

An Automatic System for Measuring Arm Blood Pressure, J. R. Vogt, *Conference Record of the Third Annual IEEE Rocky Mountain Bioengineering Symposium*, 33-36 (May 1966). A system has been designed to measure arm blood pressure automatically by the Korotkoff method. Several tests of the system have been performed in the Mayo Clinic Hypertension Laboratory. Details of the system and results of the tests are presented. The Korotkoff method normally used in clinical practice is used by the system. An armcuff with an attached microphone is placed over the brachial artery of the subject. The system rapidly inflates the armcuff and then monitors the microphone output as the cuff slowly deflates. Analog processing of the microphone output is combined with unique logical processing to determine when cuff pressure is equal to systolic or diastolic pressure. At the proper instant, cuff pressure is digitized and recorded. In experimental procedures, the performance of the system was tested against the readings of trained technicians using the Korotkoff method. A three-way test compared simultaneous readings of the system and two trained technicians. Seventy-four cooperative hypertensive subjects participated in three separate tests.

Abstracts

from recent
papers by
IBM authors

The Compatibility of Value Engineering and Configuration Management, W. Wasserman, *Proceedings of the Third Space Congress*, 437-451 (March 1966). This paper is aimed at management levels responsible for ensuring system compatibility and mission success. It discusses the philosophies of system management and the interrelationships of program management, system engineering, and management tools. Value engineering and configuration management are discussed as the catalysts to be integrated into the management network, thus ensuring system compatibility and mission success at the lowest overall cost. The Aerospace Industries Association (AIA) has stated that configuration management and value engineering are not compatible. This paper is offered in rebuttal to that statement.

Computer Produces Precision Drawings, R. G. Beard and A. E. Singfiel, *The Tool and Manufacturing Engineer* 56, No. 6, 76-77 (June 1966). To relieve the demands on engineering time, manufacturing engineers have effectively "harnessed" a computer and a plotter to produce precision drawings. The example discusses how computers are being used to draw comparator charts for parts inspection.

Computer Simulation of Photo-Optical Image-Forming Systems, D. P. Paris, *Journal of Photographic Science and Engineering* 10, No. 2, 69-70 (March-April 1966). A computer program was developed to facilitate the simulation of one-dimensional images in an incoherent photo-optical image-forming system. The single or multiple stage image-forming system may consist of a sequence of linear and nonlinear components such as lenses, emulsions, and components that are described by their spread function or optical transfer function. Emphasis in developing the program was on: (1) simplicity of the statements in which the user specifies the system configuration to the program; (2) capability of requesting intermediate output at any point in the sequence of systems components; and (3) capability of providing repeat runs with varied input or component parameters. These three goals were achieved by designing a simple, user-oriented special-purpose programming language called IMSIM/I.

A Computer System for Electrocardiographic Analysis, R. E. Smith* and C. M. Hyde, *Conference Record of the Third Annual IEEE Rocky Mountain Bioengineering Symposium*, 20-24 (May 1966). A clinical system for the machine analysis of ECG's has been developed jointly by the Mayo Clinic and IBM. The data acquisition system is initiated at patients' beds when multiple electrodes are placed on patients. With the system, 300 electrocardiograms can be recorded on one console each day. An operator at the control console selects the proper patient by a switching device, and monitors the multi-channel recording on an oscilloscope, the last human intervention into the system. Frank lead system voltages are digitized and entered into the IBM 7040 Data Processing System. A recognition and measurement program determines heart rate, *P* and *R* duration, and *PR* and *QT* intervals. Magnitude and angles of the voltage vectors are determined. These measured values constitute a set of quantities upon which the analysis program is based. The program output consists of time interval measurements, narrative diagnostic statements, and graphic plots.

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DSL/90—A Digital Simulation Program for Continuous System Modeling, W. M. Syn and R. N. Linebarger, *AFIPS Conference Proceedings, Spring Joint Computer Conference* 28, 165-187 (April 1966). DSL/90 is an IBM 7090/94 FORTRAN IV program for the digital simulation of continuous system dynamics. Its nonprocedural problem-oriented input language accepts problems expressed either at the analog block diagram level or as systems of ordinary differential equations. DSL/90 permits the intermixing of DSL and FORTRAN IV statements and contains a library of subprograms which represent analog operational elements such as integrators, summers, limiters, etc. Programming consists of interconnecting these operational elements with simple connection statements. A translator converts the DSL/90 statements into a FORTRAN subprogram which is compiled and executed to accomplish the simulation. Principal features of DSL/90 are illustrated by three example applications: (1) a nonlinear CO₂ respiration control system simulation in Bio-medical Engineering, (2) the simulation of heat transfer dynamics of a recirculating furnace used in the glass industry, and (3) the simulation of the flight dynamics of a large aerospace booster rocket. A short discussion of the advantages and principal features of DSL/90 concludes the paper.

Electronic Data Processing and The Personnel Function: The Present and The Future, C. E. J. Cassidy, *Personnel Journal* 45, No. 6, 352-354 (June 1966). The results of an electronic data processing survey sent to personnel directors of various companies are reported. Specific present uses of data processing by personnel directors are reported and an estimate of future use is given.

Experience with FORMAC Algorithm Design, R. G. Tobey, *Communications of the ACM* 9, No. 8, 589-597 (August 1966). Various facets of the design and implementation of mathematical expression manipulation algorithms are discussed. Concrete examples are provided by the FORMAC EXPAND and differentiation algorithms, a basic FORMAC utility routine, and an experiment in the extraction of the skeletal structure of an expression. One recurrent theme is the need to avoid excessive intermediate expression swell in order to minimize core storage requirements. Although many details from the FORMAC implementation are presented, an attempt is made to stress principles and ideas of general relevance in the design of algorithms for manipulating mathematical expressions.

On a Family of Cubature Formulae, B. Meister, *The Computer Journal* **8**, No. 4, 368-371 (January 1966). The paper is concerned with the construction of symmetric cubature formulae, each of which is exact for polynomials up to a certain joint degree in two variables. Some examples of new cubature formulae of this kind are given.

General Purpose 30-Nanosecond Logic Circuit Family for IBM SYSTEM/360, E. F. Hahn and J. J. Tomczak, *Electrochemical Design* **10**, No. 4, 38-40, 42-43 (April 1966). The SLT 30-nsec logic circuit family is described and the design concepts are outlined. Design features include high fan-in capability, good isolation between circuits driven by the same block and uniform switching speeds. The three classes of circuit modules discussed are logic (AND-Inverter, AND-OR-Inverter, and AND-Power Inverter), logic support (Isolating Inverter, Exclusive-OR and Exclusive-OR Latch) and transistor-diode (four basic logic transistors and four pairs of the common-anode logic diodes).

High Performance Parallel-Serial Analog-to-Digital Converter with Error Correction, G. G. Gorbatenko, *IEEE International Convention Record* **14**, Part 3, 39-43 (1966). The ability to make revocable comparator decisions using a novel error correction feature provides (1) a practical means of performing parallel conversion, and (2) the A/D converter decision logic to act on the various analog signals while they are still in a transient state, thereby reducing decision time. As a result, this converter has a five-fold dynamic improvement over a conventional successive-approximation-by-bit converter using the same hardware. An example is presented using presently available components to achieve a 15-bit conversion rate of approximately 200 kc/sec.

History, Features and Commentary on FORMAC, E. R. Bond, *Communications of the ACM* **9**, No. 8, 548 (August 1966). FORMAC, an extension of IBM 7090/94 FORTRAN, is an experimental programming system to assist in the symbolic manipulations of mathematical expressions. It is a system that performs tedious, but routine, algebra and analysis on a computer. This paper attempts to convey an overall understanding of the significant features of the FORMAC system. Other reports that explore the system in depth are listed in the bibliography.

IBM 2321 Data Cell Drive, A. F. Shugart and Yang-Hu Tong, *AFIPS Conference Proceedings, Spring Joint Computer Conference* **28**, 335-345 (April 1966). The IBM 2321 Data Cell Drive economically extends on-line random access capability to a volume of data beyond that of previous storage units. With open-ended storage capacity made possible by the removability feature of the data cells, plus multiple 2321 usage, data processing requirements for billions of characters have been met. From a circular array of 10 data cells with 20 subcells each, a cell drive positions a selected subcell of 10 strips beneath an access station. At this station a selected strip is first withdrawn from the subcell, then rotated past a magnetic head for data transfer, and finally returned to its original location in the subcell. In developing the means for transporting the strip and transferring the data, some challenging efforts were undertaken, such as antilastic curvature, squeeze film, hydrodynamic lubrication film, etc. Recording reliability was achieved through the implementation of a variable-frequency-oscillator detection scheme in conjunction with dual-frequency encoding.

The IBM 2560 Multi-Function Card Machine, C. E. Spurrier, *AFIPS Conference Proceedings, Spring Joint Computer Conference* **28**, 315-321 (April 1966). The IBM Multi-Function Card Machine (MFCM) was developed to combine into one unit the functions of reading, printing, punching, collating, and selecting cards. IBM engineers were challenged to develop a machine which could feed cards from two hoppers, perform any or all of the functions of reading, punching, and printing of cards from either hopper, and stack cards from either hopper into any of five stackers. This paper is concerned with the engineering and technological aspects of developing this multi-function equipment. Development of the new wire matrix printer is discussed, including such aspects as character selection, hold-magnet requirements, noise reduction, and ink shielding and lubrication. Read station development and selecting, punching, and stacking design are considered. Also reviewed are the design of card transport mechanisms and miscellaneous electronic circuit design considerations.

Library Systems Analyst—A Job Description, T. Minder, *College and Research Libraries Journal* **27**, No. 4, 271-276 (July 1966). With the increased use of system analysis techniques in libraries, the time has come to consider the extent of systems analysis in librarianship and the duties of the analyst. This is a discussion of the job description, prerequisites and functions of a library's principal analyst.

A New Algorithm for a Class of Quadratic Programming Problems with Application to Control, M. D. Canon* and J. H. Eaton, *SIAM Journal on Control* **4**, No. 1, 34-45 (1966). The control problem considered is that of determining an input which will take a linear sampled system from a specified initial state to a desired terminal state in minimum time, subject to amplitude constraints on the input. The problem is reduced to solving a sequence of simple quadratic programming problems; a new algorithm is presented for solving this class of problems. Preliminary computational results for a fourth-order system are favorable.

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Some New Methods for Digital Encoding of Voice Signals and for Voice Code Translation, G. Knauff, H. Lamparter, and W. G. Spruth, *IBM Journal of Research and Development* **10**, No. 3, 244-253 (May 1966). Recently developed techniques are described for improving the speech quality of voice signals that are first digitally encoded, placed in random access storage, and on demand are then translated into normal speech in an audio response unit under the control of a host processor. The development is an extension and modification of the channel vocoder principle. Speech quality is enhanced by hardware and software features for treatment of unvoiced components of the coded speech signal in particular by separating harmonics from the excitation function digital signal before smoothing. A new program of bit selection is used to assure that the aggregation function digital signal carries maximum information. In addition, an efficient method of storage assignment is shown for the excitation function and the aggregate function registers in voice code translator.

Numerical Control—The First Fifteen Years, M. Morgan, *Proceedings of the Annual ASTME Engineering Conference and Tool Exposition*, 190-1 to 190-17 (April 1966). Born at M.I.T. as a new way to operate milling machines, numerical control has expanded into fields beyond machine tools. As a means of communication between man and machines, it is the basis of manufacturing enterprises that are operated through data processing techniques. What has been done in the past fifteen years—by whom, when, and how—to make possible such an evolution? Did the machine tool companies lead the way? Did the large data processing companies participate in the marketing of numerical control hardware? How did those companies contribute with software developments? What was the effect on the engineering profession? What was the role of the electrical manufacturing companies? What other applications has numerical control generated? Which applications are blossoming, which faltering? This paper reviews the aforementioned topics, analyzing the technical, business, and management aspects of numerical control as it has progressed through the years.

Numerical Inversion of Laplace Transforms Using Laguerre Functions, W. T. Weeks, *Journal of the ACM* 13, No. 3, 419-429 (July 1966). A method is described for the numerical inversion of Laplace transforms, in which the inverse is obtained as an expansion in terms of orthonormal Laguerre functions. In order for this to be accomplished, the given Laplace transform is expanded in terms of the Laplace transforms of the orthonormal Laguerre functions. The latter expansion is then reduced to a cosine series whose approximate expansion coefficients are obtained by means of trigonometric interpolation. The computational steps have been arranged to facilitate automatic digital computation, and numerical illustrations have been given.

PERT as an Aid to Logic Design, T. K. Kirkpatrick and N. R. Clark, *IBM Journal of Research and Development* 10, No. 2, 135-141 (March 1966). A new application is presented for PERT, the well-known statistical project-scheduling method. Using PERT, the logic designer could circumvent usually unrealistic worst-case criteria. He substitutes a formalized statistical method which determines (1) expected or most probable delays, (2) critical timing paths, (3) timing slack allowable between various inputs, and (4) probability of achieving an output by a certain time. From these data, the designer can make a meaningful judgement regarding the reliability of his system. Significantly, he may achieve high reliability without being forced to resort to worst-case design.

The Potentials of CAI in Industry, H. S. Long and H. A. Schwartz, *Training and Development Journal* 20, No. 8, 6-17 (September 1966). As modern industry grows in both size and complexity, the problems of industrial education mount rapidly. Accomplishing the necessary training in a work-oriented environment, in widely dispersed locations, and with heterogeneous groups of both students and instructors has proven to be almost impossible with classroom methodology. Recent techniques, notably Programmed Instruction, have been of immeasurable value in dealing more effectively with the situation. These techniques, however, may involve problems in such areas as control of the student, data collection, and course preparation. Teaching systems consisting of centralized computers and remotely located student and author terminals appear to provide a means of combining the decentralized, self-pacing benefits of Programmed Instruction with the student control and student feedback features of the classroom. Feasibility studies of computer-assisted instruction in an operational environment are presently being conducted.

Some Properties of Cycle-Free Directed Graphs and the Identification of the Longest Path, Y. C. Chen and O. Wing, *Journal of the Franklin Institute* 281, No. 4, 293-301 (April 1966). A number of interesting properties of a cycle-free directed graph are presented. By making use of these properties an efficient algorithm is deduced which identifies the longest path, or the Hamiltonian path if any, between every pair of vertices. The properties are expressed in terms of the "terminal connection matrix" which compactly describes the connectedness of the graph. Examples of practical applications of the results are given.

Remark on Rational Interpolation of Function and Derivatives, D. A. Jacobs, *Zeitschrift für angewandte Mathematische und Physik* 17, No. 1, 195-197 (1966). The inverse difference scheme is extended to furnish estimates of a function and its first few derivatives that correspond to a rational interpolation between given nodal values.

Semi-Automatic Circuit Card and Module Testing, T. A. Moilan, *Electronic Industries* 25, No. 7, 92-95 (July 1966). A failure analysis laboratory involved with the analysis of circuit cards faces the need for some form of automation. A semi-automated circuit card and circuit module tester was developed to provide a test vehicle for failure analysis cases requiring detailed and flexible testing.

Solution of Systems of Polynomial Equations by Elimination, J. Moses, *Communications of the ACM* 9, No. 8, 634-637 (August 1966). The elimination procedure as described by Williams has been coded in LISP and FORMAC and used in solving systems of polynomial equations. It is found that the method is very effective in the case of small systems, where it yields all solutions without the need for initial estimates. The method, by itself, appears inappropriate, however, in the solution of large systems of equations due to the explosive growth in the intermediate equations and the hazards which arise when the coefficients are truncated. A comparison is made with difficulties found in other problems in non-numerical mathematics such as symbolic integration and simplification.

Starting Approximations for Square Root Calculation on IBM SYSTEM/360, C. T. Fike, *Communications of the ACM* 9, No. 4, 297-299 (April 1966). Several starting approximations for square root calculation by Newton's method are presented in a form to facilitate their use in IBM SYSTEM/360 square root routines. These approximations include several for the range $[\frac{1}{16}, 1]$, which is the interval of primary interest on IBM SYSTEM/360.

Stronger than Uniform Convergence of Multistep Difference Methods,* B. Dejon, *Numerische Mathematik* 8, No. 1, 29-41 (March 1966). This paper is concerned with the numerical integration of ordinary differential equations of the order κ . Sufficient conditions and also necessary ones are given for the s th difference quotient of the approximate solution to approach the s th derivative of the exact solution for $s \geq 0$. This requires a more subtle examination of the multiplicities of the characteristic roots of modulus 1.

* The work reported in this paper was started when the author was a member of the Institut für Praktische Mathematik (Prof. Dr. Dr. h. c. A. Walther) Technische Hochschule, Darmstadt, Germany.

Survey of Formula Manipulation, J. E. Sammet, *Communications of the ACM* 9, No. 8, 555-567 (August 1966). The field of formula manipulation is surveyed, with particular attention to the specific capabilities of differentiation, integration and the supporting capabilities of simplification, displays and input/output editing, and precision arithmetic. General systems—both batch and on-line—are described. Finally, some programs to solve specific applications are discussed.

Tracing Printed Circuit Patterns by N/C Optical Techniques, G. F. Rollo, *Automation* 13, No. 4, 77-79 (April 1966). This article describes the operation of a numerically controlled system, currently used in manufacturing Solid Logic Technology circuit boards, to optically expose circuit paths on the boards. A four-head, five-beam, printed-circuit generator can trace approximately 4000 inches of circuit path in 20 minutes. Because this system is under computer program control, the generator can efficiently produce a wide variety of circuit designs; its adaptability to engineering changes is also a strong point.

Traffic Data Acquisition from Aerial Photographs by Photographic Image Processing, T. A. Baggot, *Highway Research Record for Photogrammetry and Aerial Surveys*, No. 109, 1-7 (1966). The approach to traffic data acquisition known as image processing employs electro-optical scanning and conventional electronic data processing techniques to extract useful data from imagery. Basically, image processing involves three steps: (1) digitizing, (2) transforming, and (3) processing.