and initial conditions. This double description of the model by means of systems of equations and integral identities has a number of advantages for numerical simulation.

After derivation of the identity, further operations are accomplished formally and in principle can be run on a computer. First a discrete, i.e., a summer, analog of the identity is constructed and then the conditions are written for stationarity of the summer functional with random and independent variations in trial functions at the nodes of a net region. Systems of basic and conjugate equations in discrete form are thus obtained. It was found that by special construction of approximations of the identity over time it is possible to obtain automatically from it splitting diagrams, also.

The integral identity is so constructed to be able to introduce different net regions, to combine regular and irregular nets, to approximate integrals and integrands differently, to use diagrams with an enhanced order of accuracy, etc., always keeping invariant for discrete analogs the energy balance property.

The atmosphere-ocean-continent system is unified in the energy sense. Therefore, if an energy functional is introduced for it and an integral identity is constructed on its basis, some conditions at interfaces are shown to be natural for a variational functional. Because of this, in obtaining discrete approximations a number of questions involving matching scales and approximating boundary conditions are done away with and the possibility appears of automatically monitoring energy and mass exchange at interfaces. However, let us note that the problem of

parametrizing processes of interaction of the atmosphere with the ocean and the surface of dry land must even with this approach be considered separately.

The second chapter contains a description of methods of constructing bases for the representation of multidimensional fields and spectral-difference models of atmospheric hydrothermodynamics.

The problem of constructing informative bases is of independent significance in hydrometeorology. A number of approaches to solving it are described in the literature. Only some of them are discussed here. The most promising for applications is the method based on combining an approximate solution to the particular spectral problem for linearized hydrothermodynamics operators with the isolation of the natural orthogonal components of the fields of meteorological elements ("primary components" in terms of factor analysis and mathematical statistics). Operators are linearized in the neighborhood of a certain assigned primary state, which is introduced as one of the input parameters.

With the existence of bases discrete models are derived from the integral identity or its summer analogs by an approach standard for variational difference methods. This results in closed energy-balanced systems of basic and conjugate equations in spectral-difference form. If the basis is sufficiently informative, i.e., the fields of unknown functions can be represented approximately by a truncated Fourier series with a small number of terms, then a model of this sort is customarily called few-component or few-parameter. In particular, the basis can be made up of a group of functions with finite carriers.

In view of the nonlinearity of the initial model the equations for Fourier coefficients are also nonlinear. And since in constructing the basis an approximate solution to the spectral problem is used for the operator obtained from the same initial system, then there is present in them also a linear part with a diagonal matrix made up of approximate eigenvalues of this operator, which has been shown to be convenient to take into account analytically when integrating in terms of time. This approach makes possible the integration of all equations simultaneously with the same time interval in spite of the difference in eigenvalues. Finally, for reconstructing unknown fields from Fourier coefficients A.N. Tikhonov's method for the generalized summation of series, based on the regularization idea, is used.

It must be emphasized that in spectral models Fourier coefficients represent generalized characteristics of the entity being simulated and with the successful choice of basis functions, even with a small amount of them, it is possible to carry a considerable share of useful information. Eigenvalues of the problem's linearized operator also come under the heading of generalized characteristics. From eigenvalues it is possible to judge the time scales of processes being simulated and from the sign of their real half the stability of these processes in the neighborhood of the primary state.

In the third chapter the principles of the practical implementation of numerical models based on the splitting-up method are discussed. The basic tenets of this method are widely familiar at the present time because of studies by the Soviet mathematicians Ye.G. D'yakonov, G.T. Marchuk, A.A. Samarskiy, N.N. Yanenko, etc. The splitting-up method is of fundamental importance in constructing mathematical

models of complicated physical processes. This has been convincingly demonstrated in G.I. Marchuk's books for problems of dynamics of the atmosphere and ocean.

The development of numerical simulation methods is closely allied with the technology of their practical implementation, which is being steadily improved together with progress in the field of computer technology. Already at this time it has become generally accepted that it is most fitting to employ the modular principle of programming and to create packages of applied programs. The modular structure of algorithms and programs makes it possible to approach a solution to entire classes of problems and the existence of facilities for adapting packages to specific conditions makes it possible to make active use of accumulated experience.

The practical implementation of numerical models is organized according to the following system. First a "modular" analysis is made of the entire complex of problems. Then a certain basis set of general-purpose algorithms is singled out, which are implemented in the form of program modules in algorithmic language. From these modules a special library is constructed, comprising the basis of the package of applied programs.

Of course, it is impossible within the scope of a single book to describe the entire set of basis algorithms; therefore, it was decided to limit ourselves to a presentation of only those of them which in our opinion are most interesting for the class of problems discussed. These are direct algorithms for solving transport equations and the problem of the dynamic matching of the fields of meteorological elements. Preference was not given to direct algorithms accidentally. They are fairly economical in terms of the number of arithmetic operations and as compared with iteration algorithms they reduce the degree of uncertainty in solving a problem. The advantages of direct algorithms are evidenced especially clearly in constructing perturbation theory methods, where it is a question of estimating slight variations in the solution depending on variations in the model's parameters and where it is necessary to filter out fictitious perturbations and noise caused by errors in the method of solving the problem.

The fourth chapter is devoted to methods of studying the sensitivity of discrete models of dynamics of the atmosphere and ocean. The idea basis of these methods is the perturbation theory, the principles of whose structure for the class of problems considered were developed by G.I. Marchuk. Functionally they are designed for studying the behavior of models in a space of parameters and for identifying models in terms of measurement data.

The concept of state functions and of parameters can be introduced for each mathematical model. A model essentially specifies the transformation which places a group of values of state functions in correspondence with a group of values of parameters. The difference between parameters and state functions is in many instances purely hypothetical and depends on the specific formulation of the problem. An example of this can be the interrelationship between altitude and pressure in a Cartesian and isobar system of coordinates. For the purpose of describing the behavior of the model, in addition to state functions it is possible to use a certain set of functionals determined in sets of values of state functions and parameters. An analysis of current approaches in numerical simulation has demonstrated that models constructed on the basis of just the basic system of equations

of atmospheric and oceanic hydrothermodynamics are poorly suited to studying their behavior in a space of parameters. In practice the number of parameters is shown to be too great and the organization of numerical experiments according to the traditional system of direct simulation, which reduces to a multiple solution to the problem with different input data, is poorly effective even when using very high-ouput computers. The numerical model structure described in this monograph proposes the introduction of at least three more elements--a system of conjugate equations, a system of variational equations, and a block for the calculation of sensitivity functions, for estimates of variations in functionals and for identifying the parameters of models. All elements of the model are distinguished in terms of their functional purpose. For example, by solving the basic system of equations or variational problem, it is possible to predict how the influence of perturbations of any factor will be spread in space and over time. By solving the conjugate problem and calculating sensitivity functions with a specific choice of functional it is possible to estimate whence perturbations will arrive in a specific region and to reveal regions of heightened sensitivity of the model to variations in parameters. It is especially important to have an opportunity to obtain such quantitative estimates in problems of controlling the quality of the environment.

The theory of sensitivity represents a new and actively developing scientific trend in cybernetics. An analysis of its key ideas and state-of-the-art can be found in R.M. Yusupov's review article. At the present time it is developing as a set of methods and approaches for studying the influence of the properties of operators and their perturbations on the quality of the functioning of various automatic control systems; but the range of application of sensitivity theory methods is considerably broader--it includes also various trends in mathematical simulation.

Three types of problems arise in studying the sensitivity of models. To the first type belong direct problems, when variations in parameters are known and it is necessary to estimate variations in state functions or functionals, and to the second inverse problems, when from known variations in functionals or state functions it is necessary to estimate variations in certain parameters. Problems of the mixed type, including elements of direct and inverse problems, are also known. In relation to the computing aspects of the sensitivity theory it should be mentioned that at the present time the solution of inverse problems is encountering great, and in certain cases insurmountable, difficulties (cf., for example, R.P. Fedorenko's monograph).

Sensitivity functions are introduced from physical considerations and implement a relationship between variations in unknown and input quantities. Formally they can be defined as derivatives of some characteristic of the model in terms of parameters of the same model and can be computed by solving basic and conjugate problems and variational problems. Although in nonlinear models the use of perturbation theory methods involves limitations on the magnitude of variations, nevertheless sensitivity functions play a major role in the numerical simulation process. By their means it is possible to estimate a trend in the influence of perturbations of parameters, to plan an observation experiment for estimating functionals, and in estimating variations of functionals to reduce the influence of fictitious noise produced by a discrete model.

Formalization of the individual steps in constructing discrete approximations and computing algorithms makes possible mutual compatibility of various parts of the model and facilitates the simulation process, but in no case substitutes for the intuition and experience of investigators in creation of the model itself. The more apriori information and physical meaning which are put into the model, the greater the hope of a successful solution to the problem. For a long time now the problem has been posed of introducing a two-way relationship between models and measurements of the characteristics of entities to be simulated. How is this to be done? Especially if it is taken into account that measurements are made by many measuring systems distributed unevenly in space and having various precision tolerances. The direct inclusion of measurement data in the model results in the so-called "shock" effect, the reason for which is the mismatch between the scales of perturbations contained in observation data and in simulated fields.

Here one way is suggested for implementing feedback through the minimization of functionals determining the degree of deviations between fields computed by means of the model and measured under actual conditions, by using models as space-time interpolators on the basis of the variational principle. Modern models are very complex and fitting them to actual data generally can prove to be too expensive, and the measurement data themselves are insufficient for identifying all the parameters of models. But if the cost of these studies is compared with the cost of full-scale, then it becomes clear that the development and use of methods of solving inverse problems are justified, since even for the most ideal models there will always be the problem of estimating the degree of their correspondence to real physical systems and of the intelligent use of measurement data. Combining complete models with few-component ones represents a reasonable compromise in solving this problem. Few-parameter models are simpler to identify and they are economical to implement. The spectral structure of these models makes it possible to separate perturbations in terms of scale and to take into account primarily the part of them most full of interest. At the same time complete models are more convenient for a local description and parametrization of various factors and it is advisable to use them for refining solutions obtained by means of few-parameter models.

8831
CSO: 1863/118

SELECTED ITEMS FROM JOURNAL 'INSTRUMENTS, MEANS OF AUTOMATION AND CONTROL SYSTEMS', FEBRUARY, 1981

Moscow PRIBORY, SREDSTVA AVTOMATIZATSII I SISTEMY UPRAVLENIYA, TS-2: SREDSTVA VYCHISLITEL'NOY TEKHNIKI I ORGTEKHNIKI (REFERATIVNYY SBORNIK) in Russian No 2, Feb 81 pp 1-14

[Excerpts]

4. 15332. "The complex 'Elekon-D-2M' for measuring and monitoring integrated digital dynamic parameters of microcircuits." Bondarevskiy, A. S., Pankov, Ye. D., Ostapenko, A. A., Kozlov, A. A., and Klimenko, L. V. ELEKTRONNAYA TEKHNIKA. SERIYA UPRAVNENIYE KACHESTVOM, METROLOGIYA, STANDARTIZATSIYA, 1980, No 2-3 (80-81), p 272 (Central Scientific Research Institute "Elektronika"). The urgency of development of the complex "Elekon-D-2M" is substantiated. Its main technical characteristics are compared with the Soviet and foreign analogues. The working principles, composition and metrological specifications of the complex are described. (Input by GPNTB SSSR, 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

5. 15338. "Arrangement of components on computer structures by the method of branches and bonds." Lebedev, B. K., and Kalashnikov, V. A. ELEKTRONNAYA TEKHNIKA. SERIYA MIKROELEKTRONNYYE USTROYSTVA, 1980, No 1 (19), pp 58-67, Central Scientific Research Institute "Elektronika". An algorithm is proposed for the arrangement of components of computer structures, taking into consideration the real conditions of layout by channel algorithms. In parallel with the arrangements, a forest of very short, orthogonal, connecting trees is constructed. (Input by GPNTB SSSR, 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

8. 15386. "Control and correction of a single error during cyclic shifts on the basis of Lagrangian codes." Karpukhin, A. I., and Nugmanov, R. N. ELEKTRONNAYA TEKHNIKA. SERIYA MIKROELEKTRONNYYE USTROYSTVA, 1980, No 2 (20), pp 13-19. (Central Scientific Research Institute "Elektronika"). It is shown that a single packet of errors can be detected and corrected on the basis of Lagrangian codes during cyclic shifts. Selection of the nodes of interpolation and the systematic character of the Lagrangian codes permit leaving the code word coded for the indicated operations. In that case the necessary equipment for conversion of the certifying symbols is not complex and the time is approximately the time of shift of the information part. A simple decoding algorithm is presented for detecting and correcting a single error with consideration of those operations. (Input by GPNTB SSSR, 103031, Moscow, K-31, ulitsa Kuznetskiy most 2].

20. 15388. "Integrated logical microcircuits noise stability criteria." Ural'skiy, Yu. A. ELEKTRONNAYA TEKHNIKA. SERIYA MIKROELEKTRONNYYE USTROYSTVA, 1980, No 1 (19), pp 3-16 (Central Scientific Research Institute "Elektronika". Various noise stability criteria of logical integrated microcircuits are examined for static and dynamic working conditions. Shortcomings of the presently adopted noise-intensity criteria are shown. An estimate of noise stability according to instantaneous power is proposed, scattered by the noise generator on resistances of a logical section constructed in the given system of elements. Circuits are presented. An analytical expression is obtained for the amplitude-time characteristic, which determines the noise stability under dynamic conditions. (Input by GPNTB SSSR, 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

21. 15389. "Planning operating storages on the basis of supplementary MDP-transistor large-scale integrated circuit storages." Zhemeytsev, A. G., Goslavskiy, A. V., Kabanov, I. N., and Petrova, F. Sh. ELEKTRONNAYA TEKHNIKA. SERIYA MIKROELEKTRONNYYE USTROYSTVA, 1980, No 1 (19), pp 17-22. Central Scientific Research Institute "Elektronika". On the basis of analyais and systematization of experience in the development of semiconducting operating storage with MPD integrated memory circuits with capacities of 156 and 1024 bits are formed the requirements for elements for the control circuits and organization of the operating storages file. A number of structural and ciruitry solutions of large-scale integrated circuit storages is examined, the solution of which will permit improving the characteristics and simplifying the development of storage devices on the whole. (Input by GPNTB SSSR, o03031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

23. 15400. "Questions of modeling and analysis of tests of digital devices." Fetisov, N. S. Preprint No 1 (1980), Moscow, 1980, 23 pages. The author examines questions about increasing the precision of logical modeling and calculation of the states of memory elements of sequential circuits during test analysis. (Input by GPNTB SSSR, 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

2174
CSO: 1863/99

SELECTED ITEMS FROM JOURNAL 'INSTRUMENTS, MEANS OF AUTOMATION AND CONTROL SYSTEMS', APRIL, 1981

Moscow PRIBORY, SREDSTVA AVTOMATIZATSII I SISTEMY UPRAVLENIYA, TS-2: SREDSTVA VYCHISLITEL'NOY TEKHNIKI I ORGTEKHNIKI (REFERATIVNYY SBORNIK) in Russian No 4, Apr 81 pp 1-11

[Excerpts]

16. 15805. "Development of fifth-generation computers." BYULLETEN' INOSTRANNOY NAUCHNO-TEKHNICHESKOY INFORMATSII TASS, 1980, No 29, p 19. The Japanese Ministry of Foreign Trade and Industry has decided to develop a computer of the fifth generation, which is regarded as the computer of the 1990s and whose functions more resemble those of the human brain than those of contemporary computers. The development of the new computer will be started in the 1981 fiscal year and completed in the 1990 fiscal year. The new computer will be able to make associations and analogies and reason. [Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

17. 15806. "Reduction of noises created by key pressure stabilizers." Skegirev, Yu. N., and Tomigas, O. A. OBMEN OPYTOM V RADIOPROMYSHLENNOSTI, 1980, No 6, pp 43-44. Some methods are suggested for reducing noises created by key pressure stabilizers in apparatus obtaining power from them. [Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

29. 15844. "The MIKRAS-system of microprogramming microcomputers constructed on the basis of series K589 large-scale integrated circuits." Bekasov, A. A. In book: "ALGORITMY" (Algorithms), Tashkent, 1980, pp 9-18. UzSSR Academy of Sciences. Collection of Scientific Works. No 40. A system is described for microprogramming computers construected on the basis of series K589 large-scale integrated circuits. [Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

2174
CSO: 1863/99

SELECTED ITEMS FROM JOURNAL 'INSTRUMENTS, MEANS OF AUTOMATION AND CONTROL SYSTEMS', MAY, 1981

Moscow PRIBORY, SREDSTVA AVTOMATIZATSII I SISTEMY UPRAVLENIYA, TS-2: SREDSTVA VYCHISLITEL'NOY TEKHNIKI I ORGTEKHNIKI (REFERATIVNYY SBORNIK) in Russian No 5, May 81 pp 1-11

[Excerpts]

9. 15894. "Organization of storage of data files on magnetic carriers." Gaganov, P. G. OBMEN OPYTOM V RADIOPROMYSHLENNOSTI, 1980, No 7, pp 3-5. The author analyzes the reasons for distortion of data on magnetic carriers during lengthy storage and use. Methods of increasing data storage time are examined. [Input by NIIUVM (Scientific Research Institute of Control Computers), 349940, Voroshilovgradskaya Oblast, Severodonetsk, pl Pobely, 2].

22. 16005. "Installation for monitoring commutation plates on the basis of microcomputers." Nikulin, G. V. ELEKTRONNAYA TEKHNIKA. SERIYA 9. Economics and Control Systems, 1980, No 2 (35), p 114. The paper presents the results of the development and introduction of an installation for monitoring thin-film commutation plates of hybrid integrated circuits, created on the basis of the microcomputer "Elektronika-SB-01" and an APK-1 automatic program contacting machine. [Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12]

23. 16006. "Video terminal connector to computer." Gromov, Yu. K., Kekrasov, L. T., and Tselyapin, A. N. ELEKTRONNAYA TEKHNIKA. SERIYA 9. Economics and Control Systems, 1980, No 2 (35), p 128. The paper describes the USO-5, a device intended for the organization of connection of the "Elektronika 100-I" computer with YeS computers and various video terminals, particularly with the "Elektronika T1000". Examples of the accomplishment of such a connection in automated control systems of various configurations are presented. (Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

24. 16009. "Structural organization of large-scale integrated-circuit multichannel commutators." Zolotarevskiy, V. I., and Nekrasov, V. M. ELEKTRONNAYA TEKHNIKA, SERIYA 9. Economics and Control Systems, 1980, No 2 (35), p 133. The paper examines

structural circuits of multichannel commutators constructed on the basis of MOS structures and intended for use in measurement systems and systems of communication with an object in an automated system for control of technological processes. [Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

2174
CSO: 1863/99

SELECTED ITEMS FROM JOURNAL 'INSTRUMENTS, MEANS OF AUTOMATION AND CONTROL SYSTEMS', NOVEMBER, 1981

Moscow PRIBORY, SREDSTVA AVTOMATIZATSII I SISTEMY UPRAVLENIYA, TS-2: SREDSTVA VYCHISLITEL'NOY TEKHNIKI I ORGTEKHNIKI (REFERATIVNYY SBORNIK) in Russian No 11, Nov 81 pp 1-12

[Excerpts]

21. 28936. "Complex technological line for manufacturing fragments of fields of circular ferrite cores." Bolunov, V. V., Dmitriyev, A. F., and Samiulina, A. A. In book: "Razvitiye teorii i tekhniki sredstv khraneniya informatsii" (Development of the Theory and Technology of Means of Data Storage); "Tezisy dokladov Vsesoyuznoy nauchno-tekhnicheskoy konferentsii Moskva (Abstracts of Reports of Scientific-Technical Conference, Moscow), Riga, 1980, pp 68-70 (Scientific and Technical Society of Radio Engineering, Electronics and Communication imeni A. S. Popov). The introduction of a complete set of technological equipment and instruments into production of fragments of fields of circular ferrite cores permits reducing by two-thirds the labor intensity of manufacturing fragments, improving their quality and reducing expenditures of materials. [Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

UDC 681.327.2

32. 28703. "Static storage unit with series AM-9131 random access." In book: "Kratkiye tekhnicheskiye kharakteristiki na pechatayushchiye ustroystva, nakopiteli" (Brief Technical Characteristics of Printers and Files), Severodonetsk, 1980, p 27. NIIUVM [not further identified]. A brief technical characterization is presented of a static storage unit with series AM-9131 random access. [Input by NIIUVM, 349940, Voroshilovgradskaya Oblast, Severodvodetsk, pl, Pobeli, 2].

UDC 681.327.2

33. 28704. "Static storage unit with series AM-9142 random access." In book: "Kratkiye tekhnicheskiye kharakteristiki na pechatayushchiye ustroystva, nakopiteli" (Brief Technical Characteristics of Printers and Files). Severodonetsk, 1980, p 32. NIIUVM. A brief characteristization is presented of a static storage unit with series AM-9142 random access. [Input by NIIUVM, 349940, Voroshilovgradskaya Oblast, Severovodsk, pl Pobeli, 2].

34. 28705. "Static storage unit with series AM-9140 random access." In book: "kratkiye tekhnicheskiye kharakteristiki na pechatayushchiye ustroystva, nakopiteli" (Brief Technical Characteristics of Printers and Files). Severodonetsk, 1980, p 27. NIIUVM. A brief characterization is presented of a static storage unit with series AM-9140 random access. [Input by NIIUVM, 349940, Voroshilovgradskaya Oblast, Severovodsk, pl Pobeli, 2].

35. 28706. "Static storage unit with series AM-9150 random access." In book: "Kratkiye tekhnicheskiye kharakteristiki na pechatayushchiye ustroystva, nakopitali" (Brief Technical Characteristics of Printers and Files). Severodonetsk, 1980, p 27. NIIUVM. A brief characterization is presented of a static storage unit with series AM-9130 random access. [Input by NIIUVM, 349940, Voroshilovgradskaya Oblast, Severovodsk, pl Pobeli, 2].

43. 28920. "Some results of the development of a semiconductor laser permanent holographic memory." Yelkhov, V. A., Klimov, I. I., and Shidlovskiy, P. P.. In book: "Razvitiye teorii i tekhniki sredstv khraneniya informatsii" (Development of the theory and technology of means of data storage); Tezisy dokladov Vsesoyuznoy nauchno-tekhnicheskoy konferentsii Moskva (Abstracts of Reports of Scientific-Technical Conference, Moscow), Riga, 1980, pp 102-103 (Scientific-Technical Society of Radio Engineering, Electronics and Communications imeni A. S. Popov). The paper describes prototype realizations of a module of a permanent holographic memory and device for recording holograms with use of semiconducting lasers. [Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

49. 28935. "Semiconductor large-capacity memory unit based on K565RU1 dynamic integrated circuit." Nozik, I. R., and Vasilishin, S. M. In book: "Razvitiye teorii i tekhniki sredstv khraneniya informatsii"; Tezisy dokladov Vsesoyuznoy nauchno-tekhnicheskoy konferentsii Moskva, Riga, 1980, pp 63-65 (Scientific-Technical Society of Radio Engineering, Electronics and Communications imeni A. S. Popov). A semiconductor main storage based on K565RU1 integrated microcircuits has been developed and introduced into the composition of a computer. [Input by GPNTB SSSR].

52. 28944. "Improvement of the elementary base of optical storage based on integrated optical devices." Pokrovskiy, Yu. A., Makaretskiy, Ye. A., and Khurkhulu, Yu. S. In book: "Razvitiye teorii i tekhniki sredstv khraneniya informatsii"; Tezisy dokladov Vsesoyuznoy nauchno-tekhnicheskoy konferentsii Moskva, Riga, 1980, pp 53-55 (Scientific-Technical Society of Radio Engineering, Electronics and Communications imeni A. S. Popov). Some questions of improvement of the elementary base of optical storage based on integrated optical devices are discussed. [Input by GPNTB SSSR].

53. 28945. "Unused possibilities of computer ferrite morires." Burkin, Yu. A. In book: "Razvitiye teorii i tekhniki sredstv khraneniya informatsii"; Tezisy dokladov Vsesoyuznoy nauchno-tekhnicheskoy konferentsii Moskva, Riga, 1980, pp 52-53. (Scientific-Technical Society of Radio Engineering, Electronics and Communications imeni A. S. Popov). A new technology is described for the production of ferrite storages, one developed by the Siberian Department, USSR Academy of Sciences. [Input by GPNTB SSSR].

2174
CSO: 1863/99

SELECTED ITEMS FROM JOURNAL 'INSTRUMENTS, MEANS OF AUTOMATION AND CONTROL SYSTEMS', DECEMBER, 1981

Moscow PRIBORY, SREDSTVA AVTOMATIZATSII I SISTEMY UPRAVLENIYA, TS-2: SREDSTVA VYCHISLITEL'NOY TEKHNIKI I ORGTEKHNIKI (REFERATIVNYY SBORNIK) in Russian No 12, Dec 81 pp 1-12

[Excerpts]

UDC 681.325.65.06

33. 30644. "Software for the ELEKON-SF system." Borisova, Ya. I., Vasil'yev, Ye. P., Lyshenko, V. I., Orlov, Ye. V., Popel', L. M., and Truskova, S. M. ELEKTRONNAYA PROMYSHLENNOST', 1981, No 2 (98), pp 28-33. The paper presents software developed for the series-produced system for monitoring large-scale integrated-circuit memory units and microprocessors ELEKON-SP, including the high-level monitoring language ELEKON F, a complete set of programs for statistical processing of the results of monitoring the large-scale integrated circuit and programs for monitoring working capacity, diagnosis of defects and metrological certification of the system. [Input by GPNTB SSSR (USSR Main Public Scientific-Technical Library), 103031, Moscow, K-31, ulitsa Kuznetskiy most, 12].

UDC 621.3.049.77:681.2

34. 30645. "The K594PA1 infra-analog converter." Abraytis, V. B., and Klimashauskas. ELEKTRONNAYA PROMYSHLENNOST', 1981, No 2 (98), pp 49-50. The paper presents the main characteristics of an infra-analog converter, intended for conversion of a 12-bit code into analog current with an error of 0.012 percent. [Input by GPNTB SSSR].

UDC 621.3.049.77:681.327.67

35. 30646. "K170AP3 and K170AP4 integrated semiconducting microcircuits for metallic-oxide semiconductor storage control." Samsonov, V. S., and Khmel'nitskiy, S. L. ELEKTRONNAYA PROMYSHLENNOST', 1981, No 2 (98), pp 48-49. The paper presents the main electronic characteristics of K170AP3 and K170AP4 microcircuits intended for metallic-oxide semiconductor storage. [Input by GPNTB SSSR].

UDC 621.3.049.771.14

54. 30642. "Installation for functional monitoring of a large-scale integrated circuit main storage." Danilin, N. N., and Popel', L. M. ELEKTRONNAYA PROMYSHLENNOST',

1981, No 2 (98), pp 15-18. A brief technical characterization is given of an installation for functional monitoring of the ELEKON F-ZUM large-scale integrated-circuit main storage. [Input by GPNTB SSSR].

UDC 621.382.619.3

55. 30643. "Statistical analysis of parametric reliability of a 256-bit large-scale integrated-circuit main memory." Gorovoy, V. V., and Savotin, Yu. I. ELEKTRONNAYA PROMYSHLENNOST', 1981, No 2(98), pp 43-45; Bibliography: 4 items. The paper presents the results of investigation of the parametric reliability of a static main memory with a capacity of 256 bits on ESL-structures and determination of possible ways to increase main memory reliability. Used for analysis was the physical-statistical approach, based on consideration of the interrelation of the statistical laws of distribution of the parameters of an article with the character of their variation in time. [Input by GPNTB SSSR].

UDC 621.3.049.77:681.3

56. 30647. "Data file KR555Rye4 with a 16K capacity for a symbol generator." Nazar'yan, A. R., Neklyudov, V. A., and Shchetinin, Yu. I. ELEKTRONNAYA PROMYSHLENNOST', 1981, No 2(98), pp 46-48. The paper examines the purpose, compositions and functions of a KR555RYe4 data file for a symbol generator. The main electrical parameters of the file are presented. [Input by GPNTB SSSR].

2174
CSO: 1863/99

END