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IFAC NEWS

Reports on past IFAC events

MEETING OF THE EXECUTIVE COUNCIL, CRACOW, JUNE 1964

The Executive Council of IFAC met in Cracow, Poland, from 16 to 19 June, 1964.

The application for membership of the Technical Chamber of Greece was approved. This approval was confirmed since by the National Member Organizations of IFAC and, therefore, Greece is at present the 29th National Member of IFAC.

The Executive Council discussed and adopted the President's and the Treasurer's reports, the budget for 1964 and the reports from seven Technical Committees (on Bibliography, on Education, on Applications, on Components, on Publications, on Terminology, and on Theory) as well as the reports of the Advisory Committee and of the Honorary Editor.

Chairmen and Vice-Chairmen of all Committees as well as the Honorary Editor and the Honorary Secretary were re-appointed for 1965. In accordance with the Constitution, National Member Organizations were asked to approve the postponement of the next election of officers and new members of the Executive Council until the time of the 3rd IFAC Congress in London in June 1966.

It was decided that the 4th IFAC Congress would be held in Warsaw, Poland, in June 1969. The question of the date and location of the 5th IFAC Congress in 1972 has been deferred until the next meeting of the Executive Council which will take place in Tokyo, Japan, on August 23rd and 24th, 1965.

Details of the 3rd IFAC Congress and of various symposia have been worked out and are announced hereafter.

IFAC/ETAN SYMPOSIUM ON SENSITIVITY ANALYSIS DUBROVNIK, AUGUST/SEPTEMBER 1964

This symposium was held in Dubrovnik, Yugoslavia, from 31st August to 5th September 1964, under the auspices of ETAN (Yugoslav Committee for Electronics and Automation) and of the IFAC Technical Committee on Theory. It comprised 6 working sessions during which the following 37 papers were read and discussed:

Session 1 - GENERAL PROBLEMS

Chairmen: Prof. R. T o m o v i c , Yugoslavia
Dr. R. S r i d h a r , U.S.A.

- "Sensitivity analysis and invariant imbedding" by R. B e l l m a n , R. K a l a b a and R. S r i d h a r , The Rand Corp. and Purdue University, U.S.A.,
- "The application of the theory of games to the sensitivity problem" by P. D o r a t o and R. D r e n i c k , Polytechnic Institute of Brooklyn, U.S.A.,
- "The relation between dynamic programming method and sensitivity analysis" by H. G o r e c k i , Academy of Mining and Metallurgy, Cracow, Poland,
- "The role of sensitivity analysis in engineering problems" by R. T o m o v i c , University of Belgrade, Yugoslavia,
- "Determination of component parameter variation by impulse excitation. Inverse sensitivity" by H.R. W e e d , Ohio State University, U.S.A.

Session 2 - EXISTENCE AND CALCULATION OF SENSITIVITY FUNCTIONS

Chairmen: Mr. H.F. M e i s s i n g e r , U.S.A.
Prof. M.L. B y k h o v s k i i , USSR

- "Jump conditions for sensitivity coefficients" by W. de B a c k e r , EURATOM, Italy,
- "Computation of sensitivity functions in parameter optimization problems" by G.A. B e k e y and H.F. M e i s s i n g e r , University of South California and TRW Space Technology Laboratories, U.S.A.,
- "Sensitivity and dynamic accuracy of control systems" by M. L. B y k h o v s k i i , Institute of Electronic Engineering, Moscow, USSR,
- "Application of sensitivity analysis to hybrid computations" by W. K a r p l u s , University of California, U.S.A.,
- "Sensitivity as a structural property of control systems" by P. K o k o t o v i c , Institute of Automation and Telecommunications, Belgrade, Yugoslavia.

Session 3 - STABILITY AND SENSITIVITY

Chairmen: Prof. Ia.Z. T s y p k i n , USSR
Dr. I. G u m o w s k i , Poland

- "Sensitivity analysis and Liapunov stability" by I. G u m o w s k i , Laval University, Quebec, Canada, and Université de Toulouse, France,
- "The influence of some unmeasurable parameters on the properties of quantized sampled-data control systems" by K. K u r m a n , Technical University of Warsaw, Poland,

- "Méthode de détermination du domaine de stabilité d'un point double d'une recurrence non-linéaire" by G. M i r a , Laboratoire du Génie Electrique, Toulouse, France,
- "On the global stability of a class of non-linear time-varying systems" by N.N. P u r i , Drexel Institute of Technology, Philadelphia, U.S.A.,
- "Remarks on the Liapunov function of adaptive control systems" by R. T a r j a n , Hungarian Academy of Sciences, Budapest, Hungary,
- "Theory of stability and sensitivity of non-linear sampled-data control systems" by Ia.Z. T s y p k i n , Institute of Automation and Remote Control, Moscow, USSR,
- "Sur la dynamique des systèmes échantillonnés non-linéaires" by S. W e n g r z y n and P. V i d a l , Laboratoire du Génie Electrique, Toulouse, France.

Session 4 - SENSITIVITY AND FEEDBACK

Chairmen: Dr. I. H o r o w i t z , U.S.A.
Prof. M.V. M e e r o v , USSR

- "Comparison of sensitivity properties of linear feedback systems and of self-oscillating adaptive systems" by I. H o r o w i t z , Hughes Aircraft Company, U.S.A.,
- "Structural approach to the sensitivity problem" by M.V. M e e r o v , Institute of Automation and Remote Control, Moscow, USSR,
- "The sensitivity problem in time-varying systems" by W.R. P e r k i n s and J.B. C r u z , University of Illinois, U.S.A.,
- "Sensitivity considerations for sampled-data systems with "minimal" or "dead-beat" responses" by G. S c h m i d t , Institut für Regelungstechnik der Technischen Hochschule Darmstadt, Germany,
- "Sensitivity compensation and sensitivity synthesis" by H. U r , Scientific Department, Government of Israel.

Session 5 - SENSITIVITY OF OPTIMAL SYSTEMS

Chairmen: Prof. R. K u l i k o w s k i , Poland
Prof. R. D r e n i c k , U.S.A.

- "Sensitivity problem in optimum control" by A.G. B u t k o v s k i i , Institute of Automation and Remote Control, Moscow, USSR,
- "Sensitivity of optimal control systems to measurement error" by J.M.C. C l a r k , Imperial College of Science and Industry, London, United Kingdom,
- "Sensitivity study of an optimal stochastic control system" by R. D r e n i c k and R. R e i s s , Polytechnic Institute of Brooklyn and Grumman Aircraft Corporation, U.S.A.,

- "The performance of time-quasi-optimal control systems with regard to small time-constants" by A. G o s i e w s k i , Technical University of Warsaw, Poland,
- "Sensitivity of optimum control to variation of input signals, order of differential equation and point of application of the control signal" by R. K u l i k o w s k i , Polish Academy of Sciences, Warsaw, Poland,
- "Sensitivity of a quadratic performance index to parameter variations in closed and open-loop linear optimal control systems" by B. P a g u r e k , University of Toronto,Canada,
- "Application of sensitivity concept in the analysis of small perturbation effects on the deviation from optimal trajectory" by R. P e t r o v i c , Institute of Automation and Telecommunications, Belgrade, Yugoslavia.

Session 6 - SENSITIVITY ANALYSIS APPLIED TO ADAPTIVE SYSTEMS

Chairmen: Dr. J.J. R i s s a n e n , Sweden
Prof. S.V. E m e l i a n o v , USSR

- "Minimum-sensitivity adaptive systems" by S. B i n g u l a c, Boris Kidric Institute of Nuclear Sciences, Belgrade, Yugoslavia,
- "Orthogonal model sensitivity for process identification" by J. C e r m a k , Institute of Information Theory and Automation, Prague, Czechoslovakia,
- "Synthesis of special-type automatic control systems insensitive to plant parameter variations" by S.V. E m e l i a n o v and V.J. U t k i n , Institute of Automation and Remote Control, Moscow, USSR,
- "Sensitivity analysis and the design of adaptive post-cast control" by M. H a m z a , The Swiss Federal Institute of Technology, Zürich, Switzerland,
- "Use of sensitivity analysis in adaptive systems to determine the speed of adaptation in the presence of random noise" by K. J a n a c , Institute of Information Theory and Automation, Prague, Czechoslovakia,
- "A method of reducing identification time in adaptive control systems" by M.D. K h a d k i k a r , Institut für Elektrische Anlagen der Technischen Hochschule, Stuttgart, Germany,
- "Design of self-adjusting systems by use of a functional derivative technique" by J.J. R i s s a n e n , IBM Nordic Laboratories, Stockholm, Sweden,
- "Parameter sensitivity in a mathematical model of a batch process" by M.A. W e s l e y , Engineering Department, University of Cambridge, United Kingdom.

IFAC/IFIP CONFERENCE ON APPLICATIONS OF DIGITAL COMPUTERS TO PROCESS CONTROL, STOCKHOLM, SEPTEMBER 1964

by Prof. Dr. Ing. V. B r o i d a

This conference held in Stockholm, Sweden, from September 21st to September 23rd, 1964, was attended by more than 400 persons from 24 countries: Algeria, Austria, Belgium, Bulgaria, Czechoslovakia, Denmark, Finland, France, Germany, Hungary, Israel, Italy, Japan, Netherlands, Norway, Poland, Republic of South Africa, Spain, Sweden, Switzerland, United Kingdom, USA, USSR and Yugoslavia.

The Joint International IFAC/IFIP Program Committee was under the chairmanship of Mr. W.E. M i l l e r (USA) and the Swedish Organizing Committee under the chairmanship of professor A. R a s m u s o n .

Twenty-two papers, abstracts and discussions of which are given hereafter, were read and discussed.

A. Chemical and petroleum industry

(1) A REVIEW OF CLOSED-LOOP CONTROL OF A 85.000 BARREL-PER-DAY CRUDE UNIT
by D.J. F r a a d e , Manager of Project Control, Process Control Systems, The Bunker-Ramo Corporation, Houston, Texas, USA

This paper presents a review of a closed-loop control for a large crude unit in a petroleum refinery. It also develops the philosophy and new approaches resulting from a look back at a first computer in terms of determining the need and philosophies for the operating company's next venture into the field of an on-line digital process control computer system. The paper presents a critique of the user's ideas and thoughts resulting from his first experience in this area, with the hope of correcting the situation for his second and third computer projects.

The problems that existed on the crude unit and the corresponding resolved approach taken on the new computer installation were the following:

On the crude unit, the instrument alarm limits were arbitrarily established from design data. There were far too many of these limits arrived at empirically. When the computer operated on this data, the result was a large number of meaningless alarm messages printed out by the computer peripheral typewriter. There were so many of these that occurred so often, that operators quickly disregarded them entirely. In so doing, they very often disregarded really important messages, such as dry and flood conditions being approached in the tower. On the second computer installation there will be no initial restrictive alarm points. Alarm messages will be printed out only for really essential points where the operator must control them. For start-up conditions, these limits will be very broad in range.

On the crude unit computer installation it was found that not enough instrumentation was available. For example many operating temperatures were calculated by the computer from material balances, rather than having available temperature signals from installed thermocouples.

On the second computer installation the instrumentation design of the new units, together with a review of the instrumentation of the existing unit, has been very carefully studied and adequate instrumentation has been provided for. On the existing unit for the lube oil plant, older and less satisfactory electronic instrumentation has been completely removed and replaced by the newest acceptable electronic control systems.

On the crude unit, process stream analyzers were installed somewhat arbitrarily and in retrospect, without enough study of the process dynamics and lag times involved. On the crude unit, the computer was used to evaluate analyzer performance i.e. boiling point whose lag time created dynamics problems.

The new unit will start up with no analyzers installed. Instead, the computer will generate sufficient meaningful data for studies to determine specific services where analyzers may best be used.

On the earlier installation it was not felt necessary to order more memory in spite of the shortage being keenly felt. The lube oil plant machine will allow the easy modular addition of memory capacity as required.

The user, in spite of his comparatively small size and corresponding small staff, decided to perform his own maintenance of his first system. However, he operated with the supplier's maintenance contract for one year and during this time trained plant personnel in this area. After this time, he took over his own service and maintenance and has operated successfully ever since on the first computer. The people performing this work were inexperienced plant personnel and technicians.

The second installation will follow the same pattern. The computer maintenance man from the crude unit installation has taken training courses offered by the supplier and has closely followed the system through its final factory checkout. The user expects vendor support on any major maintenance problem that may arise.

(2) THE COORDINATED MULTI-COMPUTER SYSTEM FOR MONSANTO'S CHOCOLATE BAYOU PLANT
by V.A. L a u h e r , J.R. M i d d l e t o n and T.J. W i l l i a m s , Monsanto Company, St. Louis, Missouri, USA

This paper - presented by Mr. G.I. L u m l e y - concerns the Chocolate Bayou plant near Alvin, Texas, which is a large integrated petrochemical plant. Put on stream in late 1962. the plant is designed to convert a light crude oil feedstock into ethylene, propylene, naphtalene, phenol, benzene and a wide variety of other petrochemicals. It has an annual capacity of

500.000.000 pounds of ethylene, 85.000.000 pounds of naphtalene, 55.000.000 gallons of benzene, 75.000.000 pounds of phenol and corresponding amounts of the other products.

Design and operation of this plant has benefited greatly from the use of a unified approach to the design and utilization of an over-all plant data and control system. It became apparent during the early design stages of the project that its complexity, the long data transmission distances involved, the unusually large number of control loops and the need for rapid and coordinated control required the development of advanced control techniques. The engineering solution to this control problem was to consolidate the plant data handling and analysis task into four coordinated process control-type computers. With the data problem handled by the computers, plant control was then delegated to a new type of electronic instrumentation which emphasised the deviation of plant conditions from normal. This instrument, the VSI or Vertical-Scale-Variable-Deviation Indicator, was developed for this project by Honeywell Incorporated. This method allows plant operators to quickly determine and correct areas of control difficulty. At the same time the use of plug-in connections further decreased the number of trend recorders necessary beyond those already rendered unnecessary by the computer data system.

The Chocolate Bayou computer installation has proved to be an extremely capable, reliable and flexible data gathering and analysis system. Integration of the computers into a coordinated complex by means of the intercomputer talk program and the use of computer No. 1 as a relay have been very successful. By means of this, the operators now feel as if all parts of the plant are directly at their fingertips and that each has complete control of the complete installation.

The computers have shown themselves fully capable of closed-loop control as well as data handling. This will be considered in the future after suitable systems studies if economic justification can be developed.

(3) OPERATING EXPERIENCE WITH DDC (DIRECT DIGITAL CONTROL)
by A. T h o m p s o n , Imperial Chemical Industries, Limited, United Kingdom

The need to bring down the cost of computer systems used for optimising the performance of chemical plants led to suggestions that the computer should replace the conventional control instrumentation. The paper describes what happened when the idea was tried out on a scale big enough to yield significant results.

(4) COMPUTER CONTROL OF THE OXO-SYNTHESIS PROCESS
by H. H a r d e r s , G. H e l l e r , P.R. L a u r e r, Badische Anilin- und Soda-Fabrik, Ludwigshafen/Rhein, Germany

In 1959, BASF management decided to try out an electronic computer for controlling a chemical process. The process which was selected for study was the oxo-synthesis. In this process, propylene, carbon monoxide and hydrogen are caused by a cobalt catalyst to react to butyraldehydes and butanols and a complex mixture of by-products, the so-called residue. The reaction takes place in fluid form in three high-pressure reactors of different sizes connected in parallel. Beginning with the inputs and outputs of the oxo-synthesis, a mathematical model of the process is elaborated based on statistical evaluation of the test runs. Further a description is given of the optimization performed and the main computer programs. As a special problem the DDC (direct-digital-control) of the reactor temperature is explained in more detail. Finally, economic aspects are stated concerning the additional gain with computer control.

(5) BASIC PHILOSOPHY OF COMPUTER CONTROL IN THE PROCESSING INDUSTRY
by J.J. d e J o n g , Bataafse Internationale Petroleum Maatschappij, Den Haag, Netherlands

Much has been reported in recent years about control of industrial processes by means of the computer. Starting with descriptions of how such a computer was built and connected to the plant, the reports emphasized mainly the hardware side and the time necessary for developing the various projects. Little emphasis was laid on the economics of the subject and still less can be found about how the various sorts of applications fit into the relationship between the human operator, the process and the control equipment in its widest sense.

The paper takes a philosophical look at this picture and extracts from it a few ideas which might be useful for finding the way in the jungle of the various techniques so far found feasible. It discovers at the same time that there exists a "terra incognita" which up till now has hardly been the subject of investigations but which may in the not too distant future become more important.

Good results can most certainly be obtained from the computer in replacing the human operator in the activities in which he is weakest (control of plant under normal operating conditions, error detection and diagnozing difficulties, reporting).

More studies have to be carried out in the field of switching the operating conditions of plants. More data are required to judge the economics of computer control particularly in the field of plant behaviour and drifts from once established optimum conditions.

The above 5 papers on Chemical and Petroleum Industry led to the following

DISCUSSIONS AND STATEMENTS

Mr. F r a a d e estimated that 35 to 50 % of the cost of adding computers to an existing plant are represented by the new instrumentation necessary. Of course, no extra instrumentation is necessary in an entirely new plant. Mr. F r a a d e also mentioned, in reply to a question of Prof. Dr. Ing. V. B r o i d a , France, a new sweeping patent in the field of computer control. This is the U.S. Patent No. 3.009.864 filed on 18th September 1958 by Mr. Ralph Webb, Process Group, Union Carbide Engineering Department; it has been granted on 21st November 1961. The patent specification refers to what is defined as "reflective control" consisting, in fact, in a discontinuous control system which does not effect any new measurement on the control plant as long as the result of the control action corresponding to the previous measurement has not been reflected by this controlled plant. This seems to be a particular sampled-data system which would not take the next sample until the result of the previous sampling and of the corresponding control action has been reflected by the control plant. Of course, this very general principle (the novelty of which, although the patent has been granted, seems to be still questioned by some manufacturers and by some users) is likely to cover most of the applications of digital computers to process control.

The statements of Mr. L u m l e y on account of the Chocolate Bayou plant seem to indicate that out of about a thousand circuits, only five are presently under closed-loop control. This state of things is explained by the fact that many process models are not yet completed and that open-loop optimization still takes much time. The advantages claimed for the computer control are the reduced dimensions of instruments, savings in clerical labour and savings in other equipments and materials.

According to Mr. L u m l e y , the reliability of the computers themselves was of 99.7 % during the three first months of operation; the project provided for a 99.5 % reliability only. The reliability of the whole system was certainly lower as trouble was experienced with peripheral equipment. Maintenance costs were also relatively high, particularly in what chromatographs were concerned.

Mr. F r a a d e stressed the interest of ordering well beforehand analysis equipment, such as chromatographs, so as to complete the knowledge of their proper use before the computers are commissioned.

Considering the D.D.C. (direct digital control) Mr. T h o m p s o n estimated that the best algorithm for this kind of control was the proportional-plus-integral-plus-derivative action, just as for continuous controllers.

When discussing the paper (4), Mr. M. James of the International General Electric Co., United Kingdom, wondered whether D.D.C. could not be used for direct optimization instead of proportional-plus-integral-plus-derivative control. He was answered by Mr. Heller, that this was still a very incompletely investigated field.

Answering a criticism of D.D.C. on the grounds of lack of reliability, Mr. Thompson estimated that there was no reason to duplicate for reliability reasons the number of transducers and of valves. He stated that, in case of computer failure and of a risk of leakages, in the meantime, in pneumatic servo-motors, there always existed the possibility of switching over to manual control.

Another criticism of D.D.C. concerned the difficulty for an operator to read out digital indications given one after the other. This was answered by Mr. Thompson by the statement that, with analog recordings too, the operator had anyhow to read these recordings one after the other.

Dr. P. van der Grinten of Staatsmijnen in Limburg, Netherlands, raised the problem of relationship between response time, accuracy and sampling rate in D.D.C. This was answered by Mr. Thompson by stating that D.D.C. was not convenient for small bandwidths, associated with high accuracy, which would necessitate excessive sampling rates.

In the discussion of paper (4), Mr. Heller stated that D.D.C. was mostly convenient for problems where a process model would be too complicated. He agreed with Mr. Thompson that D.D.C. was not a major difficulty for operators accustomed to analog, pneumatic or electronic equipment.

Mr. F.R. Himsworth of Imperial Chemical Industries, United Kingdom, stated that the worse which could be done was closed-loop control. He, therefore, wondered whether it was appropriate to use a computer for closed-loop control and estimated that a satisfactory solution in this case could be the combination of feedforward and of feedback.

B. Iron and steel industry

(6) COMPUTER CONTROL OF AN OXYGEN STEELMAKING PROCESS

by J. Auricoste, General Manager of CAE, and P. Westercamp, Manager, Steel Industries Applications, CAE, France

It seems that in recent years the oxygen steelmaking process and industrial computers have developed somewhat in parallel and the first question that could be asked about this application of computers is: what can the use of a computer bring to oxygen steelmaking? Though it might be difficult to pin-point the one predominant reason, several can be stated each of which having its importance:

- to ensure that product specifications are met
- to achieve maximum production rate
- to keep a more regular cycle of conversion by reacting always in the same manner to a given disturbance.

The paper attempts more specifically to study what could be the advantages that the steel manufacturer could expect from the installation of a computer in his plant:

- an increase of the production rate by lowering the average tap to tap time: that is to say a shorter operating time should be necessary for corrective action such as cooling or reblow if the right temperature is obtained at turndown or for ladle additions if the right composition and especially the end-point carbon is reached. In other words, this is a search for optimal operation and less safety margin taken need be by the operator,
- increase of the iron yield by a better knowledge of operations,
- improvement of quality control by proper proportioning of charge materials and proper oxygen blowing practice allowing the production of a steel of a more regular quality,
- reduced consumption of raw materials by a better control of the additions,
- provide the operator with all the information he might need at a certain time, especially during blowing; scan oxygen flow rate and lance height periodically and trend log values for those variables; then, after a certain time of operation, operate a direct control of the process by action on the lance height,
- receive information on pouring from the teeming platform for production calculations and heat logging,
- provide records on each heat for production and accounting purposes, including all information that can be gathered in the plant, whether they represent actual process variables or not.

(7) THE APPLICATION OF AUTOMATIC GAUGE CONTROL AND COMPUTER CONTROL TO AN EXISTING HOT STRIP MILL

by H.D. Morgan, Chief Electrical Engineer, Steel Company of Wales, Port Talbot, Glamorgan, United Kingdom, and R.W. Kirkland, Supervising Engineer, General Electric Company, Schenectady, New York, USA

The area surrounding the Abbey Works of the Steel Company of Wales at Port Talbot has been first an iron and more recently a steelmaking center since the Monks of Margam Abbey mined and smelted iron ore from the year 1253.

The present modernization program which is the subject of the paper is in keeping with the long tradition of adopting improved modern steelmaking methods and facilities whenever they become available.

A universal slabbing mill rolls slabs from 27" to 74" wide, and from 5" to 8 3/4" thick. After automatic scarfing, the slabs are sheared to length, weighed, identified and, most of them, transferred to the outer slab yard. After cooling they are passed back into the middle covered yard, inspected, hand dressed if necessary and stored in the inner covered yard for scheduling on the hot mill.

A proportion of the slabs, for tinplate and general purpose bars, are sent direct to the 80" hot strip mill and some are loaded directly into the reheating furnaces. Each of the 3 slab yards can conveniently hold 25.000 to 30.000 tons of slab. There are five 5-zone gas/oil fired slab furnaces designed to handle up to 145 tons each.

Rimming, balanced, stabilized, silicon and special purpose steel strip is produced, the bulk of the product later being cold-rolled for the motor-car trade, producer goods, industry and tinplate.

The hot-strip mill which was commissioned in 1951 was at that time the technical equal of any comparable facility; today, with the introduction of new technology, it is no longer competitive with the newest mills in Europe or the USA in respect of the consistency of the product.

After a study and an assessment of the economic operation it was decided to improve the operation of the hot strip mill by the installation of modern technical improvements, particularly by adding an additional powerful free-standing edger, automatic gauge and computer control, thus making the mill competitive once more. It is estimated that the addition of the computer control will increase the throughput by no less than 2.000 tons per week.

More accurate and consistent width from the hot mill, reducing side trimming at the pickling stage, will significantly increase the yield of tinplate. The estimated increase in revenue resulting from all these changes will amount to 1350000 pounds sterling per annum and the capital cost will be recovered in approximately two years.

While it is true that the modernization of the 80" hot strip mill will make possible some reduction in the number of mill operators, there will be an increase of maintenance personnel. However, the expected increase in the mill throughput will result in some reduction in the labour content per ton of steel.

For the successful operation of this modernized mill, the full cooperation of the operators and the Trade Unions is essential. To ensure a smooth and rapid transition to the new automated system, plant training in many different forms is planned.

When the change-over is completed and the new control system is in operation, it is expected the mill will once again be competitive with the most modern in the world.

(8) EXPERIENCES WITH AN ON-LINE PROCESS CONTROL COMPUTER IN A STEEL WORKS

by R.H. B a u l k , R.J. J a k e w a y s and K.C. P a d l e y , Samuel Fox & Company Limited, Sheffield, United Kingdom

An account is given of some of the experiences gained in the application of an electronic digital computer to the problem of cutting steel billets to specified lengths with minimum wastage. The paper continues with discussions of both engineering and programming aspects of process computing and demonstrates the economic viability of this application. The concluding section indicated the probable lines along which computer control of the rolling mill will be extended. Where the cutting of steel billets is concerned, delivery of all the equipment was made in August 1960 and operation on-line commenced in January 1961. The delay between delivery and on-line commissioning was due to various factors connected with other mill developments but it was used to considerable advantage. The system has thus been in operation, on-line, for over three and a half years. The paper has been written entirely from a user point of view and is mainly directed to other potential users who may be contemplating the application of a computer on one of their own processes.

(9) USING COMPUTERS FOR MANAGEMENT AND PROCESS CONTROL, A SURVEY

by Prof. Dr. A.Ya. L e r n e r , Moscow, USSR

It would not be evidently a great mistake to say that in the field discussed we are nearing the end of the facts-finding period which will enable us to make certain evaluations, outline the potential and find urgent problems of development. We must bear in mind that the application of digital computers to process control is, first of all, an applications problem. The introduction of computers should have a quantitative technical and economic effect. A clear definition of this at the start of the work should be least of all based on indefinite ideas of the latest fashion, on the fact that the application of computers has a known effect or on passing requirements for personnel training.

The field of application of digital computers is very large but this is exactly the reason why we need to learn to answer where, when and under what conditions they should be introduced, so that each recommendation is based on sufficiently strict quantitative indices. This range of questions is closely associated with a solution of problems stated in the previous part. A priority of theory progress with respect to industrial applications of computers is a necessity but their introduction should in no way be hindered. The only solution to this is to develop to the maximum the whole range of theoretical research. A reasonable proportion of "tactical" and "strategic" research should be ensured.

Recently more interest has been displayed in strategic investigations but the pressure of time makes us somewhat impatient. This is why the author believes that it is important to separate and to speed up research on tactical problems which are possible and can be solved by methods already available to engineers. These are, with the already stated constraints, the problems of control of separate units, of retrieval and processing of primary data which is to characterise, on-line, the operation of production stages workshops and factories. Especially urgent seems to be the problem of reliability and, particularly, that of the reliability of external large-storage memories. These problems are mentioned just in order to emphasise their importance as well as the fact that the technological basis of optimal, adaptive and self-organizing systems depends on their solution. The fact of representing in such systems reservation or regeneration functions does not reduce the importance of reliability problems whilst the memory capacity remains a critical variable of a system. As far as synthesis of optimal control structures is concerned, it should be noted that the high cost of digital computer systems emphasises the development of regular methods for this synthesis. All these and many other problems are actively investigated in the research institutions of the USSR and of other countries.

International cooperation for their solution seems very rewarding and the author believes that this Conference is the first step in this direction. He does not doubt that in the nearest future digital computers for process control will be most widely applied in commissioned plants and become an integral part of technological and management process control systems.

C. Public utility

(10) ELECTRIC POWER STATION START-UP AND CONTROL

by M.W. J e r v i s , Nuclear Plant Design Branch, and P.R. M a d d o c k , Southern Project Group, C.E.G.B. (Central Electricity Generating Board), United Kingdom

Within the power generation industry in the United Kingdom, there are 11 computers installed or on order for power stations. These figures exclude those used on the transmission side of the industry. The paper emphasises the differing approaches and requirements between the thermal and nuclear power stations. It describes the computer system to be installed at Fawley as well as the installation proposed for Wylfa nuclear power station.

The basic difference between the C.E.G.B. and other process industries using computers for on-line operations lies in the control of the output product. The computers ordered by the C.E.G.B. for control purposes are for the start-up and shut-down while the plant is held steady at the desired load by conventional analogue control loops.

A Ferranti Argus 200 is installed at West Thurrock on the coal-fired No. 2 unit (200 megawatts). The computer is being commissioned at present but the program is still under consideration. It is hoped to use the computer to control the start-up of sections of the plant in October 1964. This installation is unsatisfactory in a number of ways, the prime cause being the superposition of a computer on a plant which had already been designed. For example some signals are taken from indicating lights on the desk and some from photo-electric digitisers on recorders.

The computers have recently been ordered for the oil-fired power station at Fawley which is under construction. One English Electric Leo KDF 7 computer will be fitted to each of four 500 megawatt boiler-turbine units. Inputs to the computer will generally be independant of the conventional instrumentation and of a higher accuracy where they are used for performance calculations.

Compared with conventional fuel power stations, nuclear stations have a high capital cost but a low running cost. There is thus a strong incentive to keep nuclear stations running on base load and to arrange that shut-down of the stations occur as infrequently as possible. Since all the plant will be running for long periods there is little economic justification to install fast start-up of either the steam-raising plant or the turbines. However, there is a case for automatic start-up to reduce the probability of damage.

Some closed-loop systems are employed in nuclear stations and in particular the temperatures of various parts of the core are controlled by temperature servo-loops. The present technique uses analogue servo-systems, the performance of which has been found adequate and so far no attempt has been made to employ digital control. The reactor is different from some other industrial plants in that optimisation is effected in the design stage and there are few operating variables to optimise. Some optimisation is available by moving the absorber which is performed on a time-scale of weeks. The control problem is relatively straightforward, an important factor being that nuclear fuel does not vary in quality.

However, one characteristic of nuclear power stations is the large amount of data which has to be gathered from the reactors and processed into a form which can be used by the operators to control the station. Nuclear reactors have the additional hazard of potential emission of radioactivity under fault conditions and so great stress is laid upon safe operation. In the initial designs of the first stations in the United Kingdom nuclear power programme, conventional chart recorders were used for temperature logging, but since they have been supplemented by automatic data loggers and these have been installed in all stations. From Oldbury onwards, control of the plant is centralised in the main control room area and so this leads naturally to a central computer installation.

Wylfa is the latest of the stations and has the most comprehensive system and so the discussions of the paper refer mainly to equipment at this station. However, where relevant, reference is also made to earlier stations.

(11) OPERATION OPTIMIZATION IN AN ELECTRIC POWER SYSTEM
by J. C a r p e n t i e r , Electricité de France

The operation optimization in an electric power system is an example of mutual assistance between theoretical studies connected with Operations Research and electrical engineering and practical realizations involving digital computation and automation.

Accordingly, the paper is divided into two parts, one dealing with the theoretical aspects of the methods of optimization, the other discussing the computation equipment. In the first part, the theories themselves are not generally described but the characteristics of the methods are stressed from the viewpoint of practical computations and of applications to automation.

As the subject is very large, the paper does not attempt to establish its complete survey but emphasises:

- the main methods used or designed and the reasons why Electricité de France has chosen some particular methods and, consequently, some particular structures of the system
- the characteristics of the last method being developed by Electricité de France.

The Electricité de France network has about 350 high-voltage nodes and the number of hydroelectric power stations is over 600, which corresponds to a very large power system.

For the despatching problem, the network is divided into 8 areas, 4 of which are essentially thermal and 4 essentially hydraulic. Each area is operated in details by a local despatching center and, over these 8 centers, a national despatching office takes the main operation decisions for the whole power system.

There will be one computer in the national despatching office, one in every local despatching center, all the local computers will be linked with the national despatching computer and the latter will be linked with a large laboratory computer. The national despatching computer will ensure the production optimization itself, whereas the local despatching computer will scan the network, gather and process data.

The national despatching computer is at present working on a load flow program and will very soon carry out a first step of the Economic Despatching. A local despatching computer will be installed in Paris at the end of 1964; the installation of the other local despatching computers will follow later.

Where the local despatching computers are concerned, their specific functions consisting in scanning the network and in gathering and processing data, they will be continuously connected to the network and will perform the following operations;

- reception of the values of active powers, reactive powers and voltage magnitudes in the network, a message being received every 12th millisecond and sent into the corresponding storage location,
- every 10th second, computation of the sums of powers produced, of powers exchanged and of leads,
- every 20th second, scanning of voltage magnitudes in order to ascertain that they remain within the foreseen range,
- every 10th minute, computation of the mean values of powers measured over the last ten minutes, their gathering so as to represent the productions of nodes and their punching in order to be used for preparing forecasts for economic despatching computations,
- "asynchronous" operations, such as everyday statistics and preparation of forecast loads for economic despatching computations,
- in hydraulic despatching centers only, "valley optimization" i.e. local daily optimization of the income corresponding to the water used in the different "valleys" (calling "valley" a set of reservoirs on the same river),
- in the eventuality of control from the national despatching computer, transmission to the latter of differences between actual and provisional loads and transmission to the plants of orders received from the national despatching computer.

The national despatching computer will have the function of taking the main operation decisions for the whole power system and will, therefore, perform the following operations:

- using the load forecasts transmitted by the local computers, production scheduling for the next day after having received these forecasts. This is the first step of the Economic Despatching which will be carried into effect in a close future. Daily operation optimization is visualized in a future stage; it will take into account start-up costs for thermal units and optimization of hydroelectric power plants,
- forecast loads of the production schedule being always different from the actual loads next day, preparation of an operation policy for this next day i.e. of the necessary indications to the despatcher on what he will have to do when these differences will occur,
- eventually, control of the network by the national despatching computer (which would be, in this eventuality, continuously connected to the network and act in a kind of asynchronous way, some other devices - including eventually

the local despatching computers - detecting the differences between the actual loads and the forecasts, so as to let the computer operate only when necessary).

The large laboratory computer will be mainly used for yearly optimization computations covering the overall mixed hydro-thermal system (i.e. the minimization of the mathematical expectation of fuel expenses over a year), leaving the weekly and daily optimization to the despatching centers.

Many points in this project are still uncertain and the above statements are only the present view of the question, some changes being likely to still occur. Amongst the theoretical points which are not yet completely solved, the author quotes the daily production optimization with a large number of hydro-electric plants and the operation policy for the next day after having received load forecasts from the local computers.

(12) COMPUTER CONTROL OF A POWER PLANT PRODUCING BOTH ELECTRICITY AND HEAT
by Dipl.-Ing. H. K r u s e and Prof. R. Q u a c k , Stuttgart, Germany

In the thermal power plant "Pfaffenwald" of the Technical University of Stuttgart, a digital computer controls the economic efficiency of a combined back-pressure-condensation steam turbine. An optimizing program is needed to precalculate optimal loading times for the heat accumulators in order to produce as much back-pressure power as possible at the most profitable hours and in order to ensure that the heat accumulators are sufficiently loaded in the evening and before the week-end to supply the necessary heat during the night and the week-end when the boilers are shut down. With this optimising program, the digital computer has to control the power exchange with the utility grid and the amount of self-produced condensation power in on-line, closed-loop operation.

The computer program is divided into a prediction program for the necessary heat and power production and an optimisation program for loading the heat accumulators.

There are two different criteria for the optimisation calculation:

- a surplus of back-pressure heat will cause the production of condensation power or the purchase of power from the utility grid,
- a deficit of back-pressure heat will lead to a production of surplus power during the peak hours and, if this is not sufficient, to a prolongation of the turbine running time.

According to the calculated values of the power and heat production, it will be estimated which plant conditions will occur at a definite hour of the prediction period. From the expected conditions the computer will decide if a variation of the set-point of the load-exchange controller in the direction of power purchase or of power supply will be more profitable for the predicted hour.

The set-point variation of the power-exchange controller will be performed by the process control computer itself. The digital-to-analog converter of the computer produces an analog output signal corresponding to the binary calculated set-point value. The converted signal will be directly switched to the set-point director of the load-exchange controller.

If the computer lapses into malfunction through some component failure, for instance, the set-point of this controller may be wrong. This, however, will not cause a dangerous situation, as the conventional turbine control system will remain in operation and take over the turbine control in emergency conditions. The set-point of this controller can be monitored by special alarm devices so that the attention of the personnel is not required if there are unexpected variations of this set-point.

The automatic control of a combined back-pressure-condensation steam turbine utilizing a single address, fixed-point, process control computer with internal stored program is described in the paper. It is pointed out how a small general-purpose control computer cannot only be used for data logging and alarm monitoring but can also operate in close-loop for supervising and optimizing the plant efficiency, especially in thermal power plants producing both electricity and heat.

(13) THE USE OF DIGITAL COMPUTERS IN FRENCH THERMAL AND NUCLEAR POWER STATIONS
by P. J o n o n , Head of the Special Tests Laboratory, Electricité de France

The present E.D.F. realizations are too recent to give material proof of advantages offered by computers in operating plants.

However, despite a justifiable carefulness in this field, the number and diversity of studies started caused a maximum delay of 3 to 4 years before conclusions appear on the technical and economical interest of the various functions dealt with by the computers.

If these conclusions are for the best, utilisation of computers in all the new conventional and nuclear plants will become systematic and will, probably, be introduced in certain stations presently in use.

During this experimental period, the technological and technical problems which still remain should be solved such as:- improvement of the reliability and accuracy of existing pick-ups, creation of certain special measuring devices, particularly for coal-fired plants (measurement of volatile matter content and heat value of coal, of unburnt coal content in ashes) etc. As far as the computers themselves are concerned, it must be considered that their intrinsic reliability will become such that their duplication by other computers or devices will no longer be necessary. Finally, at the end of this experimental period, the frontier will be clearly defined between computers and conventional operating equipment: analog control systems used in continuous control, wired switching circuits used for sequencing control.

These technical considerations should not conceal the human and organization aspects of the problem.

The use of computers for operating a thermal plant is preceded by a large-scale study carried out by a group of engineers, including representatives from the user's design and operation departments and from the different companies manufacturing the main production equipment, computers and controllers.

It is shown from experience that the difficulties encountered in promoting the work of such a group are widely compensated by the quality of the design and the knowledge which each participating company draws from it.

In terms of operation the use of computers will entail, in the next years, a small change in plant manpower; the re-employment problem for the workers will thus be progressive and will finally be less critical than the one raised by the modernization of thermal plants after 1955. On the other hand the use of computers requires complementary knowledge from employees to be used in programming and repairs. Operators, freed from manual and repetitive tasks, may better supervise the installation and participate in the establishment of the best operating rules; statisticians freed from tiresome averaging calculations can spend more time on periodical tests of the equipment. In both instances, the computer takes over the least interesting part of the work.

The ultimate development stage of application of digital computers to the production and distribution of electric power will, sooner or later, consist in the achievement of completely automatic thermal stations controlled from a despatching center the computers of which will both receive information from and send information to the computers of each power station.

(14) INTEGRATED ELECTRICITY SYSTEM OPERATION
by Prof. R. Q u a c k , Stuttgart, Germany

If the on-line closed-loop application of the digital process computer is the final target of the conference, the author feels that from his report on the West-German experiences in this field, the date of this conference is somewhat too early.

There exists a great interest of all West-German companies devoted to the news in this field which come from the U.S.A. and from other countries. There are some special process computers which are developed by West-German manufacturers for application in this field. There also exist some computers which are already used on-line or off-line, for special purposes, during more or less long periods and there also exist the first successful experiences with digital, one-purpose, networks for automatic start-up and shut-down of power plant equipment but the on-line, closed-loop, digital process computer is up to now an unachieved wish dream, the fulfilment of which can happen, however, in the near future.

This is why the paper should be considered as a snapshot of a fast-running development, giving only a rough survey of the momentary situation.

(15) ON-LINE DIGITAL COMPUTERS IN POWER STATIONS IN ITALY
by Prof. G. Q u a z z a , Automatica e Elettronica, Direzione Studi e Ricerche, E.N.E.L., Roma, Italy

The trend towards the use of on-line digital computers in power stations, although the first installations are quite recent, is well-established and general to day in Italy.

Computers have been installed or are to be installed within a short time in seven power stations.

The decision to proceed with the use of computers has been justified by several considerations, the most relevant amongst which is the search for better safety of the thermal or nuclear unit.

It is well known, indeed, that in Italy, until no more than ten years ago, electric power was generated almost exclusively by hydro-stations, whilst today the percentage of electric power generated by thermal and nuclear stations is as high as nearly 40 %.

This very recent and considerable growth in thermal generation has taken place just when the progress in turbine-generator construction was yielding units of larger and larger sizes. Two 320 megawatt units are now in operation in La Spezia power station and two 600 megawatt units will be shortly started-up.

It is evident that the plant designer confronted with the responsibility of ensuring the operation of units as large as the above, in view of the serious consequences of a fault for the possible damage to the unit and, especially, the power system transient upset it may cause, is anxious to take advantage of any available technical means to improve the safety of operation. The digital computer with its capability of detailed, alert, continuous monitoring and, moreover, very quick diagnosis of complex emergencies, consequent decisions and automatic corrective actions, appears to be the ideal instrument for achieving the desired safety.

At present, none of the computers installed or to be installed this year in Italy is yet expected to effect systematic corrective actions, whilst the safety improvement is limited to the supervision phase. However, a study is underway for computer automation for a large unit to be installed in 1966, including many automatic corrective actions.

If computer-controlled corrective actions are accepted - that is, computer automation is accepted during an emergency, wholly relying on computer system reliability - it is then quite reasonable to also accept automation in normal start-up and shut-down operations. This is another step towards increased safety, because manual errors are avoided, consistent use of

the same procedures becomes possible, without ever exceeding permissible temperature differentials or temperature gradients and procedures can be chosen, such as to ensure minimum start-up (or shut-down) time compatible with an acceptable integral unit-damage coefficient.

(16) APPLICATION OF DIGITAL CONTROL TO POWER GENERATION IN THE UNITED KINGDOM
by J.A. R o b e r t s , Automatic Control Research Officer, C.E.G.B. (Central Electricity Generating Board), London, United Kingdom

As the demand for electricity rises, an electricity generating organisation can make its product significantly cheaper by increasing the size of its plants and correspondingly strengthening its networks to transmit the energy. Such changes improve the economic case for more sophisticated and more expensive equipment for control of the process. On the other hand, since the process is not complex, simple procedures relying upon human beings can continue to keep the process efficiency certainly within 1 % or 2 % of the best achievable with the installed plant. Two consequences follow. Firstly, the functions of the control equipment must be precisely identified to strike a balance between expenditure on equipment and return, in the broadest sense, to the electric utility. Secondly, since it is unlikely that the effect on the company's operations will be directly discernable in terms of cost of energy or continuity of supply, acceptance of more sophisticated schemes must depend upon detailed technical evaluation of their probable performance in real-life conditions.

These remarks particularly apply to the Central Electricity Generating Board, which is responsible for the power generation system in England and Wales. It operates the largest fully integrated system in the world. At the end of 1963, the output capacity was almost 32.000 megawatts and planned additions should increase it to over 43.000 megawatts in 1967. Already the rate of capital expenditure, over 250.000.000 pounds sterling per annum, would be sufficient to build one British Motor Corporation every three months. Nevertheless, the system is manually controlled; there are no digital computers in use in plants and applications envisaged before 1968 are negligible. Nor is there any evidence that operating efficiency has so far in any way suffered from the policy of restraint.

Nevertheless, the Board has been devoting considerable research effort and expenditure for more than four years to theoretical and experimental investigation of both system and plant control with three purposes in mind.

Firstly, to identify worth-while applications; secondly to isolate their problems and devise solutions; thirdly, to help to evaluate interim proposals. It is from this background that the possible application of digital computers to control

are examined in the paper. The latter considers first the nature of the system and plant, since their operating characteristics determine the design of the control schemes. It then discusses system control where the requirement is now seen clearly enough for a trial installation, and finally goes on to consider integration with plant control.

Firm applications of digital computers to electricity control in the United Kingdom are largely confined to nuclear plants. A worth-while system for load despatching is defined. There is reluctance to embark on large systems in conventional stations involving precise instrumentation and an increased burden of maintenance until the "software" has reached the stage at which the control system can really assist the operation of large plant in a large system. There are reasonable prospects of such developments using known instrumentation in the next few years.

The papers (10) to (16), referring to Public Utility, led to the following

DISCUSSIONS AND STATEMENTS

Commenting on his own paper Mr. J.A. R o b e r t s , United Kingdom, stated that, in the future, the transmission of information from the lower level to the higher level in view of computations on a national scale was visualized, in the United Kingdom, every 30 minutes; this would allow safety calculations for the whole grid. At present the C.E.G.B. is mainly concerned with the lower level. As energy losses at this level are small, there exists no necessity of optimization at the lower level.

In the course of the discussion of paper No. 10, one of the authors, Mr. P.R. M a d d o c k , United Kingdom, stated that the installation cost of a computer was higher in the case of power stations than in that of chemical processes for the two following reasons:

- number of outputs generally much larger in power stations than in chemical processes,
- power station equipment generally provided for a longer life (25 to 30 years) and, therefore, more costly than that intended for chemical processes.

Mr. G. Q u a z z a , Italy, commented on the relatively high figure he quoted for damage cost previsions (800 dollars per megawatt) by stating that most of the 70 Italian thermal power stations were of an already old-fashioned type, that it was impossible to take as a basis statistics of the past and to extrapolate from 15 to 20 megawatt units to 600 megawatt units and that, under these circumstances, the damage costs were merely provisional. He estimated that computers are economical over 300 or 400 megawatts without optimisation and over 250 megawatts when optimisation is used. In Italy, the fuels used are not only oil but also coal and lignite, which causes considerable fluctuations of the heat value. Therefore

the problem of optimisation in Italy does not refer so much to combustion (and, therefore, hill-climbing techniques are of less importance than in the United Kingdom) but, much more, to superheating.

Mr. P. J o n o n , France, stressed the large economic differences from one country to another. He evaluated damage costs at 1.200 francs (or 240 dollars) per megawatt - only 30 % of the figure quoted by Prof. Q u a z z a - and stated that this figure corresponded to French conditions. According to Mr. J o n o n the use of computers would be justified for units over 200 megawatts.

Mr. R. Q u a c k , Germany, quoted some details of a German power station, the management of which is particularly favourable to the use of computers. The unit has a power of 176 megawatts and its start-up is automatic. 126 various inputs are measured, the efficiency is computed every minute and printed-out every 15 minutes. The difference between computed efficiency and that obtained by conventional means is of 0,2 % to 0,3 % only. The heat consumption is of the order of 2250 kilocalories per kilowatt-hour at the power of 153 megawatts and of 2400 kilocalories per kilowatt-hour at the power of 83 megawatts.

The general conclusions of Mr. Q u a c k were the following:

- According to conditions, the use of computers is justified for units over 150/300 megawatts. The development of computers is hindered by promising more than can be actually achieved. It is difficult, indeed, to predict the advantages of computers; on the other hand, superheat disturbances depend much more on the system than on the controller;
- Taking into account the engineering expenses of the computer manufacturer or of the power station, a computer at present costs about a million dollars. This figure is much too high and should be reduced in the future;
- It will be always necessary to have in the future conventional instrumentation. Indeed, in thermal power stations - in a way opposite to that of nuclear power stations - the process characteristics are never accurately known. This is why the computer should be a complement of instrumentation but not replace it;
- It seems to be a mistake to oppose, a priori, digital computers to analog computers. Small or old-fashioned power stations could take profit of both techniques and in some cases, it could be useful to begin with a second-hand computer.

Coming back to paper (1), Mr. B a u d e l a i r e , I.B.M., France, wondered why the technique used for automatic start-up at West Thurrock was that of closed-loop control instead of that of operating-guide. This technique, experimented in co-operation with Electricité de France at the Porcheville power station (which is in operation since already 8 years),

consists in programming the results displayed to the operator, leaving to the latter the responsibility of achieving manually the necessary actions. The operating-guide start-up achieves the following functions:

- A predictive set of start-up actions taking into account the state of the turbine and the despatching requirements;
- In the course of the start-up, indication of the exact moments of each action, as well as of the pressures and temperatures to be obtained.

The experience gained with this operating guide has allowed the following statements:

- The general philosophy of this start-up technique is suitable for a power station;
- It is possible to program the start-up with a computer by observing closely manual start-up conditions;
- The number of human errors is reduced (less switch-offs);
- The duration of start-up is reduced.

Commenting on the intervention of Mr. B a u d e l a i r e , Mr. J o n o n stated that it would be necessary to visualize in some years the simultaneous start-up of several units. This is why Electricité de France has tested the operating-guide technique.

D. Various applications

(17) AN IBM 1710 PROCESS COMPUTER CONTROLS A GAS-PIPELINE NETWORK

by F. T u p p e c k , Ruhrgas A.G., Essen, Germany

Since August 1963 Ruhrgas A.G. is using a computer for the control and supervision of their gas network. The problem has been analysed during a long and intensive pre-installation study and, due to the results of this study, the tasks of the control computer have been fixed. After that, in a year's work, 7 qualified specialists have developed the programs for the first step of the IBM 1710 computer in September 1963. Before the installation of the system Dr.-Ing. W. W ü n s c h , member of the executive committee of Ruhrgas, has given a detailed report at the 6th Meeting of the World Power Conference in Melbourne, 1962, on the planned use of the computer and on the aims which have been assigned. Some illustrations and details of this report are used in the paper.

The modern data teletransmitting and processing system built during last year by Ruhrgas A.G. controls 3000 kms of pipeline. The operation, about one year old, of the central unit of this system has resulted in taking over by the IBM 1710 process computer - which operates quite successfully - of a great number of tasks. The paper describes these tasks, some programming details and the program organization. The operating range of the computer will be expanded slowly and stepwise. Finally the computer is intended to make possible an optimizing pipeline control, the control engineer continuing however to hold the final decision capacity.

(18) EXPERIENCES WITH AN ON-LINE COMPUTER IN PAPERMAKING
by Dr. L. H y v ä r i n e n , Systems Engineer, IBM Finland, Helsinki

The paper is a report on an on-line computer installation at the Kaukopää paper mill of the Enso-Gutzeit Company, Imatra, Finland. The mill is an integrated cellulose and paperboard mill with an annual production of 600.000 tons of sulphate cellulose, 40.000 tons of hemicellulose and 450.000 tons of kraftliner and bleached paperboard. The mill has four fourdrinier machines.

An IBM 1710 process control system was ordered in September 1963. The system was installed in November 1963 and later expanded by the addition of a disk file in May 1964.

The Enso-Gutzeit Company has appointed three engineers to the system development and IBM also three. These have not been full-time assignments all the time and the estimated work up to now is: Enso-Gutzeit, 15 man-months and IBM, 30 man-months with a total of 45 man-months.

It is too early at this stage to make any final conclusions on the economic feasibility of the system described because it is still very much in a stage of development.

Limited test material indicates that the order-handling program will reduce appreciable trim losses and lead to a more optimal use of the machines.

Technically, the system has been satisfactory with only minor trouble with some of the input-output equipment. The signals from the instruments have been free of noise due to careful shielding. The accuracy of the analog-digital converter is better than one in a thousand of the full range.

Closed-loop control of some of the manipulable variables (basis weight) is expected to start late this year.

The development of the system could have been perhaps more rapid if more manpower were available for the job.

(19) APPLICATION OF A DIGITAL COMPUTER
TO THE CEMENT-MAKING PROCESS
by J.R. R o m i g , California Portland Cement Company, Colton, California, USA, and W.R. M o r t o n , General Electric Company, Schenectady, New York, USA

Production of the highest quality product at the best efficiencies obtainable is the desire of all process industries. When California Portland Cement Company decided to modernize the Colton, California, Plant, it was concluded that this goal would best be realized through maximum use of all possible automation concepts.

Many recent advances have been made in the areas of centralized control, individual automatic control loops and automatic loading and unloading systems. Also great strides have been made in electronic instrumentation and in remote control of the set-point. However, there have remained some complex

areas of the cement process in which a higher degree of continuous, dependable and effective control is to be desired.

In the endeavour to combine the well-established automatic techniques with new process computer procedures, a joint venture was established between the companies of the co-authors of the paper. Therefore, engineers of several different disciplines were naturally drawn into the project. The paper does not cover any of the automatic control concepts using the more conventional systems and process instruments. It is confined to the use of a digital computer to supervise and control the process on-line in certain important areas.

At the offset of this joint venture, it was agreed to take the direct approach involving pre-analysis of the process and development of a computer control system for use right from start-up of the plant. It was also agreed that the computer would be used only in those areas which could benefit most from its ability for repetitive performance and high-speed decision-making and calculating. Upon final analysis, it was decided to program the computer to perform the following principal functions:

- Scanning of critical points at appropriate time priority intervals, particularly pressures, temperatures, power values and motion sensors. This program includes checking for off-limit conditions;
- Primary raw control formulation at the first stage crushed-raw storages;
- Final raw control formulation in the streams from the proportioning silos, through the raw grinding mills and into the homogenizers;
- Rotary kiln control to include cold start-up procedures as well as those for normal peak operation;
- Automatic calculation and typeout routines for production logging, chemist's logging and alarm logging.

At the time of writing the paper the computer control system has been in operation for sixteen months. First the blending system was put on-line while the kiln feed storage silos were being filled initially. Using the start-up program the kilns were put on-line, right from day one. After they had reached the initial desired production level, the normal kiln control program was initiated.

As would be expected, a number of problems arose in the mechanical system as well as in the computer program. The program is naturally quite voluminous for all the functions to be performed, and is written as a series of small sub-programs which then must be fitted together to form the whole system. Prior to start-up, time did not permit the full checking of all phases, so this was done while the plant was being started and operated.

After the initial program problems had been corrected there was a second phase where various program constants had to be revised to get the best performance not only for minor variations but for upset conditions. In addition, as time went on, it was found that new ideas were generated which would improve the system performance and then certain program additions or modifications were made.

For some time now the computer system has been working successfully under the control of the central operator and the chemist. Although operating time has been short it is possible to estimate some of the benefits which have been derived.

Full on-line control is now achieved greater than 95 % of the time. The uniformity of raw mix blending control is such that kiln upsets, which might otherwise be derived therefrom, are practically non-existent. Kiln production rates and fuel economics are estimated to be improved by 5 % to 10 % as a result of greater steadiness of operation. Greater Kiln refractory lining life will also result as an added bonus due to stable operation. Finish grinding efficiencies are improved due to a more uniform clinker. In the final analysis the major payoff rests in the ability to consistently produce a high quality end product.

To obtain benefits such as these requires more than purchasing a computer and plugging in the power. From top management on down there must exist a deep-seated belief in the gains to be made as well as the realization that it requires the concentrated effort of all parties involved to ensure ultimate success of the system. The successes achieved to date are not the only ones possible. There is sufficient memory capacity and time remaining in the computer system to obtain additional benefits in other areas. The need for this was anticipated and work is still progressing in new endeavours.

(20) SOME MAIN PROBLEMS INVOLVED IN THE USE OF COMPUTERS FOR THE AUTOMATION OF RAILWAY OPERATING PROCEDURES
by Prof. Dr.-Ing. W. S c h m i t z , Ministerialrat bei der Hauptverwaltung der Deutschen Bundesbahn, Frankfurt/Main, Germany, and Union Internationale des Chemins de Fer, Paris, France

Railways neither produce nor trade with any commodities as the industries do; they perform service. They share in hard competition with other transportation carriers, such as road transportation, inland-waterways transportation and air transportation.

The railway operation's advantage is the ability to haul a large number of passengers and goods vehicles within a train formation by one traction unit only. Also, the adhesion to the rail allows a transportation track in one dimension only.

The accurate detection of trains and shunting groups and the thereby achieved safety distance from the preceding formation as well as a well-timed setting of the points allow a centralized traffic control covering larger and larger areas.

A centralized operation allows the overall control of a larger railway network as well as to ascertain, at any time, the course of operation according to the operational schedule. Thereby the operational controller is more easily enabled to arrange for any necessary changes in operation in the event of irregularities.

Fully-mechanized installations and a centralized traffic control with data-processing centers enable to ascertain, simultaneously and centrally, information for statistics, administration, finance and service. This aim will be achieved only stepwise in the course of many years to come or even probably of decades.

At the first stage, a fully mechanized railway traffic might be achieved on primitive railway systems, industrial railways and suburban lines. Only later on it will be possible to operate extensively full-mechanized national networks for a large number of transportation species with the appropriate large variety of car types and special handlings.

Nevertheless, theoretical investigations and practical experiments are already necessary now in order to enable a far-reaching combination of computing centers and of a great number of local and mobile control systems with an appropriate input and output equipment using excellent data-transmitting networks. Only in this way can be solved in due time the overall problem of an extensive automatic control of a multi-network transportation system.

(21) OPTIMIZED RAIL TRANSPORTATION IN THE KIRUNA MINE OF LUOSSAVAARA - KURUNAVAARA AKTIENBOLAGET (LKAB)
by J. E l b r ö n d , Civil Engineer, LKAB, Kiruna, Sweden

The subject of the paper is the control of the trains in a transportation system of the Kiruna underground mine of LKAB.

The ore is mined and transported on mine trucks to surge bins the total number of which amounts to 90 and which are assembled in 15 groups of 3 to 7 each. These groups are spread out along the 3,5 kms of the ore body. The surge bins lead to a main level which connects them to the crushers. These are arranged in a group of 5, each of which supplies 2 hoisting shafts; a sixth separate crusher supplies a single hoist. After its arrival to the surface, the ore is processed on screens, separators etc. before the expedition to the harbour by the national railway. Further processing is being installed for producing concentrates and pellets. The ore can be divided in the mining phase into several qualities, which require several channels during transportation and processing. The number of qualities is actually 3: high, medium and low phosphorus. The capacity of the mine is of 16 to 20 million tons per year (235 days in 2 shifts).

The transportation on the main level is achieved by means of a track system on which trains of fixed size move. One locomotive hauls twelve 25-ton cars. The track forms a closed circuit with a total length of 20 kms. It comprises 110 blocks, some of which are loading and unloading stations, and about 115 shunts. The blocks have a maximum length of 700 feet. They are equipped with signals corresponding to "stop" or "full speed" as well as to "back stop". The network is primarily controlled by a security system of the traditional type preventing two trains to go simultaneously to the same shunt as well as keeping distance between the trains (only a single train per block). This part of the control is actuated by the trains themselves as they proceed in the network. The allowed movements of the trains, according to their destinations, are decided in the CTC (centralized traffic control). The destinations are calculated by a program in a computer.

(22) DESIGN AND APPLICATION OF THE "DNEPR" DIGITAL CONTROL COMPUTER
by Prof. B. M a l i n o v k s y , USSA

The computer is designed to control technological plants, workshops and other industrial controlled plants of concentrated nature. It can be easily used besides for preparing data for program-controlled machine-tools, for automating complex experiments, for investigating by means of computer techniques industrial processes in the course of their preparation for automation etc.

The computing unit of the computer is built according to the general-purpose asynchronous two-address parallel computer principle for multi-purpose applications and other requirements specific to industrial control systems. The latter include high reliability, simple programming real-time performance, large memory capacity, digit and letter printing, easy and fast exchange of information with a communications unit etc.

The paper describes the structure of the computer and its applications, by way of examples, to the automation of a steelwork Bessemer converter plant and to the compiling of gas-cutting machine-tool programs for shipbuilding automation.

At this stage, the Honorary Editor having attended the whole Conference wishes to draw the following general and personal

CONCLUSIONS

from the 22 papers presented and from some of their discussions.

(1) The first impression is that most of the papers refer to process computers which have either not yet been commissioned at the date of the Conference or were commissioned, at any rate, recently. Indeed, with two exceptions only, these papers refer to non-commissioned computers or to computers working for only one to two years. In the chemical and petroleum industry the computer control of the B.A.S.F. oxo-synthesis

process - paper (4) - has been achieved since 1959, but the coordinated multi-computer system of Monsanto's Chocolate Bayou plant - paper (2) - has been put on stream in late 1962 only. In the iron and steel industry, the on-line process control computer of Samuel Fox & Co, Sheffield - paper (8) - is working since January 1961, but the automatic gauge control and computer control of the Steel Company of Wales at Port Talbot - paper (7) - was not yet commissioned. In public utility practically all papers, with some very few exceptions, referred to the future or to very recent experience. In various applications the process computer controlling the gas-pipeline network of Ruhrgas A.G. - paper (17) - operates since August 1963, the on-line computer of the Kaukopää paper mill - paper (18) - since November 1963 and the digital computer of the California Portland Cement Company plant in Colton - paper (19) - since 16 months only.

(2) This lack of long experience is probably responsible for the large difference in opinions between the four rapporteurs on integrated electricity systems, Mr. P. J o n o n (Electricité de France - paper (13) -), Prof. R. Q u a c k (Germany - paper (14) -), Prof. G. Q u a z z a (E.N.E.L., Italy - paper (15) -) and Mr. J.A. R o b e r t s (Central Electricity Generating Board, United Kingdom - paper (16) -).

This difference of opinion is large on such a particular topic as damage cost previsions with 800 dollars per megawatt according to Prof. Q u a z z a and only 240 dollars per megawatt according to Mr. J o n o n . On the much more general problem of economic justification of computers, opinions range from the practically negative position of Mr. R o b e r t s (no digital computers in use in British plants and negligible applications envisaged before 1968), passing through the very cautious position of Prof. Q u a c k to the much more enthusiastic positions of Prof. Q u a z z a and Mr. J o n o n . The latter two do not however agree on the level over which computers would be economically justified, Prof. Q u a z z a quoting a figure of 300-400 megawatts (and 250 megawatts only when optimisation is used), whilst Mr. J o n o n quotes a figure of 200 megawatts only.

(3) The general impression gathered from the papers themselves - and, above all, from their discussion - is that of a very cautious position, if not of some pessimism, of many users. This seems quite natural, after a first period of enthusiasm, at a moment when the economic justification of process computers has to be considered, with information still lacking in most of the cases on the returns from their installation, but with an exact assessment of the corresponding costs of investment. It is probably to be expected that this, perhaps excessive, pessimism will be corrected in the future by an exact evaluation of the returns ensured (at least in some instances) by the installation of process computers, just as the definite evaluation of investments against the uncertainty of returns has somewhat cooled-off the initial, probably also excessive, optimism in this respect.

(4) All this illustrates the normal development of a new field in which purely theoretical considerations - which are and should continue to be well ahead of practice - can lead sometimes to somewhat optimistic forecasts as long as well-known cost-and-return figures have not traced a frontier between what is economically feasible and what is not. In this respect the IFAC/IFIP Conference on applications of digital computers to process control has had the great merit of being the first international attempt to approach this large field in a most realistic and very objective way.

(5) It seems to result from most of the discussions that in power utility and even in chemical and petroleum industry, closed-loop computer control and, even more, direct digital control will still continue to be, during the next few years and in many instances, what the German popular expression calls "Zukunftsmusik" ("music of the future").

Announcement of future IFAC events

IFAC SYMPOSIUM ON AUTOMATIC CONTROL IN THE PEACEFUL USES OF SPACE, STAVANGER, NORWAY, JUNE 1965

Organizers: Norwegian National Committee of IFAC

S e c r e t a r y : Lars Monrad-Krohn
A d d r e s s : IFAC-Symposium, P.O.Box 66, Kjeller, Norway. Telex: Oslo 6361, Telephone: Lillestrøm 713617
T i m e : June 21 to June 24, 1965
P l a c e : Hotel Atlantic, Stavanger, Norway

Presentation
Full papers printed in advance, to be read in 10 minutes, discussion 10 minutes followed by an intermission of 10 minutes.

Languages
In order to simplify the translation problems, the Organizing Committee has decided to have only two official languages, namely English and Russian. In order to avoid simultaneous translation at the oral presentation the preferred language is English.

Program Committee
Dr. J.A. A s e l t i n e , Chairman, Aerospace Corporation, P.O. Box 95085, Los Angeles 45, California, U.S.A.
Prof. A.M. L e t o v , Institut Avtomatiki i Telemechaniki, Kalanchevskaja ul. 15a, Moscow I-53, U.S.S.R.
Prof. J.G. B a l c h e n , Technical University of Norway, Trondheim, Norway.

Schedule
1 Nov. 1964: Deadline for submission of abstracts;
English language papers: Dr. J.A. Aseltine
Russian language papers: Prof. A.M. Letov

1 Dec. 1964: Final selection of papers

1 Feb. 1965: Complete papers to be submitted to the National Committees or to the Program Committee

15 Feb. 1965: Final version of papers to be sent from National Committees to the Secretariat for printing.

Russian language papers will be translated into English and vice versa. The National Committees are kindly asked to send copies of the abstracts directly to the Secretariat.

Maximum number of participants
Preference will be given to those presenting papers.

Exhibits
Ample space will be provided for exhibits.

Topics

I n j e c t i o n i n t o s p a c e
Control of launching vehicles for stability of operation
Guidance of vehicles for correct trajectory

A t t i t u d e s t a b i l i z a t i o n
Passive methods of satellite and exploratory vehicle stabilization
Methods based on expenditure of fuel
Methods based on gyroscopic phenomena
Methods based on magnetic phenomena

R e m o t e c o n t r o l o f s p a c e v e h i c l e s
Correction of orbits at great distances
Remote control of planetary landings
Reentry control techniques

P r o b l e m s o f m a n n e d s y s t e m s
Characteristics of man as part of a vehicle control loop
Optimum use of man in control of space vehicles, on orbit and during reentry

G r o u n d s y s t e m s
Automatic launching systems
Systems for control of ground antennas
Closed loop systems with control from the ground

R e p o r t s o n c o n t r o l o f s p e c i f i c s y s t e m s
Unmanned systems for explorations
Manned systems
Communication systems
Weather observation systems
Other systems

Advanced components for space vehicle and instrumentation control problems
- Inertial, stellar and terrestrial navigation sensors
- Power control elements
- Signal processing components
- Signal conditioning telemetry
- Optical components

Computers as used in automatic control systems in space vehicles or ground stations
- Computer systems
- Computer components
- Programming of computers

Future control problems
- Systems for remote exploration of planets
- Requirements for control components for space vehicle control.

IFAC SYMPOSIUM ON SYSTEMS ENGINEERING FOR CONTROL SYSTEM DESIGN, TOKYO, AUGUST 1965

This international symposium is organized by the IFAC Tokyo Symposium Committee and sponsored by the IFAC Technical Committees on Theory and on Applications under the auspices of the Science Council of Japan. The Symposium Committee is under the chairmanship of Professor Kankuro Kaneshige with Professor Akira Nomoto acting as Secretary.

Time and Place : from Wednesday 25th to Saturday 28th August 1965 in Tokyo, Kokuritsu Kyoiku Kaikan (National Education Hall).

Scientific Programme

The Symposium will be arranged as a series of round-table type discussions, where nearly 20 papers may be read to initiate most effective discussions. The term "Systems Engineering" may have rather a broad facade, but in combining it with the control problems, emphasis would be placed on introducing the Systems Engineering concept into the design of large and complicated control systems. The subject may range from the theory to the application, and it would be most advisable if the Symposium may contribute to bridge the theory and practice on the basis of Systems Engineering approach. The following items may be dealt with at the Symposium, though the sessions will be finally classified in accordance with the papers accepted.

Identification of systems characteristics
- Description of the organization of systems
- Identification of static and dynamic characteristics
- Modelling and simulation of systems
- System objectives and/or evaluation

Algorithms of complicated control systems
- Multi-level control systems
- Optimization and adaptation
- Learning systems
- Multi-variable control systems

Realization of large systems
- Large industrial production processes
- Utility, transportation and communication systems.

Languages

As no simultaneous translation will be available it is desirable that speakers read their papers in English. If a paper will be presented in a language other than English, the summary should be translated into English. During discussions, it is hoped that participants versed in languages will kindly assist in overcoming any translation difficulties that may occur.

Papers

Offers of papers should be submitted not later than 1st November 1964 by sending two copies of the abstract to the Symposium Committee. Abstracts should contain approximately 600 to 900 words, typewritten, double-spaced. In case a paper is written in a language other than English the full English translation should be attached to the abstract, if possible. The author will be notified by 15th February 1965 whether his paper is accepted or not. Invited authors will be requested to send two copies of the full paper to the Symposium Committee by 1st June 1965.

Technical visits and excursions

Visits to research institutes, universities and industrial companies are planned and some excursions after the Symposium will also be arranged.

Secretariat

IFAC Tokyo Symposium Committee
Tokyo Central Post Office Box 1057
Tokyo, Japan.
Cable address: IFACSYMPOSIUM TOKYO.

2nd IFAC SYMPOSIUM ON THE THEORY OF SELF ADAPTIVE CONTROL SYSTEMS, TEDDINGTON, U.K., SEPTEMBER 1965

An international Symposium on "The Theory of Self Adaptive Control Systems" will be held in Teddington, at the invitation of the National Physical Laboratory, from 14th to 17th September, 1965. An organising committee under the chairmanship of Professor J.H. Westcott has been appointed by the Society of Instrument Technology on behalf of the United Kingdom Automation Council.

The number of participants will be restricted to about 100. Preliminary invitations to attend and to submit papers will be sent out in November, both to individuals and through IFAC to national member organizations.

The subjects will be grouped under the general headings:-
(i) Hill climbing and searching controls
(ii) Deterministic adaptive dynamic control, including model building
(iii) Control using statistical decision processes.

Papers which contain examples drawn from biological systems will be welcomed. It is hoped that about 20 papers will be presented; these will be appropriately grouped and followed by general discussion periods.

The participants will be able to inspect some of the automatic control work in progress at both Imperial College and the National Physical Laboratory, and it is hoped to arrange one or two social events.

The National Physical Laboratory is providing facilities to help the organisation. The Society of Instrument Technology will be assisting with publications and with the administrative arrangements.

All enquiries concerning the Symposium should be addressed to:

IFAC (Teddington) Symposium 1965,
Secretary, S.I.T.,
20 Peel Street, London, W.8., England.

IFAC SYMPOSIUM ON MICROMINIATURIZATION, MUNICH, GERMANY, OCTOBER 1965

An international Symposium on Microminiaturization in automatic control is planned to be held in Munich, Germany, from 21st to 23rd October 1965, on the initiative of the IFAC Components Committee and at the invitation of the VDI/VDE-Fachgruppe Regelungstechnik and the Nachrichtentechnische Gesellschaft im VDE. The general theme is planned to be: "New components for automatic control and computer techniques by microminiaturization and integrated circuits".

All further information may be obtained from:-

Mr. Gerd Müller,
Secretary of the Preparatory Committee
for the Symposium,
c/o Siemens & Halske AG,
Wernerwerk für Messtechnik,
Postfach 834, Karlsruhe, Germany.

THIRD CONGRESS OF THE INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL, LONDON, JUNE 1966

This Congress will be held in London from 20th to 25th June, 1966 at the invitation of the United Kingdom Automation Council (UKAC). Authors wishing to offer papers should approach the IFAC national member organization of their country whose address may be requested from the IFAC Secretary, Postfach 10250, Düsseldorf 10, Germany. Printed invitations to authors with details about the presentation of papers will be available by the end of 1964.

Papers should be submitted to the IFAC national member organization of the author's country early in spring 1965 (the exact date to be fixed by the national member organization). The papers should deal with topics on components or on applications or on the theory of automatic control. The theory papers should preferably bridge the gap between theory and practice. Some papers will be admitted on traffic control and on biological control problems as well as on management.

After approval by the national member organization the papers will be passed over to an international selection committee for final decision on their adoption.

The adopted papers will be printed before the Congress in order to allow the attendants of the Congress to prepare discussion remarks. At the Congress itself, several papers will be grouped together and will be presented by a rapporteur. The authors will be asked to answer the remarks made in the discussion. Therefore the presence of the authors at the Congress will be obligatory.

After the two IFAC Congresses which were held in Moscow 1960 and in Basle 1963 it is hoped that the third Congress will be equally successful.

WORLD ACTIVITY IN CONTROL TERMINOLOGY, 1963

A report by Dr. H. L. M a s o n , Chairman,
IFAC Technical Committee on Terminology

-INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC),
1, rue de Varembé, Geneva, Switzerland

Mr. G. N a s s e , Secretary, states that TC 1 has completed its revision of Group 37, Automatic Control and Regulating Equipments for edition 2 of the International Electrotechnical Vocabulary. Its 125 terms are defined in French and English, and appropriate German terms have been added by Prof. H.D. H o c h r a i n e r , Austrian Standards Committee.

To the 23 international organizations likely to be concerned with nomenclature in edition 3 of IEV, Mr. L. R u p p e r t, Secretary-General, has addressed a circular letter announcing plans to publish that edition chapter by chapter, and asking them if they would cooperate with comments on early drafts.

Working Group R of TC 4, notes Mr. L e u m , has been preparing a draft of a test code for Hydraulic Turbine Governors. A set of symbols was agreed upon, and it was decided to prepare drafts on speed rise and pressure rise tests. Agreement was not reached as to whether frequency response tests should be included.

The U.S. National Committee of IEC, meeting in March 1963, has recommended to the IEC that a Microelectronics Subcommittee be established to formulate standard definitions and ter-

minology in this field. Further recommendations cover standardization of dimensions, ratings, and characteristics, also techniques for measuring parameters and performance.

Publication 125: Ferromagnetic Oxide Materials suggests a general classification on the basis of the function of the material. Some 40 terms are defined in five sections: permeability; losses; variability; magnetostriction; and resistivity.

Publication 117-3: Contacts, Switchgear, Mechanical Controls, Starters, and Elements of Electromechanical Relays contains some 140 recommended symbols.

Publication 148 is intended to provide a uniform system of letter symbols to be used internationally in the semiconductor field.

Standardizing agencies of both Germany and U.S.A. have proposed to TC 47 sets of definitions, letter symbols, color code and circuit symbols for voltage-generating plates manifesting the Hall effect. The U.S.A. proposal described by Mr. S. R u b i n is based on MKSA rationalized units as noted in NBS Monograph 47, and contains 39 definitions useful for specifying test procedures.

-JAPANESE NATIONAL COMMITTEE OF AUTOMATIC CONTROL,
Science Council of Japan, Ueno Park, Tokyo

Japanese Industrial Standard JIS Z8103, writes Mr. M a s u b u c h i , contains 38 terms (in English and Japanese) with definitions (in Japanese only) relating to Accuracy and Precision in Instrumentation. JIS Z8104 has 90 terms and definitions for Instrumentation (General). JIS Z8111 has 64 terms and definitions, and Z8112 has 115 terms and definitions, all relating to Digital Computers. JIS Z8204 is a 20-page document giving graphic and (English) letter Instrumentation Symbols apparently correlated with Instrument Flow Plan Symbols of the Instrument Society of America and Graphical Symbols for Instrumentation of the British Standards Institution. Another JIS Glossary of General Terms in Automatic Control contains 32 items; most of these are included (with English and German equivalents) in a 96-term list in the JSME Journal 67-109, April 1964. For defining the electrical, pressure and flow characteristics of hydraulic Servovalves, a committee chaired by Prof. Y. O s h i m a has proposed a tentative set of 24 terms.

-INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO),
1, rue de Varembé, Geneva, Switzerland

The ISO Council has approved the following definitions prepared by a Standing Committee: "Standard - A standard is the result of a particular standardization effort, approved by a recognized authority. It may take the form of (1) a document containing a set of conditions to be fulfilled (in French 'Norme'); (2) a fundamental unit or physical constant (in French 'étalon') - examples: ampère, absolute zero; (3) an object for physical comparison (in French 'étalon') - example: meter."

"Standardization is the process of formulating and applying rules for an orderly approach to a specific activity for the benefit and with the cooperation of all concerned, and in particular for the promotion of optimum overall economy taking due account of functional conditions and safety requirements.

Is is based on the consolidated results of science, technique, and experience. It determines not only the basis for the present but also for future development, and it should keep pace with progress. Some particular applications are: (1) Units of measurement; (2) Terminology and symbolic representation; (3) Products and processes (definition and selection of characteristics of products, testing and measuring methods, specification of characteristics of products for defining their quality, regulation of variety, interchangeability, etc.); (4) Safety of persons and goods.

Specification: A specification is a concise statement of a set of requirements to be satisfied by a product, material, or a process, indicating, whenever appropriate, the procedure by means of which it may be determined whether the requirements given are satisfied.

Note: (1) A specification may be a standard, a part of a standard, or independent of a standard. (2) As far as practicable, it is desirable that the requirements are expressed numerically in terms of appropriate units together with their limits."

-FINLANDS REGLERINGTEKNISKA SÄLLSKOP,
P.O.B. 419, Helsinki, Finland

A terminology committee has been set up under the chairmanship of Mr. Paavo A n t t i l a .

-INSTYTUT AUTOMATYKI PAN,
Krajowej Rady Norodowej 55, Warszawa, Poland

Polish Standard PN/N-02050: Metrology: Terminology took a tentative draft form during 1964, reports Mr. J. T h i e m e . It contains 175 definitions in the sections: General concepts; Quantities; Measurement units; Measurements; Measurement errors; Measurement equipment: its elements; Metrological properties of measurement tools; Metrological operations in production, checking and exploitation of measurement tools.

Work on a draft standard on Terminology in Automatic Control has been initiated, and range, methods, and materials have been chosen. The first stage will cover the preparation and definition of about 450 terms.

-NEMZETKÖZI AUTOMATIKA SZÖVETSEG MAGYAR,
Nádor utca 15, Budapest V, Hungary

Publication of the Multilingual Vocabulary No. 19 in 1962, reports Mr. J.J. S z a l a y , has already prompted moves to expand its list of 1000 definitions in Hungarian, with indexes of equivalent terms in German, English, and Russian. The basic

standard No. 18450, dealing with terminology, definitions and symbols of control engineering, is now being extended.

-NORMEN-ARBEITSGEMEINSCHAFT FÜR MESS- UND REGELTECHNIK (NAMUR), Leverkusen-Bayerwerk, Germany

Two drafts of proposed literal and graphic symbols for measurement and control in the process industries have been circulated by Dr. B. S t u r m . Over 200 items are noted, most being distinctive geometric shapes, lettered to indicate the measurand, for use on process flow charts. Many are identical with those of DIN. Graphic symbols for subassemblies will be treated later.

-L'UNION DES ASSOCIATIONS TECHNIQUES INTERNATIONALES (UATI), 62, rue de Courcelles,Paris 8e, France

At the request of Prof. E. G e r e c k e , Past-President of IFAC, and of the Swiss Federation of Automatic Control, reprints of the SFAC Basic Graphical Symbols with 7 Application Examples were distributed by UATI to the 1500 engineers attending the 2nd IFAC Congress in Basle. Prof. C. P e n e s c u is proposing these symbols as an IFAC standard for use in signal-flow diagrams.

-BRITISH STANDARDS INSTITUTION, 2 Park Street, London W.1, England

Mr. D.T. B r o a d b e n t notes that B.S. 3669:1963, "Recommendations for the Selection, Formation and Definition of Technical Terms" is of general interest, and is based on the recommendations of I.S.O./T.C. 37. B.S. 3586: Part 1: 1963, "Specification for Electrical Signals for Telemetry and Control, Part 1, Analogue direct current signals" establishes a preferred current range for the first time, from 0 mA to 10 mA, and defines some relevant terms. B.S. 3527:1962, "Glossary of Terms relating to Automatic Data Processing" is a substantial document which has become adopted during the past year.

Three parts of B.S. 1523 on Automatic Control Terminology have been issued to date; Section 2:1960, "Process Control"; Section 3:1954, "Kinetic Control"; and Section 5:1954, "Components of Servo-mechanisms". Work on Section 4, "Automatic Regulators" is well advanced, and it will be combined with revised versions of the three earlier parts into a single document, together with additional general terms, being prepared by a committee under the chairmanship of Prof. K.A. H a y e s.

B.S. 1646 has been revised consistently with B.S. 1523 and 2643, and will shortly be re-issued under the title "Graphical Symbols for Process Measurement and Control Functions". A copy was submitted to ISO/TC10 with the suggestion that these lettered geometric shapes for process flow sheets be considered for international standardization. Other graphical symbols are given in B.S. 3238, Part 1, "Transductors and Magnetic Amplifiers", which appeared in 1960; it will be supplemented by Part 2, "General Servomechanisms", to be published early in 1964.

Of B.S. 1991, "Letter Symbols, Signs and Abbreviations" Part 6:1963, "Electrical Science and Engineering" is the latest to be published.

-UNION POUR LA COORDINATION DE LA PRODUCTION ET DU TRANSPORT DE L'ELECTRICITE (UCPTE), Ziegelhäuser Landstrasse 5, Heidelberg, Germany

Mr. W. R e b s k e reports a new edition of "System Regulation Terminology" with about 100 terms and their definitions in French, German, Italian, and Dutch has been published. An appendix with USA and UK versions has just appeared.

-USTAV TEORIE, INFORMACE A AUTOMATIZACE, Vysehradská 49, Praha 2, Czechoslovakia

Dr. J. K r i z e k advises that during 1963 the common scientific terminology of the multiloop control was established, involving 47 terms with definitions. Also, terminology of sampled-data control systems and a table of graphic symbols for logic elements are being prepared.

-VVB REGELUNGSTECHNIK, GERÄTEBAU UND OPTIK, East Berlin, Germany

DDR Standard TGL 14591, Concepts and Terms for Automatic Control, by Dr. G. S c h w a r z e , contains 200 words and their definitions in German, with 54 figures, and a graphic table of transfer functions. Its sections cover open and closed loops, signal flow, transmission characteristics, graphic functional symbols, sections of the loop, types of control action, types of physical components for signal conversion and logic.

-ENTE NAZIONALE ITALIANO DI UNIFICAZIONE (UNI), Piazza Armando Diaz 2, Milan, Italy

Physical characteristics of Perforated Tapes to be used with data processing equipment and machine tools will be coordinated by Mr. R. P e d r e t t i 's ISO/TC 95/SC8. Other participating groups are ISO/TC 97, IEC/TC 53, and ASA/X3.

-USSR NATIONAL COMMITTEE OF AUTOMATIC CONTROL, Kalanchevskaja ul. 15a, Moscow I-53, USSR

Prof. B.S. S o t s k o v presented to the IFAC Components Committee meeting at Basle a lengthy paper defining in graphical and mathematical terms a number of parameters and characteristics needed for the specification of automation elements. Devices for continuous action and for intermittent action, static and dynamic errors, reliability, and costs are included. Discussion of these terms were scheduled for JACC at Palo Alto, California, and IMEKO at Stockholm.

-VDI/VDE FACHGRUPPE REGELUNGSTECHNIK,
Postfach 10250, Düsseldorf 10, Germany

Dr. G. V a f i a d i s reports that the VDI/VDE Committee on Graphic Symbols for open- and closed-loop control technology has offered several comments on the Swiss proposal presented by Professor E. G e r e c k e , looking to further discussion by IFAC. They feel, as noted by Dr. R. O e t k e r , that separation between functional and material operations is inadequate, also that the number of geometrical forms to represent the symbols should be reduced. A new DIN 40700 Graphical Symbols for Digital Circuits was issued in November 1963, and a proposed DIN 66001 covers graphical symbols for data flow charts and program flow charts for information processing. DIN 2481 of 1954, relating to charts for heat power installations, is under review, and standards are in prospect for symbols in analog computation, information processing and the process industries.

NEWS FROM NATIONAL MEMBERS

Bulgaria

CONFERENCE ON AUTOMATION, MAY 1964

A scientific and technical conference on the problems of automation was held in Sofia, May 12 to 14, 1964, organized by the Bulgarian National Council of Automatic Control. The total number of papers presented was 58, divided into four sections covering theoretical problems of automation, automation devices, application of automatic control systems and computing techniques. The sessions met both separately and simultaneously.

The aspects of optimizing control, automatic optimization, self-adjusting models, electric modelling, synthesis of relay control schemes, and surveys on algorithmization of industrial processes, control process computers and pattern-recognition devices and techniques were discussed in the first section during the conference.

The papers in the second section dealt with various types of transducers and other devices, program controllers, potentiometers and compensators, pneumatic devices, converters of non-electric variables to electric, remote control systems, counters, and flowmeters. A survey on applications of nuclear magnetic resonance was also presented.

The aspects of program control of milling machines, automatic supply devices, automatic processing of electric motor details, process monitoring of bearing details, applications of automatic control systems in power utility, metallurgy, transport etc., as well as surveys on automation of metallurgical and chemical industrial processes were discussed in the third section.

The papers in the fourth section dealt with universal digital computers and electronic measuring instruments for ferrite cores hysteresis curves.

The aim of the conference on automation was to revise the present state of the theory and practice of automation in the country and to outline some directions of the future activity in the field of automation.

The more interesting papers will be published in various periodicals in Bulgaria.

Switzerland

15th INFORMATION MEETING, SEPTEMBER 1964

The ASSPA (Association Suisse pour l'Automatique - Swiss Association for Automatic Control, National Member Organization of IFAC for Switzerland) held its 15th Information Meeting in Zürich from 24th to 25th September 1964, on the general topic

DYNAMICS OF HEATING AND AIR-CONDITIONING PLANT CONTROL

with the following papers:

- "Die Bedeutung dynamischer Untersuchungen für die Klimaregelung" (The importance of the dynamic research for heating and air-conditioning control) by Prof. Dr. P. P r o f o s , ETH Zürich,
- "Dynamisches Verhalten von Temperatur- und Feuchterreglern" (Dynamic behaviour of temperature and moisture regulators) by L. M e l i o n , Luwa A.G., Zürich,
- "Messung und Auswertung des Übertragungsverhaltens von Regelstrecken der Klimatechnik" (Measurement and evaluation of the transfer behaviour of heating and air-conditioning controlled plants) by R. S p ü h l e r , Landis & Gyr A.G., Zug,
- "Dynamische Untersuchung einer Raumtemperatur-Regelung mit Hilfe des Analogrechners" (Dynamic investigation of a room-temperature control by means of an analogue computer) by M. B l u m e r , Honeywell A.G., Zürich,
- "Die rechnerische Erfassung des Wandeinflusses auf das Übertragungsverhalten durchströmter Räume" (The calculation of wall influence on the transfer behaviour of ventilated rooms) by H. J u z i , ETH Zürich,
- "Das Übertragungsverhalten von Lüftungskanälen" (The transfer behaviour of ventilation channels) by P. H e m m i, ETH Zürich,
- "Die rechnerische Bestimmung des Übertragungsverhaltens von Lufterhitzern und Luftkühlern" (The calculation of the transfer behaviour of air-heaters and air-coolers) by B. J u n k e r , Fr. Sauter A.G., Basle,
- "Experimentelle Untersuchungen über das Temperatur-Übertragungsverhalten von Räumen" (Experimental investigations on the temperature-transfer behaviour of rooms) by H. L e u t h o l d , Sulzer A.G., Winterthur,
- "Rechnerische Vorausbestimmung des Temperatur-Übertragungsverhaltens künstlich belüfteter Räume unter Benutzung von Modellversuchen" (Predictive calculation of the temperature-transfer behaviour of artificially ventilated rooms by using simulation investigations) by W. W e r n e r , ETH Zürich.

United Kingdom

LONDON MEETINGS OF THE SOCIETY OF INSTRUMENT TECHNOLOGY, DECEMBER 1964

1 Dec.1964 "Process Instrumentation up to 1984" by E.N. M a r t i n and R.J. W e i r,

16 Dec.1964 "The Control of a Warehouse by Computer" by L. R o w l a n d,

13 Jan.1965 "The Use of on-line Computers to generate Dynamic Models of Plant" by P.H. H a m m o n d and D.L.A. B a r b e r, "On-Line Model Making for a Chemical Plant" by J.W. B r a y , R.J. H i g h, A.D. McC a n n and H. J e m m e n s o n,

26 Jan.1965 "Computer Control of a Four Stand Mill" by M. B u t t e r f i e l d,

10 Feb.1965 "Measurement of Transient Events in Armaments Research" by F.I.L. K n o w l e s and D.N. G a s c o y n e,

23 Feb.1965 "Automatic Instrument Manufacture" by J. Å v e r y,

10 Mar.1965 "Automatic Control Applications of Solid State Rectifiers" by Prof. E. G e r e c k e , Zürich, Switzerland,

30 Mar.1965 "System Design in Steel Works Automation" by Dr. K.D. T o c h e r,

14 Apr.1965 "The Meaning and Value of Measurement in Industrial Processes" by R.T. E d d i s o n,

27 Apr.1965 "Direct Digital Control" (One Day Symposium.Advance Registration required. Preprints supplied to attendants),

12 May 1965 "Directions of Research in Control in the USA" by Dr. H.H. R o s e n b r o c k.

All the above meetings with the exception of the meeting on 27 April will be held at Manson House, 26 Portland Place, London, W.1., and, unless otherwise stated, at 5.30 for 6 p.m. Except for the meeting on 27 April it is hoped to provide preprints or summaries for all meetings. These may be obtained from the Secretary, The Society of Instrument Technology, 20 Peel Street, London, W.8., cash with order on publication as follows: 3s. per meeting or £ 16s.0d. for a complete set.

SYMPOSIUM ON GYROS, FEBRUARY 1965

A Symposium on Gyros has been arranged by the Automatic Control Group of the Institution of Mechanical Engineers. Some 16 papers will be presented in four groups: general, aircraft and spacecraft (inertial), aircraft and spacecraft (non-inertial), and ship. The Symposium will be held at the Institution of Mechanical Engineers, in London, on 25th/26th February 1965. Further details will be available from the Conference Section of the Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London S.W.1.

CONVENTION ON ADVANCES ON AUTOMATIC CONTROL, APRIL 1965

A Convention on Advances in Automatic Control, sponsored by the United Kingdom Automation Council, will take place at Nottingham University from 6 to 9 April 1965. The Institutions of Mechanical, Electrical, Chemical, Production, Electronics and Radio Engineers, the Royal Aeronautical Society and the Society of Instrument Technology are co-operating in the arrangements. The Organizing Committee invites offers of papers. Further information can be obtained from: The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W.1.

A DAY'S DISCUSSION ON DIRECT DIGITAL CONTROL, APRIL 1965

Conventional analogue controllers are yielding place in a number of instances to digital devices. This development in control engineering will be discussed at a one-day symposium held by the Society of Instrument Technology on 22 April 1965 at Northampton College of Advanced Technology, London. The symposium will be concerned with both digital computer systems and digital systems involving a small number of loops. The technical and economic benefits of direct digital control, the requirements and reliability of equipment and the theory of sampled data and modes control, all come within the terms of reference. Discussion of the conversion of analogue measuring-instrument signals into digital form, and of the application of outputs from digital devices to analogue control valves, will be deemed appropriate. The object of the papers delivered at the symposium will be to stimulate discussion.

Registration opens on 1st January 1965 and closes on 19 March 1965. Further particulars of the symposium may be obtained on application to The Symposium Secretary, Direct Digital Control Symposium, Society of Instrument Technology, 20, Peel Street, London, W.8.

CONFERENCE ON MEN, MACHINES AND AUTOMATION, NOVEMBER 1965

The Institution of Production Engineers is to hold a conference on 'Men, Machines and Automation' from the 7th to the 10th of November 1965, at the Congress Hotel, Eastbourne. Further particulars will be announced later.

USA

PAST EVENTS

5th JOINT AUTOMATIC CONTROL CONFERENCE, JUNE 1964

This Conference took place at Stanford University, Stanford, Calif., 24-26 June 1965. The following papers - preprints of which may be obtained at a total price of $20 from the Institute of Electrical and Electronics Engineers - were read and discussed. They are quoted with the following abbreviations:
IEEE - paper by the Institute of Electrical and Electronic Eng.
AIChE - paper by the American Institute of Chemical Engineers
ASME - paper by the American Society of Mechanical Engineers
ISA - paper by the Instrument Society of America
C.P. - conference paper only, not in any society journal.

Session I - ADAPTIVE CONTROL

IEEE C.P. "A Learning Control System" by Dr. M.D. W a l t z and K.S. F u , Control and Information Systems Laboratory, Purdue University, Lafayette, Ind.,

IEEE C.P. "Threshold Training of Two-Mode Signal Detection" by J. S k l a n s k y , Radio Corp. of American Laboratories, Princeton, New Jersey,

ASME "On the Formulation of Adaptive Optimal Control Problems" by Prof. Allan E. P e a r s o n , Div. of Engineering, Brown University, Providence 12, Rhode Island, and P.E. S a r a c h i k , Dptm. of Electrical Engineering, Columbia University, New York, N.Y.,

IEEE C.P. "The Model-Reference, Self-Adaptive Control System as Applied to the Flight Control of a Supersonic Transport" by D.C. C l a r k , Cornell Aeronautical Laboratory Inc. Buffalo 21, N.Y.,

ASME "On Performance Losses in Some Adaptive Control Systems" by Prof. Masanao A o k i , Dptm. of Engineering, University of California, Los Angeles, California,

IEEE "The Principle of Contraction Mapping in Nonlinear and Adaptive Control Systems" by K.N. L e i b o v i c , Buffalo, N.Y.,

IEEE "The Characteristics of Model-Following Systems as Synthesized by Optimal Control" by J.S. T y l e r Jr., Cornell Aeronautical Laboratory Inc., Buffalo 21, N.Y.

Session II - SYSTEM DESIGN AND ANALYSIS I

AIChE C.P. "Sonic Delay Line Used for Buffering of Pulse Inputs of a Control Computer System" by H.G. E l m e r , Intern. Business Machines Corp., Monterey and Cottle Rds., San Jose, California,

IEEE C.P. "Queues in Multi-Channel Systems Remotely Controlled via a Common Communication Link" by C.E. T h e o b o l d , System Development Corp., Paramus, N.J., and D.W.C. S h e n , Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.,

ASME "Application of Volterra Series Analysis to an Electrohydraulic Control Valve" by J.B. B e r g e r , Guidance and Control Mechanics, McDonnell Aircraft Corp., St. Louis 66, Missouri,

IEEE C.P. "Calculation of Quadratic Moments of High Order Linear Systems via Routh Canonical Transformation" by N.N. P u r i and C.N. W e y g a n d t , Dptm. of Electrical Engineers, University of Pennsylvania, Philadelphia, Pa.

AIChE P.P. "Systematic Determination of Optimal Parameters" by V.J. L a w and R.E.C. W e a v e r , Dptm. of Chemical Engineering, Tulane University, New Orleans 18, Louisiana.

Session III - COMPONENTS I

AIChE C.P. "The Frequency Response of an Actuator Supplied by Two Long Hydraulic Lines" by W.E. Schiesser, Dptm. of Chemical Engineering, Lehigh University, Bethlehem, Pa.,

ASME "Hot-Gas Actuators: Some Limits on the Response Speed" by D.R. Vaughn, Douglas Aircraft Company, Santa Monica, California,

IEEE C.P. "Elastic Mode Effects on Closed-Loop Stability of a Winged Booster" by R.L. Swaim, USAF Wright-Patterson Air Force Base, Ohio,

ASME "Mechanical Fingers as Control Organ and its Fundamental Analysis" by Prof. M. Mori and T. Yamashita, Institute of Industrial Science, University of Tokyo, Tokyo.

Session V - SYSTEM DESIGN AND ANALYSIS II

IEEE "Analysis of Pulse-Width Modulation with a Variable Transport Lag in a Rendezvous Radar" by G.S. Axelby, Westinghouse Electric Corp., Air Arm Division, Baltimore, Maryland,

IEEE C.P. "Word-Length Sample-Rate Tradeoffs in Computer Control Systems" by R.M. Linebarger and Dr.G.K. Chien, Cottle and Monterey Rds., San Jose, California,

AIChE C.P. "Intercomputer Talk on Chocolate Bayou" by V.A. Lauher, Mansanto Chemical Company, Texas City, Texas,

AIChE C.P. "Dynamic Effects of Material Recycle" by E.R. Gilliland, MIT, Cambridge 39, Mass. and T.J. Boyle, Atomic International Div., North American Aviation, Canoga Park, Cal. and L.A. Gould, MIT, Cambridge 39, Mass.,

ISA C.P. "Dynamic Temperature Control of the Styrene-Butadiene Rubber Process" by D.A. Wismer and W. Brand, Bunker-Ramo Corp., Canoga Park, California,

AIChE C.P. "Dynamic Response of a Continuous Stirred-Tank" by G.L. Esterson, and R.E. Hamilton, Dptm. of Computer Sciences, Washington University, St. Louis, Missouri.

Session VI - STABILITY I

IEEE C.P. "Sensitivity and Stability in Multiloop Systems" by Dr. R.A. Haddad and Dr. J. Truxal, Electrical Engineering Dptm., Polytechnic Institute of Brooklyn, Brooklyn 1, N.Y.,

ASME C.P. "The Parameter Variation Problem in State Feedback Control Systems" by Prof. W.S. Perkins and J.B. Cruz, Dptm. of Electrical Engineering, Co-ordinated Sciences Laboratory, University of Illinois, Urbana, Ill.

IEEE "The Elliptic Describing Function" by A.D. Jopling, Canadian Armament, R and D Establishment, Quebec, Canada, and R.A. Johnson, Dptm. of Electrical Engineering, University of Manitoba, Winnipeg, Manitoba, Canada,

IEEE C.P. "The Describing Functions for Hysteresis" by C.B. Neal and D.B. Bunn, San Fernando, California,

IEEE C.P. "On the Computation of Self-Sustained Oscillations in Piecewise Linear Systems with Two Nonlinearities" by Dr. G. Kovatch, Research Institute for Advanced Studies, Baltimore 12, Maryland,

IEEE "Stability in Linear Systems Having a Time-Variable Parameter" by W.W. Cooley and R.N. Clark, Dptm. of Electrical Engineering, University of Washington, Seattle 5, Washington, and R.C. Buckner, The Boeing Comp., Seattle, Washington,

IEEE "Bounds on Limit Cycle in Two-Dimensional Bang-Bang Control Systems with an Almost Time-Optimal Switching Curve" by J.J. O'Donnell, Bellcom Inc., Washington, D.C.

Session VIII - OPTIMAL CONTROL I

ASME "Investigation of Optimal Control with Minimum-Fuel Consumption Criterion for a Fourth Order Plant with Two Control Inputs; Synthesis of an Efficient Sub-Optimal Control" by Prof. A.J. Craig and Prof. I. Flügge-Lotz, Div. of Engineering Mechanics, Stanford University, Stanford, California,

IEEE C.P. "Determination of Optimal Control and Trajectories Using the Maximum Principle in Association with a Gradient Technique" by C.H. Knapp and P.A. Frost, Dptm. of Electrical Engineering, University of Connecticut, Storrs, Connecticut,

IEEE C.P. "A New Approach to the General Minimum Energy Problem" by Dr. W.A. Porter, Electrical Engineering Dptm., University of Michigan, Ann Arbor, Michigan,

IEEE "On the Problem of Optimal Thrust Programming for a Lunar Soft Landing" by J.S. Meditch, Aerospace Corp., Los Angeles 45, California,

IEEE C.P. "Minimum-Energy Attitude Control for a Class of Electric Propulsion Devices" by L. Schwartz, Hughes Aircraft Company, Los Angeles 9, California,

IEEE C.P. "Fuel-Optimal Singular Control of a Nonlinear Second Order System" by M. Athans and M.D. Canon, Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts.

Session IX - STABILITY II

IEEE C.P. "Construction of Liapunov Functions for Nonlinear Feedback Systems with Several Nonlinear Elements" by E.S. I b r a h i m , Control and Information Systems Laboratories, Purdue University, Lafayette, Indiana, and Z.V. R e k a s i u s , Electrical Engineering Dptm., Purdue University, Lafayette, Indiana,

IEEE C.P. "Numerical Applications of Liapunov Stability Theory" by J.J. R o d d e n , Div. of Engineering Mechanics, Stanford University, Stanford, California,

IEEE C.P. "Synthesis of Control Systems with Stability Constraints via the Direct Method of Liapunov" by G.W. J o h n - s o n , International Business Machines Space Guidance Center, Huntsville, Alabama,

IEEE C.P. "On the Lagrange Stability of a Class of Saturating Sampled-Data Systems" by Dr. J.B. P e a r s o n Jr., Control and Information Systems Laboratories, Purdue University, Lafayette, Indiana,

IEEE "Approximation of the Asymptotic Stability Boundary of Discrete-Time Control Systems Using an Inverse Transformation Approach" by R.P. O'S h e a , Dptm. of Electrical Engineering, University of Pittsburgh, Pittsburgh 13, Pa.,

IEEE C.P. "On the Stability of Nonlinear Feedback systems" by R. W. B r o c k e t t , Case Institute of Technology, Systems Research Center, Cleveland 6, Ohio.

Session XI - OPTIMAL CONTROL II

IEEE C.P. "Sufficient Condition for Optimal Control of Linear Systems with Nonlinear Cost Functions" by S.S. C h a n g , New York University, New York, N.Y.,

IEEE C.P. "The Necessary and Sufficient Conditions for the Optimal Controller to be Linear" by R. S i v a n , Dptm. of Electrical Engineering, California Institute of Technology, Pasadena, California,

IEEE "Recoverable and reachable Zones to Control Systems with Linear Plants and Bounded Controller Outputs" by J.L. L e M a y , Guidance Systems Dptm., Aerospace Corporation, Los Angeles 45, California,

IEEE "On the Inverse Problem in Optimal Control" by Dr. Z.V. R e k a s i u s , Dptm. of Electrical Engineering, Purdue University, Lafayette, Indiana, and T.C. H s i a , Control and Information Systems Laboratories, Purdue University, Lafayette, Indiana,

ASME "On a Problem of Letov in Optimal Control" by Prof.C.F. J o h n s o n , Electrical Engineering Dptm., University of Alabama, Huntsville Center, Huntsville, Alabama, and W.M. W o n h a m , Center for Control Theory, Research Institute for Advanced Studies, Baltimore, Maryland.

IEEE C.P. "Two Classes of Optimum Linear Systems" by N.E. N a h i, Dptm. of Electrical Engineering, University of Southern California, Los Angeles 7, California.

Session XII - SYSTEMS IDENTIFICATION

IEEE "The Minimization of Measurement Error in a General Perturbation-Correlation Process Identification System" by H.J. P e r l i s , College of Engineering, Queens Campus, Rutgers University, New Brunswick, New Jersey,

IEEE C.P. "On the Estimation of the Plant State, Plant Parameters and External Disturbances from Observations of the Output of a Control System" by R. C o a s e r t , Cecles-Eldo, Paris, France,

IEEE C.P. "Nonlinear Process Identification Using Statistical Pattern Matrices" by R.W. M i l l e r and R. R o y , Rensselaer Polytechnical Institute, Troy, New York,

IEEE C.P. "Optimal Control of Limited Plants with Random Parameters" by R.F. D r e n i c k and L. S h a w , Dptm. of Electrical Engineering, Polytechnic Institute of Brooklyn, Brooklyn 1, N.Y.,

IEEE C.P. "On the identification of Linear Systems" by K.S. K u - m a r and Dr. R. S r i d h a r , Control and Information Systems Laboratories, Purdue University, Lafayette, Indiana,

IEEE C.P. "Control Without Model or Plant Identification" by J. Z a b o r s z k y , Washington University, School of Engineering, Automatic Control Area, St. Louis 30, Missouri, and W.L. H u m p h r e y , Amerson Electric Company, St. Louis, Missouri.

Session XIV - IDENTIFICATION AND CONTROL

IEEE C.P. "Estimation of State Variables via Dynamic Programming" by Lt. H. C o x , David Taylor Model Basin, Washington, D.C.,

ASME "A Bayesian Approach to Problems in Stochastic Estimation and Control" by Y.C. H o , Dptm. of Electrical Engineering, University of California, Berkeley, Cal.,and R.C.K. L e e , Honeywell Comp., Boston, Massachusetts,

ASME "On A Priori Statistics in Minimum Variance Estimation Problems" by Prof. T.T. S o o n g , Dptm. of Engineering, State University of New York, Buffalo 14, N.Y.,

ASME "Near Optimal Control in the Presence of Small Stochastic Perturbations" by Dr. H.J. K u s h n e r , Research Institute for Advanced Studies, Baltimore 12, Maryland.

Session XV - SYSTEMS DESIGN AND ANALYSIS III

ASME "On the Control of Linear Systems with Pure Time Delay" by Dr. R.W. K o e p c k e , International Business Machines Corp., San Jose Research Laboratory, San Jose, California,

ASME "Optimal Bounded Control of Linear Sampled-Data Systems with Quadratic Loss" by G.W. D e l e y , Defense Research Corp., Santa Barbara, California, and Dr. G.F. F r a n k l i n , Stanford Electronics Laboratories, Stanford University, Stanford, California,

IEEE C.P. "Optimization of Discrete Control Systems through Linear Programming" by Dr. H.C. T o r n g , Dptm. of Electrical Engineering, Cornell University, Ithaca, N.Y.,

IEEE C.P. "Linear Programming Design of Digitally Compensated Systems" by G. P o r c e l l i and K.A. F e g l e y, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.,

IEEE "On the Use of Optimization Theory for Practical Control System Design" by W.L. N e l s o n , 28-210, Bell Telephone Laboratories, Whipping, N.Y.

Session XVI - OPTIMAL CONTROL III

IEEE C.P. "Bounds for Convex Variational Programming Problems arising in Power System Scheduling and Control" by Dr. R.J. R i n g l e e , General Electric Company, 1 River Road, Schenectady, N.Y.,

IEEE "Sub-Optimal Design of Intentionally Nonlinear Controllers" by Dr. Z.V. R e k a s i u s , Electrical Engineering Dptm. Purdue University, Lafayette, Indiana,

ASME "Optimum Nonlinear Control for Step and Pulse Disturbances" by Prof. R. O l d e n b u r g e r , Dptm. of Mechanical Engineering, Automatic Control Center, Purdue University, Lafayette, Ind., and R.C.C. C h a n g ,

ASME "Optimum Control with Desired Input Piece-Wise Continuous" by Prof. C.N. S h e n and F.G. H a a g , Dptm. of Mechanical Engineering, Rensselaer Polytechnic Institute, Troy, N.Y.,

AIChE C.P. "The Synthesis of Nearly Optimal On-Off Controllers with Application to Chemical Processes" by C.B. B r o s i l o w , Case Institute of Technology, Cleveland 6, Ohio, and L.M. N a p h t a l i , Polytechnic Institute of Brooklyn, Brooklyn 1, N.Y.

Session XVII - MULTIVARIABLE AND MULTILEVEL SYSTEMS

IEEE "The Synthesis of Linear Multivariable Systems by State Variable Feedback" by B.S. M o r g a n Jr., Air Force Office of Scientific Research, (SRMS), Washington 25,D.C.

IEEE C.P. "On Organization Approach to the Optimization of Multivariate Systems" by G.J. C o v i e l l o , Sylvania Electronic Systems, Buffalo 21, N.Y.,

IEEE C.P. "The Reproducibility of Multivariable Systems" by R.W. B r o c k e t t and M. M e s a r o v i c , Systems Research Center, Case Institute of Technology, Cleveland, Ohio,

IEEE C.P. "On the Reticulation Problem in Multivariable Control Systems" by C. S p r a g u e , Fremont, III Univac, Division of Sperry Rand, San Diego 8, California,

IEEE C.P. "Practical Aspects of State-Space Methods", Part I - "System Formulation and Reduction", Part II - "System Analysis and Simulation" by M. E n n s , Electric Utility Engineering Dptm., Westinghouse Electric Corp., East Pittsburgh, Pa., and J.E. M a t h e s o n , Stanford Electronics Laboratories, Stanford University, Stanford, Cal., and J.R. G r e e n w o o d , Westinghouse Electric Corp., East Pittsburgh, Pa., and F.T. T h o m p s o n , Westinghouse Electric, Churchill Boro, Pa.,

IEEE C.P. "Multi-Level Control" by Prof. J.L. S a n d e r s , Systems Engineering Dptm., University of Arizona, Tucson, Arizona.

Session XVIII - COMPONENTS II

IEEE "Reduction of Errors in Vibratory Gyroscopes by Double Modulation" by R.W. B u s h and G.C. N e w t o n Jr., Electronic Systems Laboratory, Massachusetts Institute of Technology, Cambridge 39, Massachusetts,

ASME "A Magnetic Support for Vibration Minimization" by R.A. S m o a k , Dptm. of Mechanical Engineering, University of Virginia, Charlottesville, Virginia, and J.P. R a n e y , Dynamic Loads Div., NASA Research Center, Hampton, Virginia,

ISA "A Lumped Parameter Technique for Predicting Analog Fluid Amplifier Dynamics" by W.A. B o o t h e , General Electric Comp., Schenectady, N.Y.,

ASME "Some Design Techniques for Fluid Jet Amplifiers" by C.P. W r i g h t , International Business Machines Corp. Endicott, N.Y.,

ASME "An Improved Method for Determining the Effects of Sloshing on Liquid-Propellant-Filled Booster Transfer Functions" by E.D. R y a n , Space and Information Systems Division, North American Aviation, Inc., Downey, California.

Sessions IV, VII, X, and XIII were by special invitation without preprints.

19th ANNUAL ISA INSTRUMENT-AUTOMATION CONFERENCE AND EXHIBIT, OCTOBER 1964

The Instrument Society of America (ISA) held its 19th Annual Instrument-Automation Conference and Exhibit in New York, from October 12 to October 15, 1964.

We have abstracted for publication in this Bulletin from the very numerous papers read in course of this Conference the following titles of 59 papers which seem to be of particular interest to Automatic Control Engineers. The preprints of these papers may be obtained from the Instrument Society of America, Penn Sheraton Hotel, 530 William Penn Place, Pittsburgh 19, Pa., U.S.A., at a price of $ 0,75 per paper copy.

Session 6.1 - PROCESS COMPUTER SYSTEMS

- "Hydro-Electric Power System Control" by R.J. M a s t e r s o n and D. B u r g e s s , Westinghouse Electric Corp.

Session 11.1 - PRIMARY ELEMENTS (TRANSDUCERS)

- "Design of pH Control Systems by H.S. W i l s o n and W.J. S y l u p e k , Moore Products Company.

Session 6.2 - PROCESS SIMULATION BY ANALOG METHOD

- "Process Modeling and Analysis of Batch Reactor Control" by L.J. S c h r o c k , The Dow Chemical Company,
- "Analog Simulation of Packed Tower Distillation Columns" by Dr. R.J. R u s z k y , E.I. du Pont de Nemours & Comp. Inc.,
- "A pH Control System Implemented from a Simulated Design" by W.B. F i e l d , Union Carbide Corp., and R.M. G r e e n, The Foxboro Comp.

Session 3.1 - AUTOMATIC CONTROL - ITS IMPORTANCE AND APPLICATION

- "Review of General and Economic Aspects of Direct Digital Control Concept" by K.R. K n o b l a u c h , Fischer and Porter Co.,
- "Applying Digital Control Computers to Metals Industry Processes" by A.S. B r o w e r , General Electric Co.,
- "Integrated Industrial Testing Systems" by R.A. E d w a r d s, IBM Corp.,
- "Why Direct Digital Control?" by W.E. W a r e, Honeywell Inc.

Session 24.1 - NUCLEAR POWER INSTRUMENTATION

- "Controls and Instrumentation for the Peach Bottom Atomic Power Station" by M.E. K a n t o r , General Dynamic Corp.

Session 13.1 - INSTRUMENTATION AND MEASUREMENT IN THE METALS INDUSTRY

- "Computer Control of Oxygen Steel Making" by R.P. N o o n a n, Honeywell, Inc.

Session 21.2 - THE STATE OF THE MEASUREMENT ART IN JAPAN

- "Super Precise Temperature Control" by Dr. I. S i g i u r a, Nagoya University, Chikusa-Ku, Nagoya, Japan and A. M a r u h a s h i , Mitsubishi Electric Manufacturing Company, Nagoya, Japan.

Session 3.2 - ADVANCES IN AUTOMATIC CONTROL I

- "Adaptive Gain Tuning Applied to Process Control" by R.M. B a k k e , IBM Corporation,
- "The Approximate Time Optimal Control of Higher Order Systems Using a Generalized Model" by Dr. G.H. C o h e n , University of Rochester and W.C. E v a n s , Taylor Instrument Companies,
- "An Analysis of Extreme Seeking Nonlinear Systems" by Dr. A. L a v i , Carnegie Institute of Technology and Dr. E.J. M a s t e s c u s a , Magnetics, Inc.,
- "An Active Filter for the Measurement of Process Dynamics" by P.E.A. C o w l e y , IBM Corporation.

Session 13.2 - CONTROL OF PHYSICAL PROCESSES IN THE METALS INDUSTRY

- "The On-Line Digital Computer as Applied to Continuous Casting" by R.V. A d a m s , Bunker-Ramo Corp.,
- "Digital Computer Control in a Copper Smelter" by T.K. McM a h o n , IBM Corporation and J.H. F o r e m a n, Kennecott Copper Corporation,
- "Computer Control Application to the Continuous Casting Process" by G.A. D e F a z i o , IBM Corporation,
- "Computer Controlled Hot Rolling of Steel" by D.R. B r i s t o l , Control Data Corporation.

Session 11.4 - NEW DEVELOPMENTS IN CONTROLLERS

- "The Periodic Error Integrating Controller, PEIC" by J.L. H i l l , Ramsey Engineering Co.,
- "Graphical Solution of the Three-Mode Controller" by J.O. J a c q u e s , IBM Corporation,
- "A Programmable Process Controller" by R.C. M a s t e r , Rockwell Manufacturing Company,
- "A Precision Pneumatic Pressure Controller with Unique Dynamic and Static Characteristics" by S.W. B r e s e n o f f, Autonetics.

Session 3.3 - INTEGRATED PLANT AUTOMATION

- "Examples of Digital Computer Simulation" by J. B e l k i n, U.S. Steel Corporation,

- "Computer Simulation of a Steel Mill Ingot Processing Area" by Dr. E.Y. K u n g , Jones & Laughlin Steel Corporation and Dr. K. C h e n , Westinghouse Electric Corporation,
- "Computer Scheduling of Plate Mills" by A. C o l k e r , US Steel Corporation,
- "Decentralized Plant Control" by Dr. J.D. S c h o e f f l e r and Dr. L. L a s d o n , Case Institute of Technology.

Session 11.5 - HIGH-ENERGY CONTROL VALVES - SELECTION AND APPLICATION I

- "Selecting Velocities of Compressible Fluids in Reducing Valves" by H.D. B a u m a n n , A.W. Cash Co.,
- "Velocity as a Factor in Valve Selection" by P. W i n g Jr., Mason-Neilan,
- "High Pressure Valves" by J.W. T e e g a r d e n , Fisher Governor Company.

Session 17.1 - PULP AND PAPER INSTRUMENTATION I

- "Headbox Control" by R.H. P e n t e c o s t , Oxford Paper.

Session 3.4. - ADVANCES IN AUTOMATIC CONTROL II

- "An Analysis of the Distributed Lag" by Dr. B.J. B a l l , Mississipi State University and Dr. M.G. R e k o f f , Jr., Texas A and M University,
- "Optimum Tuning of Controllers in Digital Simulations" by D.C. U n i o n , IBM Corporation,
- "Feedback Design of Systems with Saturation Constraints" by W.C. F o s t e r and Dr. D.R. V a u g h n , Douglas Aircraft Co., Inc.,
- "Minimizing Instrumentation by Using Model Feedback and Adaptive Control System Techniques" by W.K. W a y m e y e r, P.N. C o w g i l l and M.R. P r i c h a r d , Douglas Aircraft Co., Inc.

Session 5.3 - SYSTEMS ENGINEERING IN PROCESS DESIGN, TROUBLE SHOOTING AND OPERATOR TRAINING

- "Use of Dynamic Analysis in the Design of a Process and Its Control System" by M.J. de P a s q u a l e , Socony Mobil Oil Company, Inc.
- "Control of an Exothermic Reactor" by P.E.A. C o w l e y , IBM Corporation and D.E. J o h n s o n , Shell Development Company,
- "Application of Systems Engineering in Trouble Shooting an Existing Process" by B.D. S t a n t o n , Shell Development Company,
- "Dynamic Simulation Adds Realism to Operator Training" by R.E. L i e b e r , Esso Research and Engineering Company.

Session 11.6 - HIGH ENERGY CONTROL VALVES - SELECTION AND APPLICATION II

- "Control Valve Cavitation" by S.F. L u n a , Westinghouse Electric Corp. and R.K. Van A u s d a l , The Bendix Corp.,
- "Characteristics of Ball Valves for Throttling Control" by G.R. Y t z e n , Fisher Governor Co.

Session 4.1 - CEMENT AND LIME INSTRUMENTATION

- "Digital Proportioning Control of Raw and Finish Mills" by L.D. McE v o y , The Foxboro Co.,
- "Automatic Control of Feed Rates to Grinding Mills in the Cement Industry" by J.O. B r e n t , Milltronics Limited.

Session 5.4 - DIRECT DIGITAL CONTROL

- "Direct Digital Control - Questions that must be Answered" by J.W. B e r n a r d and G.C. H e n d r i e , The Foxboro Company,
- "Digital Simulation Techniques for Direct Digital Control Studies" by R.N. L i n e b a r g e r , IBM Corporation.

Session 8.1 - ELECTRONICS IN MEASUREMENT, DATA HANDLING AND CONTROL I

- "Interfacing Problems between Digital Computers and Analog Controller" by R.N. P o n d , IBM Corporation.

Session 11.7 - MEASUREMENT SYSTEMS

- "Standard Environmental Specifications for Process Control Instrumentation" by J.T. B e a v e r s , IBM Corporation,
- "A New Approach to Temperature Control" by W.A. M o r g a n, U.S. Weather Bureau.

Session 4.2 - GLASS INSTRUMENTATION

- "The Application of Radiation Pyrometry to Glass Temperature Measurement and Control" by J.R. B e a t t i e , Pilkington Brothers, Ltd.,
- "Automatic Control of Recuperative Glass Tank" by W.C. T r e t h e w e y , Owens-Corning Fiberglas Company,
- "Unique Combustion Control of a Regenerative Furnace" by H.C. B e v i n s , American St. Gobain Company.

Session 5.5 - VARIOUS ASPECTS OF PROCESS CONTROL

- "Cascade Control in the Process Industries" by L. G e s s , Honeywell, Inc.,
- "Dynamic Response of the Dominant Bath Reactor" by H.H. M a r h a u e r , The Procter & Gamble Company,
- "Operator-Oriented Control Room Design" by D.K. H a n k i n s o n , Bailey Meter Company,

- "Batch Control of a Steam Sparge System" by W.A. F i n n e r a n , Monsanto Company.

Session 11.8 - ANALOG COMPUTERS - WHY, NOT HOW!

- "Flow Measurement and Blending by Special Purpose Analog Computer" by J.E. G r a d e r , Taylor Instrument Companies,
- "On-Line Applications of Analog Techniques in Steelmaking" by N.F. S i m c i c and J.R. D a h m , Jones & Laughlin Steel Corporation,
- "Control Systems Engineering through Analysis and Simulation" by T.R. S c h u e r g e r , U.S. Steel Corporation.

COMING EVENTS

MICROWAVE RESEARCH INSTITUTE (MRI)
SYMPOSIUM XV, April 1965

Call for Papers

The Symposium committee consisting of Professors R. Drenick and L. Shaw as Co-chairmen, Dean J.G. Truxal, Professors A.E. Laemmel, W.A. Lynch, E.J. Smith and D. Youla, with Mr. J. Fox as Secretary, announces:

P.I.B. International Symposium on System Theory.

The Polytechnic Institute of Brooklyn announces that the fifteenth in its series of annual international symposia will be devoted to "System Theory". It will be held in New York City on April 20-22, 1965. It is the aim of this symposium to present mathematical developments and engineering interpretations of mathematical theories which together define system theory. In this context the term system theory includes the concepts which are fundamental to problems of control, communication, information processing, economic forecasting etc. as well as those developments in these specialized problem areas which show promise of relating to the general class of problems.

The topics considered for presentation are, more specifically, the following:

1. Basic notions of system theory
2. Mathematical representations of systems
3. Dynamic Systems (including finite-state machines)
4. Systems with random inputs
5. Optimal systems
6. Systems identification
7. Large-scale systems
8. The relation of system theory to science and engineering.

The symposium is organized, as in past years, under the aegis of the Microwave Research Institute (MRI) of the Polytechnic Institute of Brooklyn, with the co-sponsorship of the Air Force Office of Scientific Research, the Office of Naval Research and the Army Research Office, and with the cooperation of the Institute of Electrical and Electronics Engineers and

the Society for Industrial and Applied Mathematics. The Proceedings of the Symposium will be published by the Polytechnic Press as Volume XV of the MRI Symposia Series and will be available at a reduced rate to members of participating societies.

This symposium will continue the tradition of providing a review of the present status of system theory and a forum for discussion by engineers, physicists and mathematicians. The program is being organized around invited papers and the Symposium Committee Co-chairmen, Professors R. Drenick and L. Shaw, will welcome contributed papers up to the deadline for submission of January 15, 1965. Please address all correspondence to: Symposium Committee, Polytechnic Institute of Brooklyn, 333 Jay Street, Jerome Fox, Secretary.

OTHER COMING EVENTS

The following alterations and new announcements are to be added to the information already listed in Bulletins No. 15 (pp. 41 and 42), No. 16 (pp. 46 and 47) and No. 17 (pp. 16, 17 and 18):

Feb. 7-11, 1965	The 1965 AIChE (American Institute of Chemical Engineers) Petrochemical and Refining Exposition and Conference	Sam Houston Coliseum, Houston, Texas
Apr. 13-15, 1965 (originally announced in 1965 without any date)	14th National Telemetering Conference with Exhibit. Co-Sponsors: ISA, AIAA, IEEE. Program contact: R.W. Towle, 26493 Weston Rd., Los Altos Hills, California	Shamrock-Hilton Hotel, Houston, Texas (originally announced in El Paso, Texas)
Apr. 19-21, 1965	3rd National ISA Biomedical Sciences Instrumentation Symposium. Contact: Prof. H.W. Shipton, University of Iowa Medical School, Iowa City, Iowa	Marriott Motor Hotel, Dallas, Texas
April 1965	3rd National ISA Marine Sciences Instrumentation Symposium. Contact: Dr. W.C. Knopf, University of Miami, School of Engineering, Coral Gables, Florida 33124	Miami, Florida
May 5-8, 1965	6th International ISA Pulp & Paper Instrumentation Symposium. Contact: R.L. Stoughton, P.O.B. 242, New London, Wisconsin	Hotel Northland, Green Bay, Wisconsin
May 12-14, 1965	8th National ISA Power Instrumentation Symposium. Contact: H.H. Johnson, 4 Irving Place, New York, N.Y. 10003	New York City

May 26-28, 1965 (originally announced in 1965 without any date)	11th National ISA Analysis Instrumentation Symposium, jointly with 6th National ISA Chemical & Petroleum Instrumentation Symposium, with Section Exhibit. Analysis Instrumentation Program contact: G. Doering, Industrial Nucleonics Co. 650 Ackerman Rd., Columbus 2,Ohio. Chemical & Petroleum Instrumentation Program contact: W.C.Virbila, The Bristol Co., Box 1790, Waterbury 20, Connecticut	Sheraton-Mount Royal Hotel, Montreal, Canada (originally announced in Oakland,Cal. and then in Houston, Texas.
Oct. 5-7 1965	11th National ISA Aerospace Instrumentation Symposium. Contact: A. Sherman, Beckman Instruments, Inc., 2400 Harbor Bvd., Fullerton, California	Los Angeles, California
1965	18th Annual Conference on Engineering in Medicine and Biology, with Exhibit. Co-sponsers: ISA, IEEE. Contact: Dr. H. Schwan,Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pennsylvania	Sheraton Hotel, Philadelphia, Pennsylvania
1966	7th Annual Joint Automatic Control Conference. Co-sponsors: ISA, AIAA, AIChE, ASME, IEEE	Denver, Colorado
1966	7th International ISA Pulp and Paper Instrumentation Symposium	Augusta, Georgia
1966	12th National ISA Analysis Instrumentation Symposium	Houston, Texas
1967	8th Annual Joint Automatic Control Conference. Co-sponsors: ISA, AIAA, AIChE, ASME, IEEE	Philadelphia, Pennsylvania
1967	8th International ISA Pulp and Paper Instrumentation Symposium	St. Paul, Minnesota
1968	9th Annual Joint Automatic Control Conference. Co-sponsors: ISA, AIAA, AIChE, ASME, IEEE	Austin, Texas
1968	9th International ISA Pulp and Paper Instrumentation Symposium	Savannah, Georgia

ISA HONOURS AND AWARDS 1964

On 13th October 1964 the Instrument Society of America has granted in New York City the following awards:

THE HONORARY LIFETIME MEMBERSHIP
(reserved to those individuals whose outstanding contributions to the advancement of the arts and sciences of instrumentation are worthy of special recognition)
- to Dr. B.G. B a l l a r d, President of the National Research Council of Canada, Ottawa, Canada.

THE DONALD P. ECKMAN AWARD FOR DISTINGUISHED ACHIEVEMENT IN EDUCATION
(presented annually to an individual in recognition of an outstanding educational contribution to the science and technology of instrumentation)
- to Professor T.J. H i g g i n s, University of Wisconsin, Madison, Wisconsin.

THE PHILIP T. SPRAGUE AWARD
(presented annually to an individual in recognition of an outstanding achievement in the conception, design or implementation of power plant instrumentation)
- to Dr. E.D. S c u t t, Assistant to the Vice-President, Systems Dep., Leeds and Northrup Comp., North Wales, Pennsylv.

THE EXCELLENCE IN DOCUMENTATION AWARD
(presented annually to an author in recognition of the most outstanding article, paper or other document published under the auspices of the Instrument Society of America)
- to Dr. R. O l d e n b u r g e r, Professor of Mechanical Engineering and Director of the Automatic Control Center, Purdue University, Lafayette, Indiana.

THE ARNOLD O. BECKMAN AWARD
(presented annually to an individual in recognition of a significant technological contribution to the conception and implementation of a new principle or instrument design, development or application)
- to Dr. W.P. M a s o n , Head, Mechanics Research, Bell Telephone Laboratories, Murray Hill, New Jersey.

NEW DYNAMICAL SYSTEMS RESEARCH CENTER

Twelve mathematicians who have been associated with the Research Institute for Advanced Studies (RIAS) of Baltimore, Md. and who have more particularly devoted themselves to non-linear differential equations and their applications to dynamical systems, information processing, control of machines, space exploration, guidance systems, communications and Automatic Control, are joining the new Dynamical Systems Research Center of Brown University, Providence, R.I. These are: Dr. S. Lefschetz, Dr. J.P. LaSalle, Dr. J.H. Hale, Dr. J. Florentin, Dr. H.J. Kushner, Dr. M.M. Peixoto, Dr. W.M. Wonham, Dr. L. Weiss, Dr. H.G. Hermes, Dr. E.O. Roxin, Dr. K. Meyer and Dr. F.W. Wilson, Jr.

WORLDWIDE AUTOMATIC CONTROL

Reports on past international Conferences

IMEKO 1964

As announced in Bulletin No. 17 (pp. 7 to 9), the joint 3rd INTERNATIONAL MEASUREMENT CONFERENCE (IMEKO III) and 6th International Instruments & Measurements Conference I & M VI took place in Stockholm, Sweden, from September 14 to 19,1964. The Section 2.14 on border questions of measurement and automation, jointly organized with the Technical Committee on Components of IFAC, comprised the following papers; each of the latter is indicated with its code figure of the ACTA IMEKO 1964:

- W.G. A t a m e n k o , USSR: Recording transfer function analyser for infra-low frequencies with six channels, for the examination of control loops (in Russian). 14-SU-215
- R.H. B a r k e r and W.R. G o s l i n g , United Kingdom: A new system of guidance by modulated light beam (in English). 14-UK-241
- Y. D o i and H. S u z u k i , Japan: A numerically controlled linear dividing machine (in English). 14-JA-172
- D.J. F r a a d e , U.S.A.: Advanced instrumentation and the control computer (in English). 14-USA-256
- V.S. M a l o v , A.M. P s h e n i c h n i k o v and I.A. K u p e r s h m i t , USSR: Multi-channel devices for transmission of measurement information by communication lines and for its reproduction in digital form (in Russian). 14-SU-216
- J. M a x , France: Numerical correlator (in French). 14-FR-169
- F. S z l a v i k and I. P a l m a i , Hungary: A novel system for the complete automation of multiphase measurements (in English). 14-HU-134
- T u n g S h i n - H u n g and C h i a n g X i n - S o n g, China: Application of extremal seeking principle to the d.c. null-detecting system (in English). 14-CH-222
- E.G. W o s c h n i , Germany: Theoretical investigation of information flow and channel capacity as applied to measuring technique (in German). 14-DDR-235

Information on the IMEKO Proceedings is given under the item 'Publications' on page 74 of this Bulletin.

4th INTERNATIONAL CONFERENCE OF AICA

As announced in Bulletin No. 16 (pp. 32 and 33), the 4th International Conference of AICA (Association Internationale pour le Calcul Analogique - International Association for Analogue Computing) took place at the College of Technology of Brighton, United Kingdom, from September 14th to 18th,1964.

We give hereafter the titles of some papers related to

simulation, optimization and control

and likely to be of interest to Automatic Control engineers.

1 "Simulation of a Hybrid Computer on a Digital Computer" by J.R. H u r l e y , R.M. J a n o s k i , V.C. R i d e o u t, J.J. S k i l e s,

10 "The Synthesis of Optimum and Quasi-Optimum Minimum Time Controls for Second Order Systems" by H. T i t u s ,

15 "Dynamic Simulation of Steam Flow Problems in Turbines and Heat Exchangers" by D. G r a u p e and A.S. A l d r e d ,

17 "Space-time Analog Model for Nuclear Power Reactor Burn-up Computation" by A. M a t h i s ,

20 "Critical Comparison of Different Analog Models for Nuclear Fuel Rods" by A. M a t h i s , P. G i o r d a n o , S. P e t r a r c a ,

27 "Use of a Dead-Time-Generator to Simulate the Water Hammer Effect Including the Elasticity of Water and Conduit" by E. P r o e l l ,

28 "Analog Study of Turboblower Dynamic Behavior" by G. C h a z a l and J.P. M e r l e ,

40 "Synthesis of Optimal Control and Hybrid Computation" by W. de B a c k e r ,

56 "The Analysis of Water-Gas Heat Exchangers by Means of an Analogue Computer" by W.G. L i t t l e j o h n and A.G. B r a d s h a w ,

67 "The Simulation of a Simple Chemical Process" by N.W. R e e s and D.H. S t o c k w e l l ,

68 "Synthesis and Optimization of a Model of Cardiovascular Dynamics with an Analog Computer" by G.A. B e k e y ,

69 "Parameter Optimization by an Automatic Open-Loop Computing Method" by H.F. M e i s s i n g e r ,

70 "Analog Method in the Algebraic Synthesis of Linear Control Systems" by P. K o k o t o v i c and D.D. S i l j a k ,

75 "Hybrid computer solution to the optimum hydro-steam dispatch problem" by E.B. D a h l i n and D.W.C. S h e n ,

78 "Realisation d'un simulateur de retard pur pour calculatrice analogique" by J. Lagasse, Y. Sevely, and C. Durante,

97 "Prediction for an Optimal Steering of an Object containing an Oscilating Member, by means of an Analog Computer" by N.N. Mikhailov and Z.N. Novoseltsev,

105 "Optimizing a Diffusion Problem with the help of a High Speed Analogue Computer" by L. Dekker,

115 "High-frequency computing techniques applied to industrial control" by F. Garnier and M.H. Hassid,

117 "A Transient study of a Once-Through Boiler" by R.A. Laws, D.H. Brereton and L.N. Carling,

119 "Operational Amplifier Networks for Transfer Function Synthesis" by A.W. Keen,

120 "Optimization study of a stirred tank reactor" by R. Petrovic,

130 "The Simulation of a Once-Through Boiler" by D.Wilson and W.G. Proctor,

135 "On the Use of Hybrid Computing Technique in a Missile Guidance Computer" by R.W. Williams,

137 "An Analogue Computer Application to Controlling Production Processes subject to Trend" by S. Eilon and D.P. Deziel,

140 "The Simulation of Fluctuation and Propagation in Nuclear Reactors on a Hybrid Computer" by L.G. Kemeny,

141 "Analog Simulation of Discrete State Models" by C.H. Hoffman,

142 "A Five Degree of Freedom Moving Cockpit Flight Simulator" by D.I. Robertson, N. Brenchley and P. Rumsey.

4th INTERNATIONAL CONGRESS ON CYBERNETICS

As announced in Bulletin No. 17 (p. 10), this Congress took place in Namur, Belgium, from October 19th to 23rd, 1964.

We give, hereafter, the titles of some papers of interest to automatic control engineers:

- "Measuring the internal information exchange in a System" by R. Ashby (United Kingdom), University of Illinois, USA,
- "Automatic Decision Making with Sequential Probability Ratio Tests" by W.B. Kendall (USA), California Institute of Technology, Jet Propulsion Laboratory,
- "L'aspect actuel de la Cybernétique dans les cheimins de fer" by C. Laurent (France), Société Nationale des Chemins de Fer,

- "Nouveau Concepts dans l'auto-adaptation" by C. Penescu (Rumania), Member of the Academy of Sciences,
- "Reliability and Learning Matrices" by U. Piske (Germany), Institut für Nachrichtenverarbeitung und Nachrichtenübertragung, Technische Hochschule, Karlsruhe,
- "Etude des Systèmes auto-organisateurs (self-organizing systems) par la méthode du transfert d'ordres" by J. Polonsky (France), Television Department, Compagnie Générale de Télégraphie sans Fil,
- "Optimisation du lissage d'un signal inconnu en présence de bruit blanc" by M. Tournarie (France), Commissariat à l'Energie Atomique.

Announcements of future international Conferences

AUTOMATION IN THE IRON AND STEEL INDUSTRY

As announced in Bulletin No. 17 (p. 11), this conference will be held in Amsterdam, Netherlands, from Monday, the 29th of March to Wednesday, the 31st of March 1965, and in Düsseldorf, Germany, from Thursday, the 1st of April to Saturday, the 3rd of April 1965.

We are now in a position to publish the detailed program of this conference. All further details may be obtained from:

Centre National de Recherches Métallurgiques (C.N.R.M.), Abbaye du Val-Benoit, Liège, Belgium, Phone: 527050, Telex: 04202, or from

Verein Deutscher Eisenhüttenleute (VDEh), Breitestrasse 27, Düsseldorf, Germany, Phone: 10151, Telex: 08582512.

Technical visits will be arranged both in Amsterdam and in Düsseldorf.

The programme of the conference itself is as follows:

Amsterdam Section
Monday, 29th March, 1965

A - AUTOMATION IN SINTERING

- "Moisture and Chemistry Control in Sinter Plant Operation" by Dr. H.N. Lander and Dr. M.C. Chang, The Youngstown Sheet and Tube Co., Youngstown, U.S.A.,
- "Automation in the Dwight-Lloyd Sintering Process" by Dr. K. Tsujihata, Yawata Iron and Steel Co.Ltd., Japan,
- "Application of Sampled-Data Control to the Dwight-Lloyd Sinter Strand at the Hirohata Works" by K. Morinaga and T. Katada, Fuji Iron and Steel Co., Ltd., Japan,

- "L'automatisation complète d'une bande d'Agglomération" (Complete Automation of a Sinter Strand) by M. Erpelding, S.A. Hadir, Differdange, Luxembourg, G.D.,
- "L'automatisation de la bande d'agglomération des Forges de la Providence" (Automation of the Sinter Strand at Les Forges de la Providence), Research Department, Les Forges de la Providence, Marchienne-au-Pont, Belgium.

B - AUTOMATION OF THE BLAST-FURNACE

- "Rechnerische Erfassung der Erzreduktion im Gegenstrom als Grundlage eines mathematischen Hochofenmodells" (Mathematical Study of Counter-Current Ore Reduction as a Basis for a Mathematical Model of a Blast-Furnace) by L. von Bogdandy and R. Wartmann, Hoesch A.G., Westfalenhütte, Dortmund, Germany,
- "Dix-huit mois d'expériences industrielles de contrôle d'un haut fourneau à l'aide d'un ordinateur" (Eighteen Months of Industrial Experience of Blast-Furnace Control by means of a Computer) by C. Staib, P. Dancoisne and J. Michard, Institut de Recherches de la Sidérurgie Française, France,
- "Computer Control of a Blast-Furnace" by K. Katsura, Nippon Kokan K.K., Japan,
- "L'automatisation du haut fourneau V de Koninklijke Nederlandsche Hoogovens en Staalfabrieken" (The Automation of Blast-Furnace V of the Koninklijke Nederlandsche Hoogovens en Staalfabrieken) by G.W. van Stein - Callenfels and J.M. van Langen, Koninklijke Nederlandsche Hoogovens en Staalfabrieken, N.V., Ijmuiden, Holland,
- "Contrôle du haut fourneau no. 3 de Piombino à l'aide du calculateur. Résultats d'exercice et perspectives" (Computer Control of Blast-Furnace No. 3 at Piombino" Results and Prospects) by Ing. G.B. Spallanzani and Ing. N. Andreotti, Italsider, Ing. G. Sironi and Ing. L. Pompilio, C.S.M., Italy

C - AUTOMATION OF OXYGEN STEELMAKING

- "Computer Control of L-D Converters" by Dr. N. Yazamoto, Sumitomo Metal Industries, Ltd., Japan,
- "Recent Advances in Basic Oxygen Furnace Control" by H.W. Meyer, Jones and Laughlin Steel Corp., U.S.A.,
- "Computer-Controlled L-D Steelmaking", Lysaght's Scunthorpe Works and English Electric Co., Ltd., Great Britain,
- "L'automatisation de l'affinage des fontes à l'oxygène et exemple d'application à l'affinage des fontes phosphoreuses par le procédé OLP" (Automation of the Oxygen Refining of Pig Irons Exemplified by its Application to the Refining of Phosphoric Pig Irons by the OLP Process) by P. Vayssiere and P.H. Cesselin, Institut de Recherches de la Sidérurgie Française, France,

- "Computer Control of the Kaldo Operation at Sharon Steel", Dravo Corp., (USA), (tentative),
- "Beitrag zur Automatisierung eines LD-AC Stahlwerkes" (Contribution to the Study of the Automation of LD-AC Steelworks), Dortmund-Hörder Hüttenunion, Germany,
- "Neue Verfahren zur Überwachung und Steuerung des metallurgischen Ablaufes bei den Sauerstoffaufblasverfahren" (New Methods of Supervising and Controlling the Metallurgical Processes in Oxygen Steelworks) by J. Maatsch, K. Borowski and H. Krainer, Friedr. Krupp, Essen, Germany.

Düsseldorf Section
Thursday, 1st April, 1965

A - THE TECHNIQUE OF MEASUREMENT ON HOT ROLLING MILLS

- "Die Anwendung von Hallsonden zur Messung des Magnetischen Flusses bei Walzantrieben" (The Use of Hall Probes to measure the Magnetic Flux in Mill Motors) by W. Nürnberg, Technische Universität Berlin, Germany,
- "Etude comparative des différentes méthodes de mesure du couple de laminage" (Comparative Study of the Various Methods of Measuring the Rolling Couple) by A. Danthine, C. Stolz and Ch. van den Hove, Centre National de Recherches Métallurgiques, Benelux.

B - AUTOMATION OF REVERSING HOT MILLS

- "Centralised Information System on Soaking Pits and a Slabbing Mill" by M. Oshima, Chiba Works, Kawaraki Steel Corp., Japan,
- "Comparaison des résultats d'exploitation d'un blooming de 1150 mm en marche manuelle et semi-automatique" (Comparison of the Operating Results of an 1150 mm Blooming Mill Controlled by Hand and Semi-Automatically) by A. Danthine and R. Pirlet, Centre National de Recherches Métallurgiques, Benelux,
- "Contrôle du train à tôles de Taranto à l'aide du calculateur" (Computer Control of a Plate Mill at Taranto) by C. Ando, E. Cavazzoni, Italsider, and G. Daneu, Colsider, Italy.

C - AUTOMATION OF HOT WIDE-STRIP MILLS, BILLET MILLS AND SMALL AND MEDIUM-SECTION MILLS

- "Entwicklungsstand und Betriebserfahrungen mit teilautomatisierten Anlagen einer Feinstahl- und einer Mittelstahlstrasse" (Present Development and Operating Experience with Partially Automated Plant in a Small- and Medium-Section Mill) by K. Eichacker and H.H. Billen, Röchling'sche Eisen- und Stahlwerke, GmbH., Völklingen, Saar, Germany,

- "Automatisierung von Warmbreitbandstrassen" (Automation of Hot Wide-Strip Mills) by N.H. R i e s k a m p , August-Thyssen-Hütte A.G., Duisburg, Germany,
- "Computer Control of a Hot Strip Mill", Richard Thomas and Baldwins, Ltd., Great Britain,
- "Automatic Gauge Control of 68 inch Hot Strip Mill at Tokai Steel Works" by K. T s u r u t a , Hot Strip Mill, Tokai Steel Company, Japan.

D - AUTOMATION OF COLD ROLLING MILLS

- "Messtechnik in Kaltwalzwerken als Voraussetzung für die Automatisierung" (Measuring Technics on a Cold Strip Mill preparing Automation), Teil I: Erfassung der wesentlichen Prozessgrössen (Part I: Measuring of Basic Process Data) by A. S t e i d l , Rasselstein AG, Neuwied, Germany, Teil II: Vergleich verschiedener Verfahren zur Messung von Walzkraft und Walzmoment (Part II: Different Methods of Measuring Pressure and Torque during Rolling) by O. P a w e l s k i , Max-Planck-Institut, Düsseldorf, F. L i n d e m a n n , Bochumer Verein AG, Bochum, A. S t e i d l , Rasselstein AG, Neuwied, R. D a h m , Rasselstein AG, Andernach, Germany,
- "Computer Control of 4-Stand Tandem Cold Mill", The Steel Company of Wales, Ltd., Steel Division, Great Britain,
- "Détection continue sur ligne industrielle de l'évolution du décapage chimique des bandes et application au contrôle du processus" (Continuous Observation of the Chemical Cleaning of Strip on the Production Line and its Application to the Control of the Process) by Ch. van den H o v e and Y. N o e l , Centre National de Recherches Métallurgiques, Benelux.

IFIP CONGRESS 1965

As announced in Bulletin No. 15 (p. 14), this Congress will be held in New York, May 1965. We are now in a position to announce its exact date: May 24 to 29, 1965, and location: 345 East 47th Street (at United Nations Plaza), New York 17, as well as to give its provisional programme with the following abbreviations:

Sp - specialists Pa - panel
Sy - symposium Ge - general

Monday, May 24

Afternoon:
(Ge) Organization of Large Storage Systems I
(Sp) Optimization
(Sy) Parallel and Concurrent Systems
(Sy) Pattern Recognition and Self-Organizing Systems
(Sy) Recent Developments in General Purpose Programming Languages

Tuesday, May 25

Morning:
(Sp) Partial Differential Equations
(Sp) Outlook in the Memory Area
(Sy) Methods of Describing Information Systems
(Sy) Mechanization of Theorem Proving
(Sy) Digital Automatic Control
(Pa) Trends in Computer Logic Development in connection with a class of solved problems
(Sy) Requirements and Prospects for Commercial Programming
(Sy) Numerical Methods
(Sy) Batch Processing versus Direct Processing

Afternoon:
(Ge) Programming
(Sp) Future of Switching Elements
(Sy) Switching Theory and Application of Automata Theory to Computer Design
(Sy) Experiences on Multiprogramming
(Sy) Design of Processors for Programming Languages I
(Sy) Scheduling Problems
(Sy) High-Speed Read only Random-Access Memory

Wednesday, May 26

Morning:
(Sp) Organization of Large Storage Systems II
(Sp) Artificial Intelligence
(Sy) Formal Aspects of Programming Languages
(Sy) Linear Systems
(Sy) Microelectronics and Integrated Circuiting
(Sy) Mathematical Programming
(Sy) Mass Memories

Afternoon:
(Ge) Automata Theory and Simulation of Thought Processes
(Sp) Programming Theory
(Sy) Strategy of File Organization
(Sy) Information Processing by Electro-optical Means
(Sy) Application of Computers to the Graphic Arts
(Pa) Content Addressable Memories
(Sy) Man Machine Interaction: Engineering Design
(Sy) Computer Based Teaching, R. Goodman
(Pa) Economics of Programming

Thursday, May 27

Morning:
(Sp) Programming Practice
(Sy) System Testing of System Programmes
(Sy) Graphs and Combinatorial Problems
(Sy) Remote Consoles and Displays
(Sy) Mathematical Models af Languages
(Sy) Message Store and Forward Systems
(Sy) Ultra High Speed Computers
(Sy) Algebraic Automata Theory
(Sy) Problems in Partial Differential Equations

Afternoon:
(Ge) Trends in Computer Design
(Sp) Mechanical Translation
(Sy) Large Interconnected Programmes
(Sy) Constructive Analysis: non-well set Problems
(Sp) The Design of Processors for Programming Languages
(Sy) Extra
(Sy) Approximation Theory
(Sy) List Processing and Applications
(Sy) Programme Development, Programme Documentation

Friday, May 28

Morning:
(Sp) Design of Information Systems
(Pa) Education in International Processing Sciences
(Sy) Languages for Simulation Processes
(Sy) New Components
(Sy) Error Analysis
(Sy) Man-Machine Interaction: Graphics of Data Processing
(Sy) Application of Computers to Number Theory and Discrete Problems
(Pa) Mechanization of Creative Processes
(Sy) Multi-Computer Systems

Afternoon:
(Ge) Application of Function Spaces to Numerical Analysis
(Sp) Mathematical Theory of Automata and Switching Theory
(Sy) Programming Strategy to insure Continuous Performance
(Pa) Must Commercial Languages be disjoint from Scientific Languages?
(Sy) Application of Computers to the Study of Social Systems
(Sy) Pattern Recognition Devices
(Sy) Design of Processors for Programming Languages II.

INTERKAMA

The 3rd INTERKAMA (International Congress and Exhibition for Measurement and Automation) will not be held from 10th to 16th November 1965 as announced in Bulletin No. 14 on page 25 but from 13th to 19th October 1965, in Düsseldorf, Germany.

PUBLICATIONS

The classification used is that of the International Bibliography of Automatic Control

The first volume of the

6.9.1.

PROCEEDINGS OF THE SECOND CONGRESS OF IFAC
Basle, 1963

has appeared under the title

AUTOMATIC AND REMOTE CONTROL
Vol. APPLICATIONS AND COMPONENTS

This volume contains the papers on Applications and Components read at the Second IFAC Congress together with the ensuing discussions.

The Section of Applications deals with the following fields:- Electric Utility - Steel Industry - Chemical and Oil Industries - Automation in Industrial Processes - Combined Man-Machine Systems - Application Techniques - Automatic Control of Aerospace Systems.

The Section of Components deals with the following fields:- Mechanical, Hydraulic and Pneumatic Devices - Electromechanical Devices and Magnetic Amplifiers - Electronic Components - Digital Devices - Process Instrumentation - Component Reliability.

The volume has 41 + 749 pages including numerous illustrations and tables.

The second volume on Theory will be published in spring 1965.

The price for both volumes is £38.0.0. or DM 425,- respectively. Attendants of the Congress may purchase the set at a reduced price. Orders should be addressed to:

Butterworth & Co., Ltd.
4-5 Bell Yard,
London, W.C.2., England.

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R. Oldenbourg Verlag,
Rosenheimer Str. 145,
München 8, Germany.

2.4.1.0.
6.9.1.

PROCEEDINGS

of the

IFAC SYMPOSIUM ON RELAY SYSTEMS AND FINITE AUTOMATA

Moscow, September, 1962

Copies of these Proceedings can be obtained from:

Dr. Warren L. Semon,
Burroughs Laboratories,
P.O. Box 782,
Paoli, Pennsylvania,
U.S.A.

The price is $7.50. The volume contains the English translation of the Russian language papers presented at the symposium; papers originally presented in the English language are not included in this volume.

6.9.1.

PROCEEDINGS

of the

THIRD INTERNATIONAL MEASUREMENT CONFERENCE IMEKO III

Stockholm, September, 1964

ACTA IMEKO 1964, vols. 1 - 3, have been released and contain the full texts of all papers presented at the meeting. A 4th volume comprising supplementary information presented by the authors, the discussion, and the review lectures will be completed shortly.

These volumes may be obtained from:

Kultura Hungarian Trading
for Books and Newspapers,
P.O. Box 148,
Budapest 62,
Hungary.

The price is approximately $30.

The lectures from the I & M Special Section on Automatic Control will be published in a separate volume.

Czechoslovakia

1.2.0. N. W i e n e r : CYBERNETICS AND SOCIETY. Praha, Nakladatelstvi Ceskoslovenske Akademie Ved, 1963, 220 p., 20,50 Kcs.

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3.1.1.1. V. N e s s e l : VOLTAGE REGULATORS FOR AUTOMATIC DEVICES. Praha, Statni nakladatelstvi technicke literatury, 1963, 160 p., 128 illus., 7 Kcs.

4.0.0. B. B o s e k , B. H a n u s , O. P a n k r a z , O. S u l a : FUNDAMENTAL OF CONTROL ENGINEERING. Praha, Statni pedagogicke nakladatelstvi, 1961, 388 p., 443 illus., 18.10 Kcs.

4.0.1.0. R. D v o r a k : ELECTRIC CONTROLLERS OF NONELECTRIC VARIABLES. Praha, Statni nakladatelstvi technicke literatury, 1963, 246 p., 132 illus., 8 Kcs.

4.2.3.1. K. K a b e s : ELECTROMECHANICAL RECORDING DEVICES. Praha, Statni nakladatelstvi technicke literatury, 1963, 190 p., 138 illus., 9,50 Kcs.

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4.5.1.3. J.S. H a s k o v e c ; N.P. V a s i l j e v a : LOGIC ELEMENTS FOR AUTOMATIC CONTROL. Praha, Statni nakladatelstvi technicke literatury, 1963, 244 p., 173 illus., 7,50 Kcs.

4.6.1.1. D u s e k , M i c k a , P o s p i s i l : ROTATING MACHINES FOR AUTOMATIC CONTROL. Praha, Statni nakladatelstvi technicke literatury, 1963, 250 p., 150 illus.,8 Kcs.

5.0. A u e r h a n , B a l d a , D r a b , R i h a : FUNDAMENTAL PROBLEMS OF AUTOMATION. Praha, Nakladatelstvi politicke literatury, 1963, 242 p., 22,50 Kcs.

5.5.1.0. J. S t e p a n : DESIGN OF AUTOMATIC CONTROL SYSTEMS IN HEAT TECHNIQUES. Praha, Statni nakladatelstvi technicke literatury, 1963, 256 p., 152 illus., 19,50 Kcs.

5.5.4.0. J. H e n d r y c h : CONTROL DEVICES FOR REMOTE CONTROL AND SIGNALISATION IN ELECTRIC POWER PLANTS. Praha, Statni nakladatelstvi technicke literatury, 1963, 244 p., 203 illus., 8,50 Kcs.

France

1.1.2.1. F.E. N i x o n : TRANSFORMATION DE LAPLACE. Tables et exemples (The Laplace transform. Tables and examples). Paris, Dunod, 1964, 114 p., 3 illus., 18 F.

1.1.6.0. R. F a u r e , J.P. B o s s , A. L e g a r f f : LA RECHERCHE OPERATIONNELLE (Operational research). Paris, Presses Universitaires de France, 1961, 126 p.

1.1.6.0. E. L u k a c s : FONCTIONS CARACTERISTIQUES (Characteristic functions). Paris, Dunod, 1964, 230 p., 32 F.

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2.0. P. D e c a u l n e , M. C a r p e n t i e r , J.C. G i l l e , M. P e l l e g r i n : PROBLEMES D'ASSERVISSEMENTS AVEC SOLUTIONS (Control problems with solutions). Paris, Dunod, 1963.

2.0. J. L a g a s s e : ETUDE DES CIRCUITS ELECTRIQUES. Vol. 2. REGIMES DE FONCTIONNEMENT (Investigation of electric circuits. Vol. 2. Operating regimes). Paris, Eyrolles, 1963, 301 p.

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2.0. E. Kollmann, B. Dirr : LÖSUNGEN REGELUNGSTECHNISCHER ÜBUNGSAUFGABEN (Solution of Automatic Control exercise problems). Braunschweig, Friedrich Vieweg & Sohn, 1963, 267 p., 222 illus., 16.80 DM.

2.0. E. Samal : GRUNDRISS DER PRAKTISCHEN REGELUNGSTECHNIK (Fundamentals of practical Automatic Control). München, R. Oldenbourg Verlag, 1964 (4th Edition), 343 p., 195 illus., 24 DM.

2.1.2. H. Gronbach : DER FREQUENZGANG EINES DAMPFÜBERHITZERS (The transfer function of a steam superheater). Stuttgart, Dissertation Technische Hochschule Stuttgart, 1963.

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2.4.0.3. M. Thoma : EIN EINFACHES VERFAHREN ZUR BESTIMMUNG DER WURZELVERTEILUNG (STABILITÄT) VON LINEAREN ABTASTREGELSYSTEMEN (A simple method for estimating the root distribution (stability) of linear sampled-data control systems). Darmstadt, Dissertation Technische Hochschule Darmstadt, 1963.

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5.5.1.5. K.W. Geisler : REGELUNG VON HEIZ- UND KLIMAANLAGEN (Control of heating and air-conditioning plants). Berlin-Charlottenburg, Carl Marhold Verlagsbuchhandlung, 1963.

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Poland

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Sweden

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Switzerland

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United Kingdom

1.1.0. J.L. D o u c e : AN INTRODUCTION TO THE MATHEMATICS OF SERVO-MECHANISMS. London, English Universities Press, 1963, 240 p., 25 s.

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USA

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1.1.6.0. H.J. K u s h n e r : ON THE DIFFERENTIAL EQUATIONS SATISFIED BY CONDITIONAL PROBABILITY DENSITIES OF MARKOV PROCESSES WITH APPLICATIONS. Baltimore, Maryland, Research Institute for Advanced Studies (RIAS), Technical Report No. 64-6, March 1964, 21 p.

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2.0. PREPRINTS OF THE 4th JOINT AUTOMATIC CONTROL CONFERENCE. New York, American Institute of Chemical Engineers, 1963, 680 p.

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2.3.1.0. L. W e i s s : THE ROLE OF SYSTEM FUNCTIONS IN THE REPRESENTATION AND ANALYSIS OF LINEAR SYSTEMS. Baltimore, Maryland, Research Institute for Advanced Studies (RIAS), Technical Report No. 64-4, March 1964, 48 p., 6 illus.

2.3.1.0. L. W e i s s , R.E. K a l m a n : CONTRIBUTIONS TO LINEAR SYSTEM THEORY. Baltimore, Maryland, Research Institute for Advanced Studies (RIAS), Technical Report No. 64-9, April 1964, 60 p.

2.3.1.7. K.S. N a r e n d r a , L.E. M a c B r i d e , Jr.: COMPARISON OF DIFFERENT MODES OF REPRESENTATION OF MULTIVARIABLE SYSTEMS. Cambridge, Massachusetts, Harvard University, Cruft Laboratory, Office of Naval Research, Technical Report NR 372-012 No. 356, June 5, 1963.

2.3.1.7. G.J. T h a l e r , B u i T i e n R u n g : ON THE REALIZATION OF LINEAR MULTIVARIABLE CONTROL SYSTEMS. United States Naval Postgraduate School, Research Paper No. 39, August 1963.

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PUBLICATIONS

The classification used is that of the International Bibliography of Automatic Control

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The price for both volumes is £38.0.0. or DM 425,- respectively. Attendants of the Congress may purchase the set at a reduced price. Orders should be addressed to:

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London, W.C.2., England.

or

R. Oldenbourg Verlag,
Rosenheimer Str. 145,
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2.4.1.0.
6.9.1.

PROCEEDINGS
of the
IFAC SYMPOSIUM ON RELAY SYSTEMS AND FINITE AUTOMATA

Moscow, September, 1962

Copies of these Proceedings can be obtained from:

Dr. Warren L. Semon,
Burroughs Laboratories,
P.O. Box 782,
Paoli, Pennsylvania,
U.S.A.

The price is $7.50. The volume contains the English translation of the Russian language papers presented at the symposium; papers originally presented in the English language are not included in this volume.

6.9.1.

PROCEEDINGS
of the
THIRD INTERNATIONAL MEASUREMENT CONFERENCE IMEKO III

Stockholm, September, 1964

ACTA IMEKO 1964, vols. 1 - 3, have been released and contain the full texts of all papers presented at the meeting. A 4th volume comprising supplementary information presented by the authors, the discussion, and the review lectures will be completed shortly.

These volumes may be obtained from:

Kultura Hungarian Trading
for Books and Newspapers,
P.O. Box 148,
Budapest 62,
Hungary.

The price is approximately $30.

The lectures from the I & M Special Section on Automatic Control will be published in a separate volume.

2.4.1.0. C h u n g L a u n g L i u : SOME MEMORY ASPECTS OF FINITE AUTOMATA. Cambridge, Massachusetts, Massachusetts Institute of Technology, Research Laboratory of Electronics, Technical Report No. 411, May 1963, 69 p.

2.4.2.1. G.W. D e l e y : OPTIMAL BOUNDED CONTROL OF LINEAR SAMPLED-DATA SYSTEMS USING QUADRATIC PERFORMANCE CRITERIA. Stanford, California, Stanford University, Department of Aeronautics, Report SUDAER No. 148, April 1963, 59 p.

2.5.1. H.J. K u s h n e r : ON THE STOCHASTIC MAXIMUM PRINCIPLE: FIXED TIME OF CONTROL. Baltimore, Maryland, Research Institute for Advanced Studies (RIAS), Technical Report No. 63-24, December 1963, 16 p.

2.5.3. M. A o k i : ON THE APPROXIMATION OF TRAJECTORIES AND ITS APPLICATIONS TO CONTROL SYSTEMS OPTIMIZATION PROBLEMS. Los Angeles, California, University of California, Department of Engineering, Report No. 62-58, November 1962, 35 p.

2.5.3. C.E. H u t c h i n s o n : MINIMUM-TIME CONTROL OF A LINEAR COMBINATION OF STATE VARIABLES. Stanford, California, Stanford University, Stanford Electronics Laboratories, Systems Theory Laboratory, Office of Naval Research, Technical Report No. 6311-1.

2.5.3. MATHEMATICAL OPTIMIZATION TECHNIQUES. Berkeley and Los Angeles, University of California Press, 1963.

2.5.3. K.S. N a r e n d r a , L.E. M a c B r i d e , Jr.: MULTI-PARAMETER SELF-OPTIMIZING SYSTEMS, USING CORRELATION TECHNIQUES. Cambridge, Massachusetts, Harvard University, Cruft Laboratory, Office of Naval Research, Technical Report NR 372-012, No. 413, June 5, 1963.

2.5.3. K.S. N a r e n d r a , L.E. M a c B r i d e , Jr.: IDENTIFICATION AND OPTIMIZATION OF MULTIVARIABLE SYSTEMS USING CORRELATION TECHNIQUES. Cambridge, Massachusetts, Harvard University, Cruft Laboratory, Office of Naval Research, Technical Report NR 372-012, No. 418, June 5, 1963.

2.5.4. M.E. H o f f , Jr.: LEARNING PHENOMENA IN NETWORKS OF ADAPTIVE SWITCHING CIRCUITS. Stanford, California, Stanford University, Stanford Electronics Laboratories, Solid-State Electronics Laboratory, Technical Report No. 1554-1, July 1962, 85 p.

2.5.4. R.L. M a t t s o n : THE ANALYSIS AND SYNTHESIS OF ADAPTIVE SYSTEMS WHICH USE NETWORKS OF THRESHOLD ELEMENTS. Stanford, California, Stanford University, Stanford Electronics Laboratories, Solid-State Electronics Laboratory, Technical Report No. 1553-1, December 1962, 95 p.

2.5.4. C.H. M a y s : ADAPTIVE THRESHOLD LOGIC. Stanford, California, Stanford University, Stanford Electronics Laboratories, Solid-State Electronics Laboratory, Office of Naval Research, Technical Report No. 1557-1.

2.5.5. D.N. S t r e e t e r , K.S. N a r e n d r a : A SELF-ORGANIZING CONTROL SYSTEM BASED ON CORRELATION TECHNIQUES AND SELECTIVE REINFORCEMENT. Cambridge, Massachusetts, Harvard University, Cruft Laboratory, Technical Report No. 359, July 20, 1962, 36 p.

3.2.4.2. L. F o w l e r : GAS CHROMATOGRAPHY. New York, Academic Press, 1963, 266 p., $ 10.50.

4.0.0. PROCEEDINGS OF THE 17th ISA ANNUAL INSTRUMENTATION-AUTOMATION CONFERENCE. Pittsburgh, Pennsylvania, Instrument Society of America, 1962.

4.0.5.1. C.L. J o h n s o n : ANALOG COMPUTER TECHNIQUES. New York, MacGraw-Hill, 1963, 315 p., 193 illus.

4.5.6. G.D. V e n d e l i n : A SILVER SULPHIDE ADAPTIVE COMPONENT. Stanford, California, Stanford University, Stanford Electronics Laboratories, Solid-State Electronics Laboratory, Technical Report No. 1853-1, January 1963, 70 p.

5.6.3.0. APPLIED MATHEMATICS IN CHEMICAL ENGINEERING. New York, American Institute of Chemical Engineers, Chemical Engineering Progress Symposium Series, Vol. 58, No. 37, 1962, 106 p., $ 15.

5.6.3.0. C.E. H u c k a b a , G.P. M o n e t , Editors: PROCESS SYSTEMS ENGINEERING. New York, American Institute of Chemical Engineers, Chemical Engineering Progress Symposium Series, Vol. 59, No. 47, 1963, 198 p., $ 15.

5.6.3.0. T.J. W i l l i a m s , Editor: PROCESS DYNAMICS AND CONTROL. New York, American Institute of Chemical Engineers, Chemical Engineering Progress Symposium Series, Vol. 57, No. 36, 1962, 172 p., $ 15.

Periodicals

THE ASME JOURNAL OF BASIC ENGINEERING

The Journal of Basic Engineering is published quarterly by the American Society of Mechanical Engineers (ASME). In the past, papers on Control Engineering were scattered through all four of the quarterly issues. In the future, ASME plans to publish a regularly-appearing annual volume on Control Engineering through one of the issues of the Journal of Basic Engineering.

The March 1964 issue of the latter is devoted entirely to papers on Automatic Control engineering. It contains 21 papers presented at the 1962 ASME Winter Annual Meeting and at the 1963 Joint Automatic Control Conference. It is hoped that the next issue, devoted exclusively to Automatic Control, will appear in December 1964 and every December thereafter.

Copies of the Journal of Basic Engineering can be obtained from the ASME, 345 East 47th Street, New York 17, at the single-copy price of $ 4.50 ($ 2.25 to ASME members) plus $ 0.50 for mailing outside of the USA or Canada.

ISA TRANSACTIONS

Issues 3 (July 1964) and 4 (October 1964) of volume 3 of ISA Transactions contain the following papers of interest to Automatic Control engineers:

Issue 3: "A stabilized automated camera for airborn eclipse photography" by Sheldon M. S m i t h , Dr. Michel B a d e r, Milton E. H e n d e r s o n and Raymond A. T o r r e y . "Sampled-data representative system: an effective concept for use in the analysis and synthesis of distributed-parameter systems" by Dr. Donald A. P i e r r e and Professor Thomas J. H i g g i n s . "Simulation evaluation of a digital control system" by Suresh C. G u p t a and Dr. C.W. R o s s .

Issue 4: "Development of a universal gas-sizing equation for control valves" by J.F. B u r e s h and C.B. S c h u d e r . "Riemann-surfaced analogs for control systems" by Dr. Donald A. P i e r r e and Professor Thomas J. H i g g i n s .

ISA Transactions are distributed by Plenum Press, 227 West 17th Street, New York, and are available at an annual subscription price of $ 20.00 (4 copies) or at a single copy price of $ 7.50.

FEEDBACK

A first issue of Vol. 1 of this newsletter has been published by the Institute for Cybercultural Research in August 1964. The Institute, under the provisional chairmanship of Mrs.A.M. H i l t o n , plans to publish a quarterly Journal, the "Cybercultural Review" (cyberculture having the meaning of cybernetics - the science of relationships, communications and control - and of culture, the way of life of a society). The Board of Directors comprises several personalities amongst whom is Dr. Richard B e l l m a n . Further particulars can be obtained from:

The Institute for Cybercultural Research, No. 12E, 405 East 63rd Street, New York.

USSR

1.1.0. Iu.N. P e c h e r s k i i , Editor: MATHEMATICAL QUESTIONS OF CYBERNETICS AND COMPUTING TECHNIQUES. Erevan, Publications of the Academy of Sciences of the Armenian SSR, 1963, 86 p.

1.1.6.0. N.A. L i v s h i t s , V.N. P u g a c h e v : PROBABILISTIC ANALYSIS OF AUTOMATIC CONTROL SYSTEMS. Vol. 1. PROBABILISTIC AND STATISTICAL CHARACTERISTICS OF INPUTS AND PROCESSES. LINEAR STATIONARY AND NON-STATIONARY SYSTEMS. Moscow, Soviet Radio, 1963, 896 p.

1.1.6.0. N.A. L i v s h i t s , V.N. P u g a c h e v : PROBABILISTIC ANALYSIS OF AUTOMATIC CONTROL SYSTEMS. Vol. 2. NONLINEAR SYSTEMS. DISCRETE-ACTION SYSTEMS. Moscow, Soviet Radio, 1963, 483 p.

1.1.6.0. Iu.A. R o z a n o v : STATIONARY RANDOM PROCESSES. Moscow Fismatgiz, 1963, 284 p.

1.1.6.1. A.A. K h a r k e v i c h : STRUGGLE AGAINST DISTURBANCES, Moscow, Fismatgiz, 1963, 275 p.

1.1.6.1. V.N. R o g i n s k i i , Editor: PROBLEMS OF INFORMATION TRANSMISSION. Issue 14. OPTIMAL CODING THEORY. Moscow, Publications of the USSR Academy of Sciences, 1963, 160 p.

1.1.6.1. V.N. R o g i n s k i i , Editor: PROBLEMS OF INFORMATION TRANSMISSION. Issue 15. INFORMATION DISTRIBUTION SYSTEMS. PATTERN RECOGNITION. Moscow, Publications of the USSR Academy of Sciences, 1963, 152 p.

1.1.6.1. F.P. T a r a s e n k o : INTRODUCTION TO INFORMATION THEORY LECTURES. Tomsk, Publications of the Tomsk University, 1963, 240 p.

1.1.7. M.A. A i z e r m a n , L.A. G u s e v , L.I. R o z e n o e r : LOGIC, AUTOMATA, ALGORITHMS. Moscow, Fismatgiz, 1963, 556 p.

1.2.0. A.A. L i a p u n o v , Editor: PROBLEMS OF CYBERNETICS. Issue 10. Moscow, Fismatgiz, 1963, 286 p.

1.2.1. R.G. B u k h a r a e v , Editor: PROBABILISTIC METHODS AND CYBERNETICS. Kazan, Publications of the Kazan University, 1963, 164 p.

1.2.1. E.I. F i l i p p o v i c h , Editor: ENGINEERING CYBERNETICS. Kiev, Gostekhizdat of the Ukrainian SSR, 1963, 200 p.

2.0. L.G. D r a p k i n , Editor: AUTOMATIC CONTROL PROCEEDINGS OF THE LENINGRAD INSTITUTE OF MECHANICS. Issue 3, Leningrad, Leningrad Institute of Mechanics, 1963, 131 p.

2.0. M.B. I g n a t i e v : HOLONOMOUS AUTOMATIC SYSTEMS. Moscow and Leningrad, Publications of the USSR Academy of Sciences, 1963, 204 p.

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2.3.1.4. E.G. U d e r m a n n : THE ROOT-LOCUS METHOD IN AUTOMATIC CONTROL THEORY. Moscow and Leningrad, Gosenergoizdat, 1963, 112 p. 35 illus.

2.3.1.7. P.I. C h i n a e v : MULTIVARIABLE AUTOMATIC SYSTEMS. Kiev, Gostekhizdat of the Ukrainian SSR, 1963, 279 p. 52 illus.

2.5.0. P.I. C h i n a e v : SELF-ADJUSTING SYSTEMS. CALCULATION AND DESIGN. Moscow, Mashgiz, 1963, 303 p.

2.5.0. A.A. K r a s o v s k i i : DYNAMICS OF CONTINUOUS SELF-ADJUSTING SYSTEMS. Moscow, Fismatgiz, 1963, 468 p. 284 illus.

2.5.3. A.A. F e l d b a u m : FUNDAMENTALS OF AUTOMATIC OPTIMAL SYSTEM THEORY. Moscow, Fismatgiz, 1963, 552 p.

2.6.2.1. A.A. V a v i l o v , A.I. S o l o d o v n i k o v : EXPERIMENTAL DETERMINATION OF AUTOMATIC SYSTEM FREQUENCY RESPONSE. Moscow and Leningrad, Gosenergoizdat, 1963, 252 p.

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4.0.0. N.M. A l e k s a n d r o v s k i i : ELEMENTS OF AUTOMATIC INSTRUMENTS (PICKUPS, COMPARATORS, RELAYS). Moscow, Moscow Energy Institute, 1962, 214 p., 54 Kopecks.

4.0.0. D.L. O r s h a n s k i i , Editor: ENCYCLOPEDIA OF MEASUREMENT, CONTROL AND AUTOMATION. Vol. 1. Moscow and Leningrad, Gosenergoizdat, 1962, 244 p., 2,08 roubles.

4.0.0. Iu.A. R i a z a n o v : AUTOMATIC CONTROL SYSTEM DESIGN. Moscow, Mashgiz, 1963, 311 p., 20 illus.

4.0.0. V.V. S o l o d o v n i k o v , Editor: FUNDAMENTALS OF AUTOMATIC CONTROL. Vol. 3. AUTOMATIC CONTROLLERS AND TRACKING SYSTEMS. Moscow, Mashgiz, 1963, 659 p.

4.0.1.2. L.P. M e l e s h k i n a : BASIC CIRCUITS FOR ELECTRONIC POWER DEVICES IN AUTOMATION. Moscow, Proftekhizdat, 1963, 144 p., 29 Kopecks.

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4.0.5.0. N.F. K o b r i n s k i i , V.D. P e k e l i s : QUICKER THAN THOUGHT. Moscow, Molodaia Gvardia, 1963 (2nd Edition), 470 p.

4.0.5.0. Iu.G. R e s h e t n i a k , Editor: COMPUTING SYSTEMS. Issue 7. Novosibirsk, Institute of Mathematics, Siberian Department of the USSR Academy of Sciences, 1963, 46 p.

4.4.1.2. V.A. K h o k h l o v : HYDRAULIC POWER AMPLIFIERS. Moscow, Publications of the USSR Academy of Sciences, 1963, 104 p.

4.5.1.3. E.I. G u r v i c h , L.B. S h c h u k i n : FERRITE TRANSISTOR ELEMENTS AND THEIR APPLICATION TO DIGITAL DEVICES. Moscow and Leningrad, Gosenergoizdat, 1963, 159 p., 43 Kop.

5.2.3. B.Kh. B o g o p o l s k i i , V.M. B e r l o v s k i i , Iu.S. K o v a l e v , Iu.V. K o z i n , L.G. M e l k u m o v , A.E. N a i m a n , E.S. F e l d m a n , A.A. S h u v a e v : AUTOMATION OF MINING VENTILATION STATIONS. Moscow, Gosgortekhizdat, 1963, 184 p., 72 Kopecks.

5.2.3. I.I. T k a c h e n k o : AUTOMATION OF MINING STATIONS. Moscow, Gosgortekhizdat, 1963, 135 p., 23 Kopecks.

5.2.6. N. A n i s i m o v , G. G i l m a n o v , V. S t r a t i e v : FREQUENCY SYSTEMS OF REMOTE CONTROL AND PETROLEUM ENGINEERING. Ufa, Bashknigoizdat, 1962, 84 p., 29 Kopecks.

5.6.2.0. V.A. D r u c h e n k o , K.K. P a v l o v s k a i a, Iu.I. M a l i u k , M.E. Z u b k o v : INSTRUMENTS FOR AUTOMATIC REGULATION AND CONTROL OF ELECTROPLATING PROCESSES. Kiev, Institut tekhnicheskoi informatsii, 1963, 158 p., 77 Kopecks.

5.6.2.0. V.A. S h c h e t i l n i k o v , Editor: THEORY AND DESIGN OF BALANCING MACHINES. Moscow, Mashgiz, 1963, 444 p., 1,55 roubles.

6.2. I.B. N o v i k : CYBERNETICS. PHILOSOPHICAL AND SOCIOLOGICAL PROBLEMS. Moscow, Gospolitizdat, 1963, 207 p.

Yugoslavia

5.9.2. PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON THE APPLICATIONS OF AUTOMATIC CONTROL IN PROSTHETICS DESIGN, 27-31 August 1962, in Opatija. Published in 1963.

NOTE ON INFORMATION BULLETIN NO. 20

Information to appear in the Information Bulletin no. 20 should reach the Editor:

Professor Dr. Ing. V. Broida,
Honorary Editor of I.F.A.C.,
13, rue de la France-Mutualiste,
Boulogne-sur-Seine (Seine), France,

not later than 15th February, 1965.