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This is a year-end report on the technical progress made in the ALOHA System project at the University of Hawaii. The research program has a two-fold set of tasks. Task I is to develop new methods of random access radio communications for computer systems, to define those situations where radio communications provides a reasonable alternative to conventional computer communication techniques, and to study packet communications techniques using satellites. Task II is to develop more effective means for intercomputer communication and more organized, systematic designs for multiprocessor computing structures. The technical accomplishments in these areas are reported in this document.

R75-155—Kitai, R., I. Renyi and F. Vajda, "Microprocessor Application in a Walsh-Fourier Spectral Analyzer" (23 pp., McMaster University, Hamilton, Ontario, Canada).

The spectrum of a frequency-limited periodic wave may be obtained rapidly by measuring its truncated Walsh spectrum, and then converting from Walsh spectrum to Fourier spectrum after the measurement. The conversion process consists of a matrix multiplication in which a measured Walsh spectrum vector, of dimension $2^k$, is multiplied by a $2k \times 2k$ conversion matrix that is compensated for Walsh-spectrum truncation, to yield the corresponding Fourier spectrum vector. The microprocessor is well suited to this end; it is also useful in monitoring instrument panel switches and driving a display and print-out. The relevant properties of available microprocessors are compared from the viewpoint of BCD processing; the Fairchild PPS25 processor is shown to be best suited to meet the requirements.

R75-156—Maestrini, P. and F. Barsi, "Error Codes in Residue Number Systems with Magnitude Index" (30 pp., Istituto di Elaborazione dell'Informazione, Pisa, Italy).

The idea of adding a magnitude index to the residue representation of numbers is reconsidered. The range of a given Residue Number System is supposed to be divided into intervals of equal width and the magnitude index of a number $X$ is defined as an integer locating $X$ into one of such intervals. It is shown that the redundancy implied by the use of the magnitude index introduced in this paper, besides allowing simplification of non-modular operations, can also provide error detection or correction. The redundancy required to detect or correct single residue digit errors is the same as in Redundant Residue Number Systems and in Product Codes in Residue Number Systems. In addition, the codes under consideration allow detection of any error affecting the residue representation, provided that the magnitude of the error exceeds a given threshold, and, whenever an error is detected, it is possible to replace the wrong number with an approximation of the correct number. The accuracy of the approximation increases as the redundancy increases.


This is a reference manual for NOR network transduction programs NETTRA-G3 and NETTRA-G4. NETTRA-G3 reduces the number of gates in a given network by means of merging of gates whereas NETTRA-G4 reduces the number of gates by means of substitution for all output connections of a selected gate. The principles of these programs will be discussed in more detail in another paper by the author and V. Kambayashi.

R75-158—Unger S. H., "Tree Realizations of Iterative Circuits" (41 pp., Columbia University, New York, New York).

It is shown how any combinational function that can be described by a flow table—or equivalently—is realizable in iterative form and can be realized in tree form. The propagation delay is then proportional to the logarithm of $n$, the number of inputs, while the logic complexity is a linear function of $n$. These results are related to
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R75-159—Hunter, G. M., “Full-Color Television, from the Computer, Refreshed by Run-Length Codes in Main Memory” (11 pp., Princeton University, Princeton, New Jersey).

Television images are constructed by a computer which sends to a display device a series of run-length codes each representing the red, green, and blue values of a segment of the picture and other control information, and thinning the segment. The display device buffers each code as it is received from the computer and supplies the video values to digital-to-analog converters during the time the corresponding segment is to appear in the video signal.


The recent extended use of computers in the design and implementation of digital filters has made inevitable the consideration of the errors due to the limited precision of the machines. An interesting class of nonlinear digital filters eligible for such an investigation is the class of polynomial minimum mean square filters with discrete input. The accumulation of computational errors causes divergence of the output of these filters from the theoretically ideal one. The minimum mean square error, instead of monotonically decreasing with the degree of the polynomial filter, increases when this degree exceeds a certain number, depending on the statistics of the problem. A general expression of the error is found when the computational errors are taken under consideration. It is shown that this error is the sum of the theoretically ideal error $e_0$ and another part $e_2$ which is a function of the computational errors and which increases monotonically with the degree of the polynomial minimum mean square filter.


Today’s technology makes it possible to build small, personal digital radio terminals with low-power consumption. Studies have shown that such lightweight terminals can be efficiently supported by packet switched radio networks using random access modes and microprocessor controlled relays. Incorporating microprocessors into the personal terminal offers an opportunity to support wider ranges of user requirements and correspondingly reduce communication loads. The capability of new liquid crystal matrix displays, greater integration of CPU memory, and RF circuits, and thinn film RF assemblies, reinforce the possibilities of fabricating these personal units. This paper discusses communication protocol and the state of the art of microprocessor technology in the design and development of compact digital terminals for distributed packet radio networks.

R75-162—Ferguson, M. J., “Optimal Control of a Two Station Polling System” (46 pp., University of Hawaii, Honolulu, Hawaii).

This paper studies the problem of servicing fixed length (time) packets at two stations where the server incurs a deterministic delay when it changes stations. Packets arrive at the stations with fixed but different arrival rates and the optimalstatonary local control, that which minimizes average system waiting time, is found. It is characterized by never having the server stay idle at the “slow” station, and only stay idle at the “fast” station under a very limited range of arrival rates. Control decisions are based only on local knowledge, the length of a queue or the time spent in an idle state. Under certain skewed traffic conditions, the optimal control can reduce system waiting time by $50\%$ over the standard procedure of never allowing the server to stay idle at a station. However, most conditions suggest that the server should not remain idle but should be either serving or travelling.


The unified theory developed by Henrici for one-step methods is extended to the more general case where the order of the system of difference equations can exceed the order of the system of ordinary differential equations. The analysis is applicable to every fixed-stepized fixed-formula method known to the author. For many of these methods the concept of consistency is inadequate. A more appropriate concept, termed quasi-consistency, is introduced.


This report is concerned with the eigenvalue problem in the context of the very high level language OL/2. Using the capabilities that are within the OL/2 language together with the high quality software that is present in EISPACK, an implementation of the eigenvalue problem is presented. The syntax and semantics of the various eigenvalue statements is given along with the parsing of these statements, the generated code, the data structures, and the particular algorithms that are used.


A series of simple examples of pricing strategies is analyzed assuming periodic demand curves and constant processing capability. The strategies, ranked according to increasing profitability, are constant price, optimal constant price, and demand pricing. Additional variables are included to consider the effect of sales resistance and variable processing capability. The basic examples are verified by computer solutions to show the results in more detail. It is shown that every strategy except demand pricing gives rise to an economic loss which benefits neither buyer nor seller and is in fact lost to the economy. This reluctance factor is suggested as the cause of inflation in the present economy. Demand pricing is optimal in the sense that it has a zero reluctance factor and results in double the revenue of the optimal constant price strategy. The implications of such a strategy are discussed and a number of approximations suggested which may make the implementation more palatable to today's consumer of computing facilities. An elementary interpretation of the Kuhn-Tucker constraint qualification is included as an appendix to aid in analysis of the optimization problems. The emphasis in this paper is to lay the groundwork for future analyses as well as to obtain some practical results which can be applied to computer centers. The results should also prove applicable to other industries where fixed costs dwarf marginal costs.


This report describes the three assembly language programs required by the UH Time-sharing System for efficient interaction of the XPL control programs and the IBM System/360 configuration of the UH Computing Center. Included is a discussion of the Console Control Program which is responsible for the processing of asynchronous interrupts from any UH TSS terminal, and the O.S. Interface Program which supervises user programs operating within the user region. The Time-sharing SVC which allows TSS control programs to run in the 360 supervisor state is also described.


It is the purpose of this document to describe the University of Hawaii Time-sharing System as it is and to solicit suggestions as to how the system might be improved, or in what ways it may fall to meet anticipated needs. A brief explanation of the commands is of the form any prospective user can get an idea how the particular tasks he wishes to do can be handled by this system.

R75-168—Binder, R., “Time Constraints in Interrupt-Driven Programs” (18 pp., University of Hawaii, Honolulu, Hawaii).

Interrupt-driven programs are frequently used to provide an interface between peripheral equipment and a large central computer, and more recently have been proposed for management information systems. In many applications the interrupt intervals are fixed by the nature of the peripheral device or task and the program must respond within these intervals, for example to transfer data in or out of a buffer. The term “interrupt-driven” refers to a program which automatically interrupts current instruction execution whenever a flag is set by an external device (or internally by the program), transferring program control to a subroutine associated with that interrupt;
Furthermore, "start-up" of the program from an idle state is also the result of external interrupts. The analysis presented here is further constrained to programs in which the interrupt levels have a preassigned priority structure, such that the level with priority i may interrupt program execution which has been initiated by any lower priority level j, where i > j ("lower priority equals higher level number).

R75-169—Binder, R., "Aloha System Multiplexer Program Description" (48 pp., University of Hawaii, Honolulu, Hawaii).

The software program for the Aloha System radio-link multiplexer is described. The multiplexer consists of an HP 2115A minicomputer, the program, and associated interface hardware. Descriptions are given of the program subroutines, communication conventions, and interlock procedures. A listing of the program is given in XPL language.


In September 1968, the University of Hawaii began work on a research program to investigate the use of radio communications for computer-computer and console-computer links. This report describes a remote-access computer system, the ALOHA System, under development as part of that research program and discusses some advantages of radio communications over conventional wire communications for interactive users of a large computer system. An analysis of the random access communication method used in the ALOHA System is provided, and it is shown that the maximum number of interactive users who can be supported by the system is about 160.

R75-171—Kanehira, E., "Teletype Communications at Optical Frequencies for the ALOHA System" (19 pp., University of Hawaii, Honolulu, Hawaii).

This paper describes a teletype to teletype incoherent optical communications link presently operating on the campus of the University of Hawaii. A carrier "on-off," direct detection communication scheme is used to transfer the binary information between teletypes. The transmission medium is the turbulent atmosphere, with emphasis on beam steering and beam spreading effects. Other types of effects, such as coherence degradation, polarization fluctuations, and beam scintillation are of no real consequence in this type of incoherent, unpolarized system. Atmospheric scattering is neglected. Receiver signal-to-noise ratio, effects of rain, and beam diameters in the transmitting and receiving planes are some of the system parameters measured and discussed. The actual light source and detector used are also discussed in some detail. The link covers about 160 yards.

R75-172—Wong, K.-N. and R. C. De Vries, "Multiple Fault Detection for Irredundant and Redundant Combinational Circuits" (34 pp., University of New Mexico).

This paper is an extension of previously developed techniques to the non-tree circuit. By circuit duplication and use of De Morgan's Laws, any combinational non-tree circuit can be transformed into an alternating AND-OR or OR-AND circuit called an equivalent non-tree normal form (ENNF). The ENNF has fan-out points only at primary inputs and inverters only at the primary inputs or the fan-out branches. For the ENNF, the basic single faults (BSFs) are defined at primary inputs that do not fan out, at fan-out branches, and at the outputs of gates whose inputs are restricted to be primary inputs or fan-out branches. A test or tests called a super set is defined for each of the BSFs. A super set detects a BSF and all its fault combinations. Though all super sets form the complete test set, not all of them are required. Minimization of the complete test set is considered.

Floppy Disk Drive: FD360 micro-peripheral floppy disk drive operates under directions from Intel or National Semiconductor microprocessor system. Hardware interfaces and FDOS (Floppy Disk Operating Systems) available for Intellic-8, Intellic-8/Mod-80, IMP-16P, 16L, 8P. Features include format compatibility with IBM 3741, 3742, 3540 systems, built-in hardware track seek and seek verification, automatic head load/unload, operation with programmed I/O or DMA interfaces, sector buffering to enable asynchronous programmed I/O. Eight input, 16 output lines provide interfacing. Single drive configuration, $2350 (unit); 2 drives, $3000. Special interfaces available. — iCOM, Canoga Park, CA.

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CALENDAR
Continued from page 80

shops covering various aspects of the main topics: arrhythmia monitoring (in-outpatient), the computer as a tool in clinical and population studies, surgical intensive care monitoring, and automated laboratory systems. Since attendance will be limited to 300 participants, it is advisable to pre-register as soon as possible. For registration packet, contact either of the conference secretaries: Cees Zeelenberg, Thoraxcentrum, Erasmus University Rotterdam, PO Box 1738, Rotterdam/The Netherlands; or Kenneth M. Kempner, Bldg. 12A, Rm. 2019, National Institutes of Health, Bethesda, MD 20014.

1975 IEEE International Symposium on Electromagnetic Compatibility, October 7-9, San Antonio, Texas. Contact Gus Van Steenberg, Southwest Research Institute, PO Drawer 28510, San Antonio, TX 78284.

4th Data Communications Symposium, October 7-9, Quebec, Canada. Contact Dr. F.E. Glave, Bell Northern Research, PO Box 3511, Station C, Ottawa, Ontario, Canada K1Y 4H7.

Workshop on Methods of Verification in Design Automation, October 8-10, East Lansing, Michigan. Contact Dr. Roy L. Russo, IBM T.J. Watson Research Center, PO Box 218, Yorktown Heights, NY 10598.

10th National Data Processing Conference, October 13-14, Jerusalem, Israel. Contact the Program Committee, 10th National Data Processing Conference, c/o Kenes Ltd., PO Box 16271, Tel Aviv, Israel.


Continued on page 92