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EAST

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SCIENTIFIC AFFAIRS

No. 601

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EAST GERMANY

USE OF MATHEMATICAL-COMPUTER AID TO INTENSIFY RESEARCH

East Berlin SPEKTRUM in German Vol 19 No 5, May 78 pp 15-19

[Article by Prof Dr Manfred Peschel, chief, Mathematics and Cybernetics Research Section, GDR Academy of Sciences; and Dr Werner Schulze, Mathematics and Cybernetics Research Section, GDR Academy of Sciences: "Intensification of Research Through Mathematical-Computer Aids"]

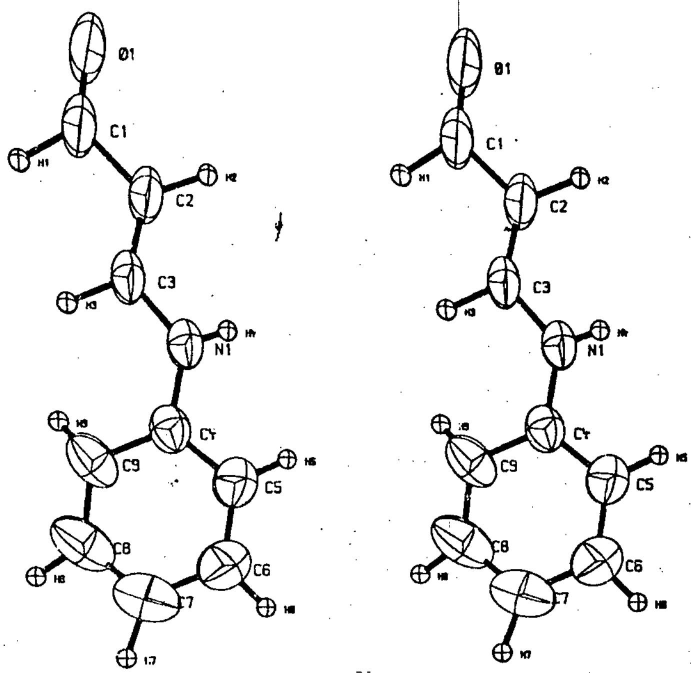
[Text] Science represents a complex and dynamic information system. This fact alone illustrates that using effective aids for data processing makes it possible to intensify research to a considerable degree. It has always been necessary for science to structure research processes in such a manner that these aids were effectively used and that requirements of them were formulated from research projects. In this manner, scientific work contributed to a large degree to their development. This complex also includes the adaptation of aids for data processing by the individual scientist or research institute. It is especially at this time that such tasks become pressing since the increased responsibility of science to society makes it mandatory to utilize all possibilities of intensification.

The aids of this type which are presently available to science can be properly subdivided into technical aids apparatus technology , processes and methods for application of apparatus technology system software and forms of application , and methematical aids which lastly are expressed in application software. Among the technical aids are EDVA [electronic data processing equipment], small and process computers, but also special peripheral devices, instruments for remote data transfer and others. Processes and methods to utilize equipment technology are especially important for computers. At the present time, we distinguish chiefly between the use of computers in batch processing, the interactive cooperation between research instruments and technical aids for data processing in experimental research, and the direct interaction of scientists and computers in a dialogue.

The use of computers in batch processing assures a high utilization rate. Batch processing will therefore remain important in the future in such areas where its drawbacks time delay in processing problems and no possibility to intervene in the running of programs play a secondary role. In order to improve the use of large scale computer technology in certain areas of the Academy, plans are to increase the proportion of remote batch processing in the next few years.

However, it should be noted here that the drawbacks of batch processing in the utilization of computer technology are becoming a major handicap for an increasing portion of the research problems handled at the Academy. For example, experiments with formalized models can be realized only with difficulty in biologic or physical research. In comparison with the test in dialogue processing, a time extension factor of 5 or greater was determined for medium-range programs for the program test in batch processing. The use of computers for recording measured values in conjunction with research devices is possible in batch processing at any rate only for simple cases off-line acquisition , and is to be ruled out when control of devices by the computer is required.

This last fact requires interactive cooperation between research devices and technical aids for data processing. In almost all experimentation facilities of the Academy of Sciences we can fall back on experience gained in the utilization of process computers. However, their use as central computers for several connected research devices is still predominant here. The tasks of the computer extend from data acquisition and evaluation exclusively--as for example in geomagnetic research, but also with some analytical devices--through the additional monitoring of experiment conditions and device and experiment progress control, as for small and lab reactors.



Defocussing series of the electron microscopic image of a copper-phthalocyanin molecule calculated in the Institute for Solid State Physics and Electron-microscopy in Halle. (Photographic parameter: Acceleration voltage 500 kV, apertural defect of the objective lens 1 mm, aperture angle 0.0085 rad, defocussing according to indication in the individual pictures in Å). The molecule calculated for a defocussing of 400 Å exhibits the best agreement with the actual molecular structure.

New aids for automation of experimental research are micro-electronic hardware for data processing and microcomputers. Among other things, they allow the subdivision of central automation complexes and make the establishment of simpler, more flexible, more reliable, but also more efficient structures possible. With their use, the direct combination of computers in terminal systems with lead computers, multilevel hierarchy systems and similar structures becomes increasingly more important. Here also experience has been gained in the Academy through intercoupling of process computers and with more efficient EDVA. We should here mention as an example the SOLAS system for on-line evaluation of track chamber pictures in the Institute for High Energy Physics, and the tandem measuring center in the Central Institute for Nuclear Research.

It will be the task for the immediate future to further develop the already existing systems and to create new ones. Microelectronic hardware for data processing, micro- and device computers will perform data acquisition, preliminary processing and device control at the lowest level if possible by means of standardized instrumentation systems such as CAMAC. Control computers take over coordination, data and program organization at the medium (level) and large-scale computers will be used for the execution of large and complex processing tasks. Systems with this division of tasks ensure maximum research economy and allow us to utilize the high efficiency of the aids for data processing in their entirety for partial research processes. At the same time, they promote to a decisive extent the integration process in research. In this sense, they represent an important component of multimethod systems; this refers to systems which permit the simultaneous investigation of an object by different research methods.

The third of the utilization methods of computers listed, the dialogue between scientists and computer, aims at combining the advantageous capabilities of creatively active man with computer technology for the purpose of problem solving. In this manner, computer technology becomes a direct field of experimentation for the scientists. Such a mode of operation makes it possible in particular to directly link the talents of the researcher with the possibilities of computers. The talents of the researcher concern here particularly the evaluation of results as a function of goal criteria which can be formulated only with difficulty or not at all and the inclusion of aspects into the problem solution which can be formalized only with difficulty or not at all, etc. Computer possibilities include the extremely rapid execution of formalized operations and working with very large memories.

The use of programmable desk and scientific-technical small scale computers implies to a large extent dialogue processing which in this context has been a part of the research technology at the Academy since the advent of such devices. However, the effect of such a dialogue is restricted by the limited efficiency of the computers. A quality of dialogue processing corresponding to modern computer technology can be obtained only when we include large scale computer technology. With the installation of EDVA of the type ES-1055, we shall improve these conditions in the Academy of Sciences. When necessary, this will also allow us to include the capacitities of more efficient computers (high performance computers) into dialogue processing.

Besides the already mentioned categories of simulation and program development, particularly program tests, areas of application for dialogue processing that are of interest in research technology include the following important sectors: development of algorithms and models, the interactive manipulation search modification of large data files, and the preparation of optimal decisions. Their realization does not only presume appropriate hardware and system software, it also requires the appropriate application software which can be created in part only by extensive research and development work. This includes, for example, the "question and answer system" problem at which is presently present handled in the mathematics and cybernetics research sector for the area of interactive manipulation of data files.

Aspects of the intensification of research processes through mathematical-computer aids can be illustrated by the examples of automated picture processing and computer-supported graphic data processing.

Picture processing as a form of discerning of optical objects is the basis for methods of data processing and diagnosis in a multitude of social sectors and scientific disciplines. Its task is to extract and refine the data contained in the geometric, densitometric and color parameters of an areal representation. Automation of picture processing makes it possible to improve the quality of picture processing as well as the data yield--frequently the desired data cannot be obtained in any other manner--and to rationalize the corresponding data processing methods.

Examples of scientific disciplines at the Academy of Sciences with tasks of picture processing

Scientific discipline	Examples of Picture Processing Tasks
Molecular biology, medicine	Irradiation planning, cytology, early recognition of morphological and functional changes in the heart, examination of bacteria colonies
Solid state physics Material research	Interpretation of electron-microscope pictures, qualitative picture improvement and quantitative picture evaluation of structures
High-energy physics	Evaluation of track chamber photographs
Astrophysics	Evaluation of photometric and astrometric photographic sky pictures and spectra
Mechanics	Investigation of spatial dynamic stresses
Chemistry	Grinding analysis, crystal structure examinations, evaluation of image recordings obtained by means of different analytical devices

Devices for scanning and digitalization of pictures, for processing of picture data picture modification to improve the interpretation possibilities, picture reconstruction, picture evaluation, object evaluation and for picture reproduction are needed as technical aids. The necessary software includes the system software for the device technology as well as algorithms for picture processing and application software. Whereas the system software is largely independent of the specific application, this is true in application software only for the elementary functions of picture processing. Through modular, expandable program systems, which make it possible for the individual user to select the desired solution, considerable rationalization results can be attained when providing application software. The third prerequisite in addition to device technology and software for a successful use of automated picture processing as a research method consists in the methodical preparation within the individual user disciplines and in the adaption and subsequent derivation of requirements for the further development of the methodological aids

In a broader sense, graphic data processing must also be grouped with picture processing. As a special case of processing image information, it includes the acquisition, storage and processing of data on geometrical formations and their reproduction into the two-dimensional plane. In research, graphic data processing is of importance when the graphic representation can be used as a communication and recognition aid . As a form of data storage graphic representation does not play as large a role in research as it does, for example, in industry.

In these cases, the use of mathematical-computer technology aids for automation of graphic data processing is a contribution to the intensification of research. The simplest form is the automatic drawing of the functional relationships determined, time trends, etc. Such representations frequently create problems in manual preparation and require great expenditures. This is particularly true for the elementary case of graphic representation of a function of two variables, as well as for the three-dimensional projection and for isoline representation, which must be evaluated parallelly in order to obtain data on the course of the function.

We have at the Academy devices for automatic drawing in various performance classifications. There are problems in providing sufficient devices to be used in conjunction with small and micro computers.

A further form of automation of graphic data processing is the use of graphic picture screen units which allow the scientists to carry on a dialogue with a computer facility. This mode of operation does not only offer extensive intensification possibilities in the development and design design of printed circuit boards or solid state switching networks, construction planning etc., but also opens up interesting technological possibilities for scientific research.

The automation of graphic data processing presumes in addition to appropriate device technology and system software a special application software whose essential task lies in assuring simple and effective communication between user and device technology and system software. In the mathematics, mechanics, cybernetics and data processing research program, the scientists at the Wilhelm Pieck University established with the DIGRA the digital-graphic programming system, an efficient aid which solves this problem both for automatic drawing devices and for graphic picture screen units. This system is being used successfully in pipeline and ship design, among other applications.

In spite of the present level of use of mathematical-computerized aids in the Academy of Sciences, there are still shortcomings in this sector for intensification of Academy research. Difficulties in their elimination must be grouped chiefly into two problem areas.

Application of this technology presumes appropriate research-specific instruments , suitable processes and methods. The task of creating them exists largely independent of specific scientific disciplines or research facilities. To solve them, it is advisable for reasons of efficiency to use centrally effective capabilities for academy research and for research in other institutions of the German Democratic Republic. Such capabilities will provide a wide range of useful solutions e.g. linguistic aids , program libraries, research-specific process-combining units . These capabilities exist at the Academy in the software sector especially in the research area of mathematics and cybernetics, and for instruments in the research area of physics, nuclear and material sciences. In addition, the solution of this problem is served by results which are provided within the framework of the mathematics, mechanics, cybernetics and data processing research program by scientific institutes outside of the Academy of Sciences. From a science viewpoint, there is the need for developing these centrally effective (capabilities) and the corresponding problem formulations in a balanced relationship with directly "productive" research.

The second problem area concerns the preparation of research tasks of the user disciplines for application of mathematical-computer technology aids by means of work in discipline-oriented research methodology. This includes the system-theoretical penetration of the user disciplines from the viewpoint of data processing, problem formulation and the planning of the problem solution, taking into account available or possible mathematical-computer aids. These steps are a necessary condition for the effective utilization of the work results of the centrally effective capabilities mentioned. Lastly, also discipline and problem-specific application software can be created only within the individual research institutes and science disciplines.

On the whole , the step-by-step, increasingly improved solution of the problems brought up here is indispensable in order to make intensification of research through mathematical-computer aids possible in a more effective manner.

PHOTO CAPTIONS

1. p 15. Measuring room of process computer-controlled system for on-line evaluation of track chamber photographs SOLAS at the Academy Institute for High Energy Physics, Zeuthen.

2. p 16. The Soviet large-scale computer facility BESM 6 in the Center for Computer Technology of the Academy of Sciences. With an average rate of 1 million operations per second, it belongs to the most efficient large-scale computers existing in the German Democratic Republic.

3. p 17. As a result of the application of mathematical methods to experimentally obtained data, the roentgen crystal structure analysis furnishes accurate stereochemical data on molecules of biologically active substances. The three-dimensional representation is given in the form of a stereoscopic pair of pictures. This figure shows a stero picture pair in central projection; it was produced in the Center for Computer Technology on the DIGIGRAF 1612 drawing board.

4. p 18. Section of a picture of the Moritzburg near Dresden is an example for point-related picture operation. By using a staged transfer function, gray values are quantized. An equidensite picture is created. (See also back title)

5. p 19. This aerial photograph of the "Susse See" [Sweet Lake] near Halle was taken with the MKF-6. It is an example of a local picture operation. Object contours characterized by non-linear gray value changes are filtered out by two-dimensional Laplace transformations. This allows image generalization, for example for cartographic task formulations. Picture processing Central Institute for Physics of the Earth.

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VARIETIES, USES OF COMMISSIONED UNIVERSITY RESEARCH

Budapest MAGYARORSZAG in Hungarian 20 Aug 78 pp 24-25

[Article by Janos Rathonyi: "Supplementary Work in the Public Interest; KK Work at the University; How Much Does the Professor Make?"]

[Text] If industry wants to keep up with the swift development of science and technology it cannot do without well trained engineers whose knowledge is always "up to date." Thus it has need of universities which prepare the experts of the future, not only on the basis of classical knowledge, but also with an awareness of the most timely problems of industry, preparing them for practical applications and satisfying the need for regular further training. At the present pace of product change a single enterprise cannot become absorbed in solving the problems of science and technology, because in most cases it will have neither the time nor the research and development capacity. The universities, on the other hand, have representatives of many specialities in a "density" which it would be difficult to achieve in industry.

It is useful for the enterprises to entrust their problems to the instructors in the faculties, to award research and development commissions, and thus to make it also possible for higher education to bring the students closer to the tasks which await them while they are still at their university desks. Modern industry and agriculture not only needs engineers, but also economists, lawyers and physicians. Thus good contacts are indispensable between the Technical University and the other universities with experts in all other branches of science.

Money For the Universities

Research done at the universities on the basis of commission contracts is called KK work. (Where does this mysterious sounding abbreviation come from?

It is now difficult to say. Many think it comes from the first letters of "kulon-kereseti" [special profit] or "kulon-kutatasi" [social research] work. It is more probable, however, that it is an abbreviation for work done outside the official budget [koltsegvetesen kivuli].) This also calls attention to the fact that for a long time the costs of university research have been covered from several sources. Even today the state budget provides significant sums for research. In addition, from the viewpoint of science policy, those research commissions are of interest which are provided to the universities by the ministries and other chief authorities and by the National Technical Development Committee, in addition to the most varied tasks offered by industrial enterprises and by agriculture. Besides all this, the special measures of the government include a research support fund called "Mufa" [muszaki fejlesztesi alap--technical development fund]. This technical development fund is a segregated fund for technical universities and natural science schools. It can be used only for development, primarily for the purchase of very valuable equipment and instruments.

A basic decree passed in 1968 regulates the undertaking of contract work to be done by institutions of higher education. This has been supplemented since by two significant modifications. The uniform regulation now in effect is contained in executive directive 131/1976 of the Ministry of Education, but the universities have issued internal directives in harmony with the decree. The new measures did not bring any essential change in the undertaking of contract work or in the distribution, utilization or accounting of money available.

If It Is Incompatible...

KK work can be put into two main categories. The first category embraces commissions requiring high level scientific work which are of major importance from the social and economic viewpoint. The second category includes other commissions of general interest which require less creative work or are of a service character. (For example, if an installation must be designed which is relatively simple and does not require special preparation on the part of the designer. But where this is not possible in another sphere of research and development, because of the well known shortage of design capacity, it is in the interest of the people's economy that this work be done as soon as possible.)

Commissions of a service character include computer technology tasks--the solution of which does not require any special intellectual capacity or program development, but for which economical use can be made of valuable instruments or computers existing in the universities.

The sum generated from the price set in the contract for the KK work can be divided up as a function of the category involved. Further shadings play a role within the two chief theoretical distinctions. Within the first category they have defined 6-7 other categories and they have defined 4 other categories within the second. Direct expenditures for research, material costs and various types of overhead make up somewhat more than half of the money paid by the client for contract work. Thus less than half of the total sum can be divided up in such a way that 40-70 percent of it can be used to pay those doing first category work and 20-40 percent of it can be used to pay those doing second category work. The remainder makes up a development fund, a cultural and social fund and a reserve and risk fund. (It has sometimes been found in the course of an internal audit that people have been employed in the work whose assignment was for some reason incompatible with the commission. In such cases the university immediately voids the contract even if this means paying reparations to the client out of its own risk fund.)

According to the decrees and the internal rules of the universities the research commissions are assumed by the deans, the leaders of the schools, but the entire system for commissions is regulated socially. Those participating in the preparation of a decision are not only the faculties which will ultimately carry out the contracts, but also advisory committees. The members of these are representatives of the special area and of the party and the social organizations. Prior to authorization these committees submit an opinion on every undertaking on the basis of technical, professional and scientific viewpoints and they do so again, on the account given of the work, after completion. The social organs judge the magnitude of the award given to those cooperating in the work.

The faculties of the Budapest Technical University get the most commissions of all Hungarian universities--in accordance with the interests of industrial development. The Technical University completes an average of 1,000 commissions per year which involves an income of 300-400 million forints. Of the commissions in 1977, research and development work made up 68.5 percent, technical design made up 15.1 percent (of which construction design came to 10.6 percent), the providing of technical professional opinion made up 12.9 percent and other work made up 3.5 percent. (The enterprises often ask other industrial planning institutions for various plan changes to provide a technical solution to some problem and they ask the appropriate faculties of the Technical University to provide a professional opinion on a solution which might be debatable).

A thousand commissions per year may seem like a lot to an outsider. But the number of major themes is substantially fewer, about 60. For example, the research and development tasks aimed at increasing the safety of motor vehicles and vehicular traffic constitutes one theme. This includes, among other things, a more modern design of motor vehicle components or the design of a service system intended to aid less dangerous vehicular traffic. The 1,600 instructors and researchers of the Technical University deal with various scientific themes. This certainly represents a great intellectual capacity. Nor is it a matter of indifference to the people's economy that this technical-scientific team is working for it. In the course of fulfilling their industrial commissions the researchers receive concrete feedback concerning the results of their work, and their views are influenced by what industry expects and timely tasks exist.

The Students Work Into It

Nor is it a subsidiary viewpoint that the students studying at the university participate directly in the research. Last year 10 percent of the students at the Technical University--700 candidate engineers--participated in this work as regular employees. The sum paid out to award their participation came to more than 2 million forints. Many of them include independent semester projects or even themes for their diploma plans in this work. Often, in the course of this work, they even find their place; that is, they "work themselves in" to their future employment. Quite outstanding student achievements are born in the KK work too, primarily in those areas where many years of research experience are not an absolute requirement. One example of this: The so-called operational system--the basis for programming--for a small computer of domestic origin was developed almost entirely through the participation of students.

According to statistical data for 1977 a total of 81,000 people work at research sites throughout the country, 35,000 of them being scientific researchers. According to data of the Patent Office 6 thousandths of the domestic researchers, 6 out of every 1,000, have patented inventions. Last year the state paid 14 billion forints for research. If we take as a basis the 300-400 million forints of price income from the annual average research at the Budapest Technical University then the patented invention activity of the university can be called an outstanding achievement--the 71 patents and the 55 inventions for which patent is pending, in the past 6 years, speak for themselves. Of these, 35 patents are in use both at home and abroad. More than 80 percent of all applications for patents are born in contract KK work.

There is much talk nowadays about the increasing grayness of the scientific qualifications system. Academicians, scientists and university professors are analyzing the causes. The debate about this has filled the columns of the journal MAGYAR TUDOMANY for months. University KK work--there can hardly be any debate about this--is the area of research where the chief stimulus is the interests of the people's economy. There is no danger here that research is self-serving, abstract work aimed only at acquiring a scientific degree. Very frequently a high quality KK project makes it possible for those cooperating in it to receive scientific qualification, the title of candidate or doctor.

Not An Ivory Tower

Here one finds most of all that he who is creative in technical life has a lively contact with industry. There is the industrial background and the material resources provided by the contract to see, for example, that an idea will be embodied in a machine. Research based on commission contracts extends to every branch of science in the universities. It would require an entire newspaper if we wanted to report on all of them.

The daily problems of industrial development generally appear in the technical universities, the experiences acquired there are probably generally valid. (Istvan Hajdu, chief of a scientific department at the Technical University, reports: "The graded scale of the categories for contract work encourage us not to dissipate our forces. When assuming commissions the university gives priority to those which require longer term and high quality research work. The number of these has been increasing steadily for the past 3 years. KK work is one way to acquire scientific qualification with creative work. At our university a good many have already won scientific degrees thanks to their industrial achievements. This has been greeted very enthusiastically by university public opinion because it not only encourages high-level scientific activity, but also leads to a view according to which the winning of a scientific degree and creativity inaccordance with the interests of the people's economy are not separate concepts; it is not necessary for a researcher to withdraw for a time--a few productive years-- because, for example, he wants to be a candidate in the sciences.")

All this would be mere theory if practice did not prove it with results achieved both here at home and abroad. In more than one case KK work has made possible outstanding export activity too. For example, the university and the Machine Export Enterprise are cooperating through a commission contract in the development of laboratories for the Algerian university being established in Oran and in the export of equipment. Thanks to the 12 million [forint] commission the university has not only exported equipment which it developed itself, it has seen to it that the best products of Hungarian enterprises can be used, thus creating for them new markets. Various faculties of the university participated jointly in the contract work; indeed, the university also delivered a textbook of more than 600 sheets to go with the equipment exported. This was written and translated into French and will be published in Oran as a technical university textbook.

In addition, going through the appropriate export and state organs, a dozen instructors traveled to Oran in recent months, to teach, in general, for 3 years. Their number will probably increase. So this is a unique area of operations characterized only in part by the export worth many millions for the university also sold its educational experience. (They recently signed another contract with the Machine Export Enterprise. The university will ship hydromechanical and flow technology laboratory equipment to a technical college in Nigeria. The contract work has a value of 2 million forints and a significant part of this is intellectual export.)

The protein concentrate patent using green fodders developed by Academician Dr Janos Hollo and his colleagues is well known both at home and abroad; it has been purchased by Denmark, Sweden, the United States and Japan. The invention, which is extraordinarily significant in protein production, is utilized here at home by an independent enterprise, VEPEX. The university transferred the patent to this enterprise in return for suitable materials. In other cases, also, the university transfers developed technical procedures to industry in such a way as to participate in practical realization, gain experience in common and jointly patent the procedure.

Supplementary Income Too

The converse is true also. In many cases an enterprise transfers its own developmental achievements as a starting point for research, transferring in addition the necessary equipment and materials and even experts for use by the university. In this way switching technology solutions have been born in electronics which can be used in private dwellings too; technologies have been created for protection of buildings and monuments which are now patented.

A number of KK commissions were born in connection with construction of the Bicske Thermal Power Plant and other energetics investments. Contract research work is linked to the construction of the 750 kilovolt power line and in the course of developing mine safety equipment, for example, the development of the electronic ventillation system for the Mecsek coal mines led to several KK commissions. Joint research is underway with the Hungarian Optical Works in the area of technical analysis and there is close cooperation with Chinoin in pharmaceutical research. In construction design there was outstanding KK work in the development of the roofing structure for the Budapest autobus garage on Recsey Ut. The task connected with the Metro track structure was interesting; several research projects deal with road construction, historically with the construction of highway E-11, with bridge structures and with solutions increasing motor vehicle traffic safety. Noteworthy results have been achieved by research on numerically controlled machine tools and the computerized production control systems built into them. Of similar importance has been parts research on commission from Remix, United Incadescent and Videoton.

The amount of information within a branch of science doubles every 8-10 years. In electronics, for example, there has been such a revolution in the past 10 years that a person who was a third or fourth year student 5 years ago can hardly deal profoundly or minutely with the microprocessors. But the students of today work with them every day in the labortories. A person can hardly graduate from the university before significant new material arises in many areas. The instructors must keep up with the pace of development and the KK work is an effective aid to this.

Of course, KK work also provides supplementary income to the instructional staff and, to no small extent, to students included in the research. We are not talking about astronomical sums; the regulations take care of that but the "ethical limits" also pose restrictions. The sums are set as a function of assignment and pay scales. But the numbers are deceiving. In the first place because the people involved here are people whose ideas bring millions to the people's economy--and there are tax regulations which control outside income in a progressive way. The university professors and their colleagues who contract to do research are well acquainted with the upper limit of income deriving from commissions; they know the sum above which it is "not worthwhile to earn."

In The Lower Region

It is not a matter of indifference to know where university instructors stand in the statistical ranking of national income averages. Comprehensive analyses were done last year. When adjusting teachers' wages the government studied the situation of those working in higher education. It could be shown, after a survey covering a long period, that by the time they are 40-45 years old university instructors attain earnings equal to the average level for graduates in society. More precisely, the earnings of university professors are about the same as the incomes of enterprise directors. The average monthly salaries of young assistants and those in training on university scholarships are less than those of their classmates who graduated with them and work in industry but--thanks to various outside jobs and KK research--the average income is more or less the same. (Of course, the average covers quite deviant individual income differences!)

In any case it is obvious that the supplementary income deriving from KK work is a good incentive and, what is perhaps more important, those participating in research work see here the swiftest utilization of their own activity and receive here a picture of the real problems of a developing industry.

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INSTRUCTION FOR PREPARATION OF NATIONAL MEDIUM-TERM RESEARCH DEVELOPMENT PLAN PUBLISHED

Budapest AKADEMIAI KOZLONY in Hungarian No 10, 9 Aug 78 pp 113-114

[Statutory provision, Resolution 30.014/1978 of the Science Policy Committee: "On the Preparation of the Medium-Term National Research-Development Plan for the Sixth Five-Year Plan Period"]

[Text] The Science Policy Committee passed the following resolution on the contents and preparation of the OKKFT (National Medium-Term Research-Development Plan for the Sixth Five-Year Plan period on basis of Council of Ministers' resolution 1003/1978 regarding the "timely problems of science policy," and Council of Ministers' resolution 2005/1978, and TPB (Science Policy Committee) resolution 30.021/1977 on the execution thereof.

I. The Nature of the Plan and Its Functions

1. The goal of the OKKFT is to knit science policy relations more closely and increase the planned nature of research-development work, science policy and research guidance activity. The plan serves these goals directly with the tasks set for the research guidance organs and the research plans included in the plan, and indirectly with the orientation effect expressed on the whole of Hungarian research development activity.

The activity set forth in the plan supports the solution of important research and technical development tasks related to a modernization appropriate to the foreign economic requirements of the production structure; social, economic and technical development following the medium-term plan period with particular regard to the anticipated demands of the Seventh Five-Year Plan period; and the practical introduction of highly important research development results preceding the plan period. The plan should contribute to the improvement of research and development effectiveness, to an intensified emphasis on quality requirements, stronger selection, and better exploitation of reserves.

2. The plans must be worked out in coordination with national economic planning, with consideration for the OTTK (Long-Term Scientific Research Plan) and with regard for the possibilities in international scientific and technical cooperation.

3. In coordination with the further development of the entire planning system for research-development, the plan serves as the basis for working out the medium-term research-development plans of the interested ministries, organs with national sphere of authority, research places, and enterprises participating in the planning.

II. The Relations Between OKKFT and OTTKT

4. Research directions set in the OTTKT provide basic orientation for the development of the OKKFT research programs, but the OKKFT programs are not limited exclusively to the tasks defined by the main lines and program goals of the OTTKT.

5. In working out the medium-term plan, the research directions formulated, or to be formulated, in the OTTKT (to the extent that this is justified from the viewpoint of national emphasis, and the direction makes it possible) and the further research tasks requiring national emphasis in the given period must be planned with program detail.

6. The time requirement for fulfillment of the programs in the OKKFT is determined by the tasks themselves. The time perspective of the programs need not coincide unconditionally with the medium-term plan period.

III. Plant Content and Structure

7. The OKKFT is built in three sections.

a) Section I of the plan includes the most important scientific policy goals for the Sixth Five-Year Plan period. It determines the main tasks in the area of an increased social role for research-development, promotion for the attainment of the major economic political goals, modernization of the structure of the research network, the training and advanced training of specialists, the development of the material-money supply system, and the fostering of international scientific relations.

b) Section II includes the most important, national level research tasks of the plan period, the tasks directed at practical introduction of research-development results of outstanding importance, and international research-development cooperation serving the fulfillment of these tasks. These research-development tasks related to the direction of the country's economic and social goals must be fixed in the research programs.

c) Section III includes the main targets for resources that can be devoted to research-development activity, and the main ratios among the various types, goals and institution groups.

IV. Preparation of the Plan

8. The working out of the sections of the plans occurs by a basic taking into account of the economic-political component concepts being prepared in the framework of national economic planning for the Sixth Five-Year Plan under the titles "Technical Development Policy" and "The Main Trends in Scientific Research."

a) Section I of the plan is being prepared by the TPB Secretariat together with the interested organs.

b) The interested ministries and organs with a national sphere of authority will make proposals for the research programs to be included in Section II. In the case of direct economic research tasks from among the proposals made by the portfolios for emphasis, the OMFB (National Technical Development Committee) will select, after hearing the opinion of the ministry, the tasks recommended for acceptance in the plan; and in the case of social science tasks, the selection will be made by the TKB (Social Science Coordination Committee) and in the case of other tasks by the MTA (Hungarian Academy).

After the emphasis proposals are made, the responsible portfolios will work out the plan studies for the research-development programs, and then the program proposals. The OMFB, MTA and TKB will prepare rationally differentiated substantive and procedural guides for working out the emphasis proposals, the plan study, and the program plan proposals.

The OMFB, MTA and TKB will coordinate the working out of the section in rational work specialization.

c) Section III of the plan will be prepared by the central planning organs together with the interested bodies according to the substantive and procedural guidelines worked out for this purpose.

9. Guidance for working out the plan:

a) The working out of the OKKFT must be performed with the guidance, in principles, of the TPB, with its observation and control.

b) The plans must be prepared with the comprehensive responsibility of the OMFB and MTA, and with the responsible participation and cooperation of the portfolios.

c) In the preparation of the plan, the TPB Secretariat collaborates with coordination activity.

10. Work program and procedure for working out the plan:

a) The working out of the OKKFT must be performed according to a unified work program approved by the TPB. The TPB Secretariat will send the work program directly to the interested bodies.

b) In the course of planning, the central organs responsible for the preparation of the plan may regulate in further instructions problems requiring certain interportfolio regulation of planning — the extent necessary and in accordance with the interested bodies.

The ministries (organs with national sphere of authority) concern themselves with the the carrying out of the planning work and further regulation in their own sphere of authority.

11. The Science Policy Committee requests the ministries (organs with national sphere of authority) which are conducting research work to see that this resolution is published in their official publications.

Budapest, 16 June 1978

Gyorgy Aczel

6691
CSO : 2502

HUNGARY

BRIEFS

EQUIPMENT FOR OIL, GAS INDUSTRIES--The Research and Development Institute of the Mechanical Measuring Instrument Factory was officially opened at Angyalfold on 18 August 1978. The legal predecessor of the institute, the metering technology central research lab oratory, was attached to the Automation Works of the Mechanical Measuring Instrument Factory in 1975. The new establishment will design, test and produce small series equipment and devices for the oil and gas industry. It will conduct no basic research, and its ultimate output will be a finished product rather than technical documentation. The institute will employ 370 persons and consist of three main departments as well as several independent departments and groups. The institute is designed to meet the needs of the domestic and Soviet oil and gas industries, the tasks of the Ministry of Metallurgy and Machine Industry and the Ministry of Heavy Industry. The scientific-technical agreements concluded in 1977 between the two ministries and their counterparts in the USSR for the period through 1990 have confronted the specialists with serious tasks. [Budapest MAGYAR HIRLAP in Hungarian 19 Aug 78 p 7]

EXPLORATION FOR OIL--Specially equipped instrument cars are cruising the streets of Mako (west of Szeged) by night in efforts to locate oil deposits. Promising sites are marked for future drilling in the search for gas and oil. [Budapest MAGYAR HIRLAP in Hungarian 19 Aug 78 p 9]

EXPECTED 1978 COMPUTER SALES--By the end of 1978, VIDEOTON expects to be able to boast of the sale of 750 systems, 1,500 line printers and 6,000 displays. [Excerpt] [Budapest SZAMITASTECHNIKA in Hungarian Jul-Aug 78 p 2]

CSO: 2502

STRUCTURE AND MAJOR SPECIFICATIONS OF FELIX COMPUTERS

Bucharest CALCULATOARE ELECTRONICE [Electronic Computers] in Romanian 1978 pp 386-393

[Chapter 11 by Major General Dr Dinu Buznea and Lieutenant Colonel Eng Octavian Teodorescu from the book "Calculatoare Electronice" published by Editura Militara, Bucharest, 1978]

[Excerpt] This chapter will present the Felix family of computers manufactured and used in Romania, as well as the one-of-a-kind computers assembled and utilized in the socialist countries who have signed the Intergovernmental Convention for Collaboration in the Computing Domain, a convention in which Romania is a participant.

11.1 Felix Family Computers

In accordance with the National Program for Endowing the Economy with Computing Technology, adopted by the Central Committee of the RCP in 1967, Romanian began the mass production the Felix C-256 computer in 1970. A result of the cooperation with the French firm Compagnie Internationale pour l'Informatique (CII), the Felix C-256 computer represents the Romanian version of the Iris-50 computer produced by CII, and is similar in structure, software, and technology.

The National Program also provides for the development of research activities aimed at building and designing, using Romanian resources, a more extensive range of equipment and computing systems needed by the national economy.

One important success of our scientific research has been the production of a family of Felix computers now being mass produced at the Bucharest Enterprise for Computers.

11.1.1 Felix C-256 Computer

The Felix C-256 is the first modern, third generation computer being mass produced in Romania at the Bucharest Enterprise for Computers. Its technical and operational specifications place it in the category of intermediate capacity, universal computers with modular, flexible hardware and software structures, usable for management, technical and scientific calculations, real time applications, remote information processing, and so on; it can operate independently or in computer networks integrated into large data processing systems.

The computer's structure (figure 11.1) includes a central unit, an internal memory unit, and an input-output system with from one to four multiple connectors, simple and multiple lines, and active peripheral units.

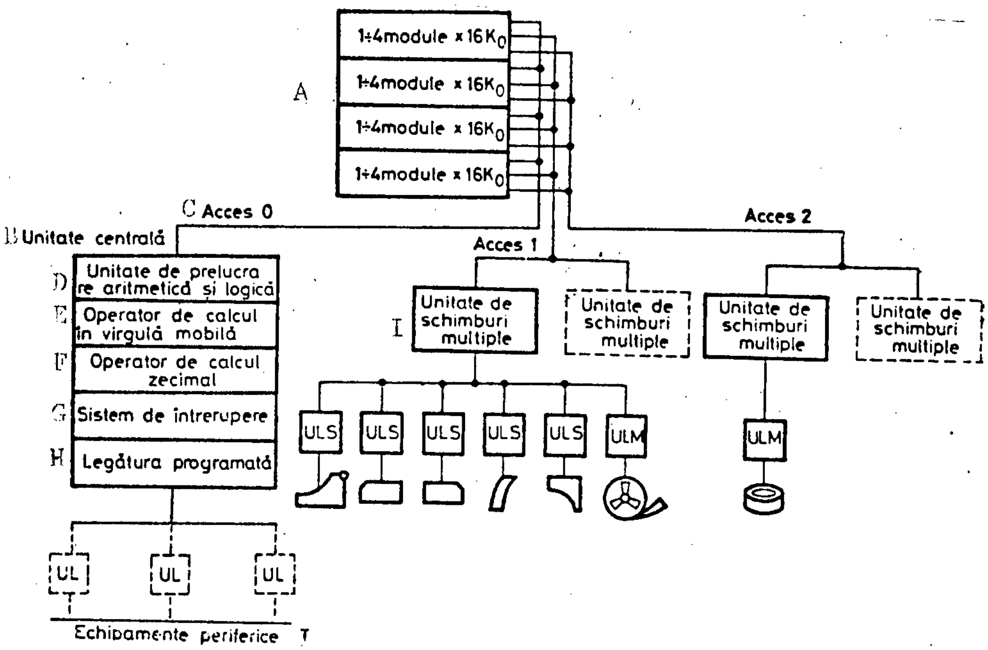

Figure 11.1 Structure diagram of the Felix C-256 computer.

Key:
- A. Modules
- B. Central unit
- C. Access
- D. Arithmetic and logic processor
- E. Decimal shift computing operator
- F. Decimal computing operator
- G. Interrupt system
- H. Programmed switch
- I. Multiple connector unit
- J. Peripheral equipment

The central unit controls the analysis and execution of instructions; it is connected both to the internal memory, from which it extracts the instructions and operands to be processed and into which it enters the results of calculations, and to the multiple connector units, to which it communicates the addresses of instructions to be given to the input-output system and from which it receives reports and requests for new instructions. Optionally, the central unit can also be provided with a shifting decimal computing operator and with a decimal computing operator. In the absence of these operators, the instructions for decimal or shifting decimal calculations are executed through appropriate programs.

The internal memory unit stores instructions, operands, and input-output programs, as well as operating system programs. The memory is composed of from one to four blocks, each block consisting of up to four modules of 16 Koctets each, and it can also be provided with a protection device. For any given configuration, a memory block has up to four modules, but the first block must be composed of at least two modules. The internal memory unit is provided with a transfer line to the central unit, and with one or two lines to the multiple connector unit or units. These are called main lines, and each memory block has its own separate access to each of them. The organization of the access enables the simultaneous execution of two or three transfers among the memory, central unit, and multiple connector units.

The structure and operation of the multiple connector unit used in the Felix C-256 computer has already been discussed in chapter 9.

The computer's memory is expanded with magnetic tape and disc units connected to the input-output system through multiple connector units.

The modular organization of the Felix C-256 computer assures that its major units or functional blocks remain independent, and thereby increases the utilization efficiency of the computer. For instance, while information is being transferred between the internal memory and an external memory unit, the central unit can perform calculations which also involve transfers with the internal memory. This is made possible by the fact that both the central unit and the multiple connector unit have independent access to the memory, and that the transfer is performed along different access channels. Simultaneous access is permitted in such cases, as long as different memory blocks are being addressed. If one memory block is addressed simultaneously by several units of the system, access is granted sequentially according to an order of priority established in the design of the system.

The internal memory is protected by zones (pages) by means of keys stored in a rapid memory devoted to this special purpose. This prevents unauthorized access to memory zones which do not belong to the program that seeks the access. This memory protection enables the simultaneous existence of several programs in the memory, and their execution in a multiprogramming mode. In order to process information in a multiprogramming mode, the Felix C-256 has a switching system that transfers the operation of the central unit from one program to another.

The SIRIS-2R[1] programming system makes it possible to use the computer rationally and to automate the operation of the entire system. This reduces to a minimum the interventions of human operators in the control and coordination of performed operations.

The computer is programmed in one of the following languages: COBOL, FORTRAN, LPG, MAGIRIS, ASSIRIS, FLOWCHART, and TTPL.

The SIRIS-2R system makes it possible to subdivide user programs into several parts that can be written independently by several programmers. When each of these sections is assembled or compiled, it is translated into machine language and placed into a binary translatable (BT) format. The program sections presented in this form are finally gathered into an object module in IMT (translatable memory-image) format, using a component of the operating system called the linkage editor.

Programs in IMT format can be loaded into the memory, thus becoming directly executable programs. The total utilization of the computer is under the control of the operating system.

Due to its technology and to the existence of well-developed basic programs, the Felix C-256 computer is highly reliable, on a par with similar computers of the same generation being manufactured throughout the world.

11.1.2 Felix C-32 Computer

The Felix C-32 is the first third generation computer entirely designed in Romania[2]. In structure and applications the Felix C-32 is a small capacity universal computer, compatible from top to bottom with other computers of the Felix family, insofar as programs written for this computer can be run both on the Felix C-256 and the Felix C-512.

The standard configuration of the Felix C-32 includes a central unit with fixed decimal computer operator, an internal memory with a capacity of 32 Koctets, an input-output system consisting of one multiple connection unit with four channel memories, simple and multiple lines, and the usual peripherals -- a typewriter console, a card reader, and a printer. The internal memory can be expanded with two magnetic disc units. Figure 11.2 shows the general structure of the Felix C-32 computer.

The central unit can perform 44 instructions which are also found in the sets of instructions of the other Felix computers. The groups of instructions of the Felix C-32 include: nine exchange instructions with the internal memory, 11 instructions for binary calculations and logic, four jump instructions, seven program instructions, two shift instructions, four character chain instructions, five standard input-output instructions, and two direct input-output instructions. The average duration of instruction execution is five microseconds, and the memory cycle is of 940 nanoseconds.

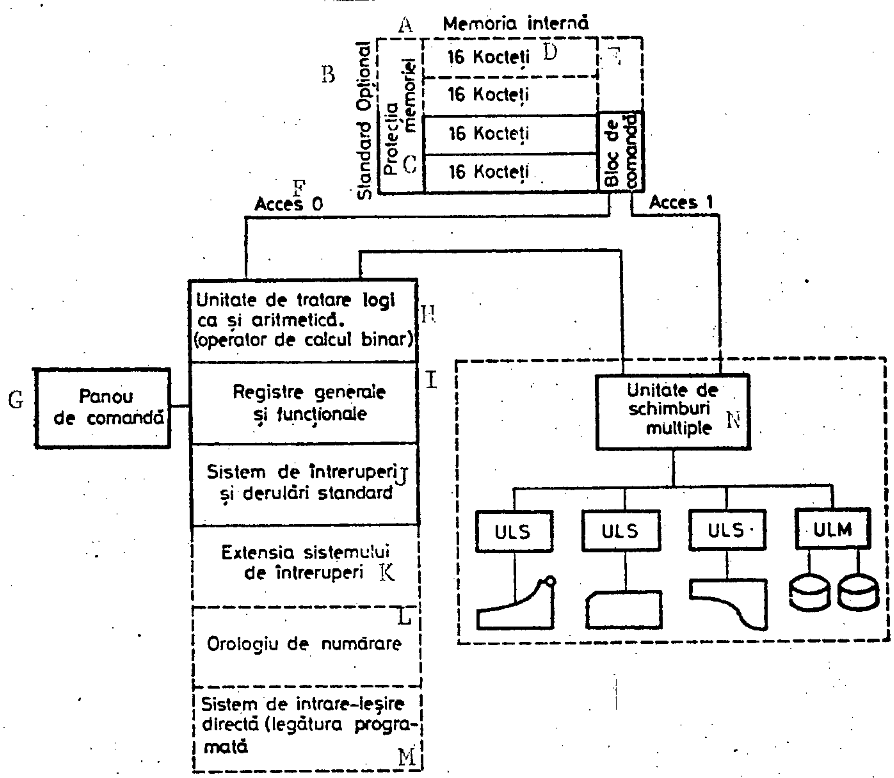

Figure 11.2 Structure diagram of the Felix C-32 computer.

Key:
- A. Internal memory
- B. Optional standard
- C. Memory protection
- D. Koctets
- E. Control block
- F. Access
- G. Control panel
- H. Logic and arithmetic treatment unit (binary calculation operator)
- I. General and functional registers
- J. Standard interrupt and run system
- K. Expanded interrupt system
- L. Counter clock
- M. Direct input-output system (programmed linkage)
- N. Multiple connection unit

The modular structure of the system allows a flexible organization of the computation system according to processing needs, and at the same time provides an efficient operational system.

The computer can be used autonomously or as a satellite to a larger computer, using a data transmission coupler which transfers information at a rate permitted by communication lines.

The operation and programming system together with the hardware structure allow a wide range of applications in manufacturing data systems, technical and scientific calculations, design, education, and so on. For management applications which require the processing of large files, or for other applications, the computer has been provided with the possibility of expanding the operational memory to 64 Koctects, and the internal memory with two magnetic tape units.

By attaching a special coupler, the Felix C-32 can also be used for process control, this model being called the Felix C-32 P[3].

The internal memory stores the permanent programs of the operation system, programs being executed, and data being processed. The memory unit includes the control block and protection circuits, and two or four memory modules with 16 Koctets each. The octet is the elementary unit of information which can be introduced, transferred, or extracted from the memory. Transfer into and from the memory requires two octets.

The operation system includes: a central monitor whose task is to treat ends of programs, to call and load segments, to start programs, conduct computer-operator dialogs, and so on; an input-output supervisor which treats interrupts and shifts, manages inputs and outputs, reactivates programs, and manages multiprogramming; a job control to automatically link operations and phases; and a file management system for file operations.

The system has a compiler for its own assembly language called LAF, as well as for the FORTRAN, COBOL, and BASIC programming languages. In addition, the system includes a program library with subprograms for matrix calculations, statistics, linear programming, enterprise management, and so on.

The Felix C-32 computer is structured for multiprogrammed operation. Security in this mode is achieved by dividing the internal memory into pages of 2048 octets and by protecting the memory with keys.

The technology of the Felix C-32 is common to all the Felix series, and the input-output interface is standard. The operation and programming system was created and is continually being developed for various configurations and specific applications by collectives of specialists at the Research Institute for Computer Technology (ICPTC) of Bucharest, and at branches of this institute in Cluj-Napoca and Timisoara.

11.1.3 Felix C-512 Computer

This computer represents the most recent achievement of our country's computer research and industry[4]. In structure and technology it is a third generation universal computer with intermediate-to-large capacity. Its structural and logic organization, as well as its programming system, make it completely compatible with the Felix C-256 and C-32 computers, which as we have shown, place it in the Felix family of computers.

The Felix C-512 is intended for a wide range of applications in various domains such as the economic management of enterprises, industrial centrals, and branches, process control of various technical processes, technical and scientific calculations, and so on.

As well as the others, this computer has a modular structure with parallel operation of the central unit and of the input-output system (figure 11.3).

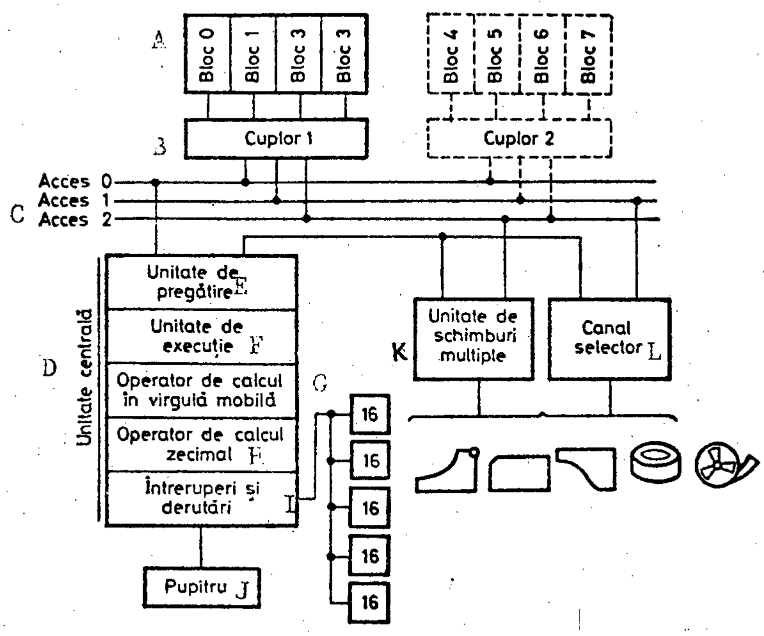

Figure 11.3 Structure diagram of the Felix C-512 computer.

Key:
- A. Block
- B. Coupler
- C. Access
- D. Central unit
- E. Preparation unit
- F. Execution unit
- G. Shifting decimal computer operator
- H. Decimal computer operator
- I. Interrupts and shifts
- J. Console
- K. Multiple connector unit
- L. Selector channel

The set of instructions includes 15 more instructions than the Felix C-256, namely 117. The average computation speed is 250,000 simple operations per second. This speed is obtained by means of two specialized units, the preparation unit and the execution unit; each of them simultaneously execute the phases of preparation and actual execution of instructions, being equipped with binary computation operators. The central unit is provided with a decimal computation operator and a shifting decimal computation operator for its calculations. The interrupt system is organized into 16 standard levels and five groups of 16 optional levels each.

The capacity of the memory is between 128 Koctets and 512 Koctects, and can be expanded to 1024 Koctets.

A memory module in the computer's system of organization has a capacity of 32 Koctets and is formed of two physical modules of 16 Koctets each. One memory block has four modules and hence 128 Koctets.

Memory data transfer is executed simultaneously along a four-octet word, with a memory cycle of 900 nanoseconds.

The memory is organized into four blocks for a capacity of 512 Koctets, or into eight blocks when the capacity is expanded to 1024 Koctets. The memory is protected with keys in pages of 2 Koctets each.

The maximum configuration of the input-output system can include up to eight multiple connector units and up to six selector channels. One multiple connector unit can connect 4-64 units. Information transfer between a multiple connector unit or a selector channel and the memory is executed with words of 32 binary digits.

The peripheral equipment in the standard configuration of the Felix C-512 is the same as that of the Felix C-256. Any other peripherals can be connected as long as a standard Felix interface is being used.

The Felix C-512 computer uses the same technology as the Felix C-256 and the Felix C-32.

The operation and programming system assures an optimum control and use of the computer's resources (memory, central unit, and input-output system) under single program, multiprogram, and real time conditions. Automatic file management offers the possibility for a rational and efficient utilization of the computer, and significant facilities for file access and handling.

The operation system includes the SIRIS-3R monitor, a file management system (SGF), a link editor, a system generator, a librarian, and programs for assembling or compiling programs written in ASSIRIS, FORTRAN, COBOL, LPG, and MAGIRIS languages.

The operation system also includes the SYMBIONT and TELESYMBIONT functions which make it possible to create files as a function of operations priority, thus following the entire path of execution of a job. Within the same job it also assures multiprogramming (multitasking), thus improving the conditions for the simultaneous utilization of the central unit and the input-output system. The operation system also includes utility programs such as programs for changing the information support, as well as standard library programs (mathematics, economics, and so on).

The Felix family of computers with which our national economy is endowed, meets the current and imediate future needs of our country with regard to the creation of automatic data processing systems.

The achievement of these means has fully demonstrated the ability of our specialists to rapidly assimilate an advanced technology, and at the same time guarantees the development of new means needed for the continued progress of our country.

FOOTNOTES

1. The SIRIS-2R system results from the adaptation of the SIRIS-2 operation system formulated by the French firm CII for the IRIS-50 computer; the adaptation and development was performed by specialists in ICPTC.

2. The Felix C-32 computer was designed at the Bucharest ICPTC by a led by Dr Emil Tudor. It is being mass produced at the Bucharest Enterprise for Computers (ICE).

3. The coupler and process control programs are being produced by specialists at the Institute for Automation Design (IPA).

4. The Felix C-512 computer was designed at ICPTC in Bucharest by a collective led by Dr Momeo Francisc. It is being mass produced at ICE in Bucharest.

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END