

EDITOR'S PROFILE of this issue

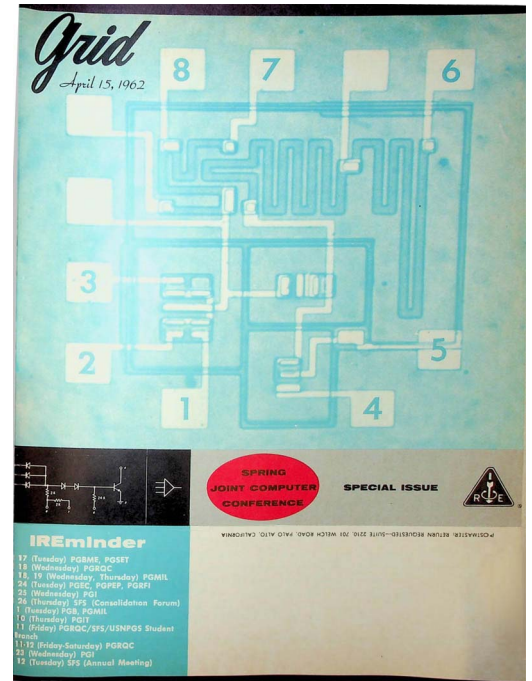
from a historical perspective ...

with Paul Wesling, SF Bay Area Council GRID editor (2004-2014)

April 15, 1962:

Cover: Shown is one of the first integrated circuits, from Sylvania – a three-input NAND gate, implemented in diode-transistor logic (DTL); the schematic is shown in the lower-left figure. This was in the days of bipolar logic, when device geometries were easy to see under the microscope, with their lovely pastel colors resulting from the varying thicknesses of the oxide layers. I saw many TTL circuits as a components evaluation engineer at Lenkurt Electric in my first job. But then, in the '70's, much of the technology changed over to CMOS, and device geometries scaled down to the micrometer level (Moore's Law), so tracing the circuit was no longer possible.

- p. 7: Edward Teller, “father of the H-bomb”, is the keynote speaker at the Spring Joint Computer Conference in S.F.; he talks on “How to Educate a Machine”. His photo is on page 9. On Thursday, the spouses take a bus ride down Skyline Drive to visit the village of Saratoga (my town) for wine-tasting at the Paul Masson Vinyards, then a visit to their champagne cellars. On the drive back, they visit Sunset Magazine's gardens and test kitchens in Menlo Park (page 9).
- p. 8: Prof. Alan Waterman of Stanford is nominated for Section Secretary; he was my undergraduate advisor. I wasn't allowed to go to his office at the Applied Engineering Lab (AEL) on campus because it was classified and secured; I met with him in the downstairs lobby.
- p. 14: WOW! You can see the future starting to come into focus. Doug Engelbart of the Stanford Research Institute (who developed the mouse, graphical user interface, networking; gave “The Mother of All Demos” at the FJCC later in the decade) heads up a session that includes Fred Brooks of IBM (360; wrote “The Mythical Man-Month”) and J C R (“Lick”) Lickliter of BBN (Bolt Beranek and Newman, which made the first Interface Message Processor for UCLA and Stanford nodes for testing TCP/IP developed by Vint Cerf, Stanford grad). Lickliter, who begins working as director of (D)ARPA in 1963, is the father of the ARPAnet, precursor to the Internet. In theory, with BBN an offspring of MIT, and working with Ken Olsen of DEC, the Internet should have been invented in Boston. But John McCarthy (AI, Lisp) left for Stanford, and entrepreneurship continued to develop faster in the west.
- p. 20: Also at the SJCC, Erich Bloch is a panelist in a session on Computer Systems. He manages IBM's 7030 and System 360 development, then goes on to direct the National Science Foundation. In 1985, he and Fred Brooks (above) are awarded the National Medal of Technology and Innovation by US President Reagan. He received the IEEE Computer Society's Computer Pioneer Award in 1993.



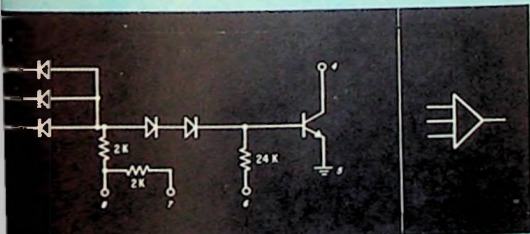
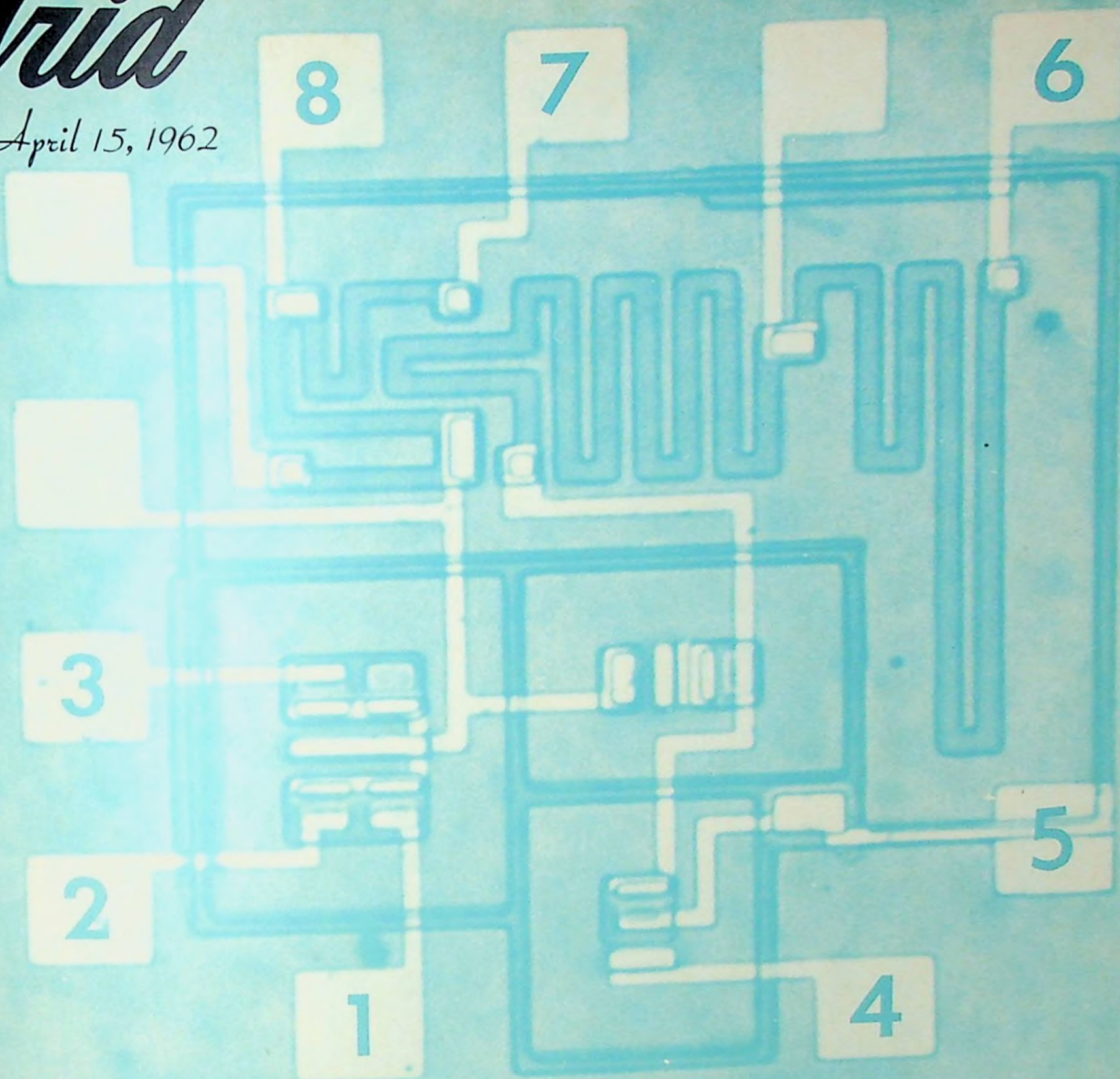
Archive of available SF Bay Area GRID Magazines is at this location:

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At time of scanning, the bound volumes are held by Paul Wesling. January, 2021 Contact p.wesling@ieee.org

Grid

April 15, 1962



**SPRING
JOINT COMPUTER
CONFERENCE**

SPECIAL ISSUE



POSTMASTER: RETURN REQUESTED—SUITE 2210, 701 WELCH ROAD, PALO ALTO, CALIFORNIA

IREminder

- 17 (Tuesday) PGBME, PGSET
- 18 (Wednesday) PGRQC
- 18, 19 (Wednesday, Thursday) PGMIL
- 24 (Tuesday) PGEC, PGPEP, PGRFI
- 25 (Wednesday) PGI
- 26 (Thursday) SFS (Consolidation Forum)
- 1 (Tuesday) PGB, PGMIL
- 10 (Thursday) PGIT
- 11 (Friday) PGRQC/SFS/USNPGS Student Branch
- 11-12 (Friday-Saturday) PGRQC
- 23 (Wednesday) PGI
- 12 (Tuesday) SFS (Annual Meeting)

Interview Employers in San Francisco Career Center, May 1-3

DEL WEBB'S TOWNEHOUSE (MARKET AT 8TH). REGISTER BY PHONE.

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Professional placement specialists are on hand to help engineers and scientists with particular specialties. The individual's own desires and interests are their main concern. Your name is revealed only to those you wish; you talk only with the employers you select. No registration or placement fees of any kind are charged.

This Career Center gives you a unique opportunity to talk with employers' representatives who have come to your home territory from all over the country. Best of all, you will probably meet their top-ranking executives. These men will be in town for the meeting of the Spring Joint Computer Conference.

REGISTER IN ADVANCE BY PHONE

By registering in advance by phone, you will have your qualifications ready for study by all employers

when they arrive in San Francisco on Monday, April 30th. Beginning that evening we will call you at home to report the names of employers who have requested interviews with you. Call San Francisco information after April 15th for the special telephone number of "CAREER CENTER (Vocational Information Agency)."

Interviewing days are Tuesday through Thursday, May 1-3. Even if you cannot be in San Francisco during this period, you may still register, and all interview requests received will be forwarded to you by mail after this Career Center closes.

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- ... you are looking for a new challenge, but must keep your search confidential.
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- ... you are considering a complete change of field and wonder if your qualifications will be of interest to employers in that new field.

Virtually all Career Center employers are seeking to fill positions in research, design and development. Of particular interest are men in the fields of physics, chemistry, electronics, mathematics, aeronautics and mechanical engineering.

FUTURE CAREER CENTERS: Career Centers will be held in Los Angeles, April 26-28 and in Seattle, May 5-7. Employers and applicants can write to the New York office of Careers Incorporated for details on these and other centers which have now been scheduled for practically all major metropolitan areas during the next 120 days.

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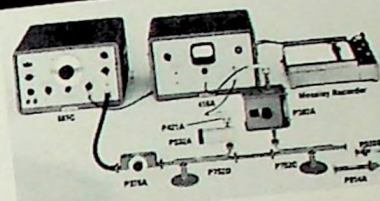
Career Centers are a service of Careers Incorporated, 770 Lexington Avenue, New York 21, N. Y. Publishers of "Career: for the College Man" and "Career: for the Experienced Engineer and Scientist."

Send for this
New Guide to
Microwave
Techniques and
Equipment!

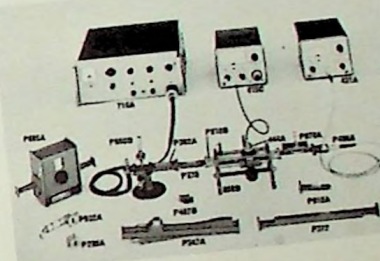


Instruments, specs listed by
frequency band!
Typical bench setups pictured
Microwave techniques authoritatively
detailed

0 GC Instruments and equipment



P 100 GC to 100 GC



Manufacture of P Band equipment is limited with a limited P Band component line.

Model	Frequency Range	Power	Attenuation
HPA	1000-10000 MC	100 W	20 dB
HPA	1000-10000 MC	10 W	20 dB
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HPA	1000-10000 MC	10 mW	20 dB
HPA	1000-10000 MC	1 mW	20 dB
HPA	1000-10000 MC	100 μW	20 dB
HPA	1000-10000 MC	10 μW	20 dB
HPA	1000-10000 MC	1 μW	20 dB
HPA	1000-10000 MC	100 nW	20 dB
HPA	1000-10000 MC	10 nW	20 dB
HPA	1000-10000 MC	1 nW	20 dB
HPA	1000-10000 MC	100 pW	20 dB
HPA	1000-10000 MC	10 pW	20 dB
HPA	1000-10000 MC	1 pW	20 dB
HPA	1000-10000 MC	100 fW	20 dB
HPA	1000-10000 MC	10 fW	20 dB
HPA	1000-10000 MC	1 fW	20 dB
HPA	1000-10000 MC	100 aW	20 dB
HPA	1000-10000 MC	10 aW	20 dB
HPA	1000-10000 MC	1 aW	20 dB

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This new ϕ Microwave Catalog gives you a complete listing of Hewlett-Packard's full-range tested microwave instrumentation, together with helpful descriptions of various microwave measurement techniques. The information and the instrumentation are fully indexed, with instruments and equipment listed by frequency bands. Just find the frequency ranges in which you are interested . . . and you have basic specs on all

available equipment and instrumentation, together with a photograph of a setup incorporating the instruments.

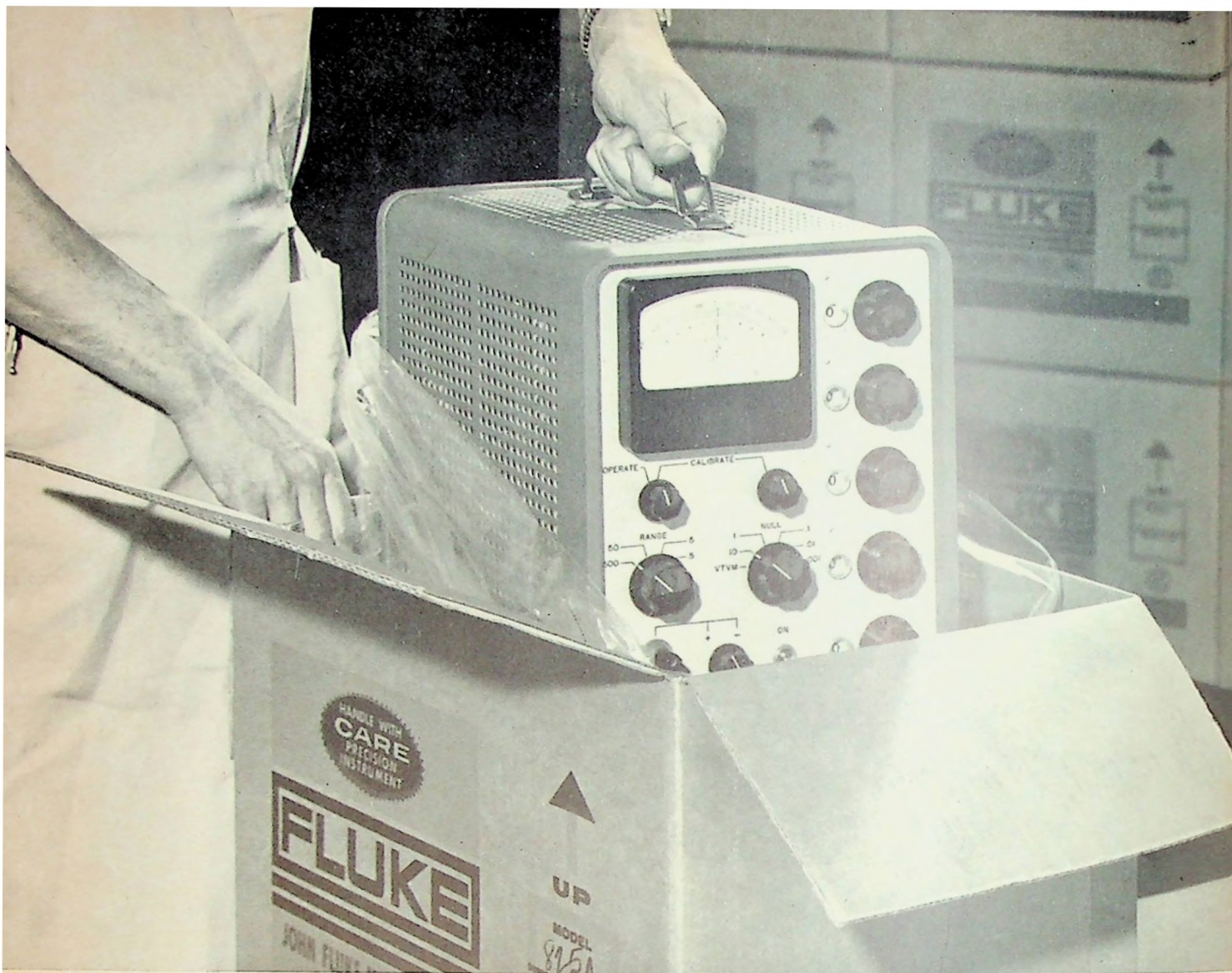
Typical of the information in the catalog are discussions of swept frequency measuring techniques, methods for measuring SWR, and measurement of frequency, impedance, attenuation, power and noise figure.

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THIS NEW VOLTMETER WAS DESIGNED BY 15,000 CUSTOMERS

You had a hand in the engineering of the FLUKE MODEL 825A DC DIFFERENTIAL VOLTMETER. Customer suggestions spanning seven years and 15,000 differential voltmeters have helped create the most versatile and reliable instrument of this type ever offered.

Beginning with an overall accuracy of $\pm 0.025\%$, this advanced model features these significant advantages: recorder output — no zero controls — taut hand meter suspension — flow soldered glass epoxy printed circuit boards.

To fully utilize the inherent advantages of high accuracy differential voltage measurements, Fluke Model 825A provides two major features not found in other instruments:

1. *Infinite input impedance at null from 0 to plus or minus 500 VDC; this feature is extremely important since all voltages to be measured have significant source resistance. With the Model 825A operated at null, there will be no measurement errors due to circuit loading. The majority of other voltmeters provide a maximum of 10 megohms input impedance. Should the unknown voltage have a source resistance in the order of 5000 ohms, the measurement error due to source loading only will be at least 0.05% and does not include the basic error specification of the voltmeter itself.*

2. *Polarity reversing switch: A feature that enables you to measure either positive or negative voltages with equal ease. This is not merely a polarity reversal of front panel binding posts — rather the internal 500 V reference supply is made either positive or negative with the front panel switch. This effectively provides you with two voltmeters for the price of one.*

PARTIAL 825A SPECIFICATIONS

OVERALL ACCURACY: $\pm 0.025\%$
 MAXIMUM FULL SCALE NULL METER SENSITIVITY: 1 MV
 MAXIMUM NULL METER RESOLUTION: 50 μ V
 STABILITY OF REFERENCE SUPPLY: $\pm 0.005\%$ per hour after warmup or $\pm 0.005\%$ for $\pm 10\%$ line voltage change
 REFERENCE ELEMENT: . . . Standard cell (zener diode optional)
 INPUT VOLTAGE: . . . 117/234 VAC $\pm 10\%$ from 50 to 400 cps

Write, wire or phone for short form catalog F-162

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 Seattle 33, Wash.
 Box 7428



PR. 6-1171 TWX — Halls Lake TLX — 8

Grid

April 15, 1962

Published twice a month except July and August by San Francisco Section, Institute of Radio Engineers

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EDITOR:
FRANK HAYLOCK
EDITORIAL OFFICE:
109 HICKORY LANE,
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cover

Enlarged 133 diameters, the main illustration shows a new solid-state logic element developed by Signetics Corporation of Sunnyvale. For circuit chasers, the schematic details are included

below. Unit is a NAND gate supplied either in a conventional welded package or a modular planar configuration for high-density packaging.

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MEETING CALENDAR

SAN FRANCISCO SECTION 8:00 P.M. • Thursday, Apr. 26
Forum: "Proposed AIEE/IRE Consolidation"
Place: Physics Lecture Hall, Stanford University

SAN FRANCISCO SECTION 8:00 P.M. • Friday, May 11
(Joint with PGRQC, USNPGS Student Branch, see below)

SAN FRANCISCO SECTION • Tuesday, June 12*
Annual meeting—details to be announced
*Note change of date

PROFESSIONAL GROUPS

Bio-Medical Electronics 8:00 P.M. • Tuesday, Apr. 17
"Experimental Biology in Space"
Speaker: Dr. Richard S. Young, Ames Research Center, Mountain View
Place: Room M-112, Medical School Building, Palo Alto-Stanford University
Medical Center
Dinner: 6:00 P.M., Red Cottage Restaurant, 1706 El Camino, Menlo Park
Reservations: Ken Gardiner, DA 6-6200, Ext. 2659, by April 16

Broadcasting 6:30 P.M. • Tuesday, May 1
Report and inspection tour of common TV transmitter site and tower of
KCRA-TV, KXTV, and KOVR
Place: Tony's, one block from bridge, Walnut Grove, Highway 24 south
from Sacramento or north from Oakland and Rio Vista to foot of Sac-
ramento River Levee. (1½ hr from S.F.)
Dinner: 6:30 P.M. (Cocktails 6:00 P.M.), Tony's (\$4.50)
Reservations: James Gabbert, KL 2-1013; Paul Gregg, LY 3-0800; or Hugh
Granberry, EM 8-4681, by April 26

Electronic Computers 8:00 P.M. • Tuesday, Apr. 24
"List Processing and Practical Problems"
Speaker: J. Weizenbaum, manager, computer organization unit, G.E.
Computer Laboratory
Place: Lockheed Auditorium, 3251 Hanover Street, Palo Alto
Dinner: 6:00 P.M., the Red Shack Hofbrau, 4085 El Camino Way, Palo Alto
Reservations: None required

Information Theory 8:00 P.M. • Thursday, May 10
"Mind, Machine, and Soul"
Speaker: Dr. Louis Fein, consultant
Place: Talisman Room, Caravan Inn, 4375 El Camino Real, Mountain View
Dinner: 6:00 P.M., Talisman Room, Caravan Inn
Reservations: Mrs. Beryl Lelo, DA 6-6200, Ext. 2944

Instrumentation 8:00 P.M. • Wednesday, Apr. 25
Lecture No. 2
"Analog-Digital System Elements"
Speakers: William Gross, Dymec, and Terry Thayer, Lockheed
Place: Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto (main lobby)
Meet-the-Speaker Dinner: 6:00 P.M., L'Omelette Restaurant, 4170 El Ca-
mino Real, Palo Alto
Reservations: None required

Instrumentation 8:00 P.M. • Wednesday, May 23
Lecture No. 3
"Storage: Processing and Printout"
Speakers: Robert N. Flanders, Dymec, and Douglas Wilcox, Precision In-
struments
Place: Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto (main lobby)
Meet-the-Speaker Dinner: 6:00 P.M., L'Omelette Restaurant, 4170 El Ca-
mino Real, Palo Alto
Reservations: None required

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MEETING CALENDAR

Military Electronics 7:30 P.M. • Wed., Thurs., Apr. 18, 19
(Joint meeting with all professional societies)
"Research for the Space Age"
Speaker: Lt. Col. Paul L. Maret, Washington office, Air Force Systems Command Headquarters
Place: Foothill College Auditorium, El Monte Avenue, Los Altos
Registration: 7:00 P.M.
Reservations: Secret clearance must be established with Major Herman H. Teifeld, director, Scientific & Technical Liaison Office, Air Force Systems Command, 1176 Los Altos Ave., Los Altos, WH 8-1434. Forms for establishment of six-month clearance are available at the Section office.
Dinner meeting has been cancelled

Military Electronics 7:30 P.M. • Tuesday, May 1
Topic and speaker to be announced
Place: Lockheed Auditorium, 3251 Hanover Street, Palo Alto
Dinner: 6:00 P.M., The Red Shack Hofbrau, 4085 El Camino Way, Palo Alto
Reservations: None required

Product Engineering & Production 8:00 P.M. • Tuesday, Apr. 24
Panel Discussion: "Packaging"
Panelists: Bronson Baker, Lockheed; R. Brockmonte, Brockmonte Co.; and Harry Wood, Hewlett-Packard Co.
Place: Beckman/Spinco Division, 1117 California Avenue, Palo Alto

Radio Frequency Interference 7:00 P.M. • Tuesday, Apr. 24
Business meeting—Nomination of officers
Place: Conference Room B, Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto

Reliability & Quality Control 8:00 P.M. • Wednesday, Apr. 18
"Should Reliability Be a Part of the Engineering Curricula?"
Moderator: J. Hall, IBM
Panelists: Dr. B. Epstein, consultant; P. W. O'Green, director of space programs, Lockheed; and Cmdr. R. Smiley, USN
Place: Room 101, Physics Lecture Hall, Stanford University
Dinner: 6:30 P.M., Chez Yvonne, 1854 El Camino Real, Mountain View

Reliability & Quality Control • Fri., Sat., May 11, 12
Third Annual Bay Area Reliability Seminar
Seminar: "Today's Reliability Challenge"
Program: See page 7
Place: U. S. Naval Postgraduate School, Monterey

Reliability & Quality Control 8:00 P.M. • Friday, May 11
(Joint with San Francisco Section and Student Branch U. S. Naval Postgraduate School)
Dinner Meeting
Speaker: Dr. Royal Weller, director of engineering, space-systems division, Lockheed Missiles and Space Co., Sunnyvale, Calif.
Place: Officers' Club, U. S. Naval Postgraduate School, Monterey, Calif.
Cocktails: 6:30 P.M. Dinner 8:00 P.M. prime ribs or lobster, \$3.50 in adv.
Reservations: J. M. Alderman, Arinc Research, 467 Hamilton Ave., Palo Alto, DA 1-0390

Space Electronics & Telemetry 8:00 P.M. • Tuesday, Apr. 17
"Traveling-Wave-Tube Developments and Their Role in Space Communications"
Speaker: Dr. L. A. Roberts, Watkins-Johnson Co.
Place: Lockheed Auditorium, 3251 Hanover Street, Palo Alto
Dinner: 6:30 P.M., The Old Plantation, 1030 N. San Antonio Rd., Los Altos*
Reservations: Cynthia Chaney, DA 6-4350, Ext. 5065
*Note change of location

spring joint computer conference

MAY FLOWERING

Two world figures in science and computer technology will be featured speakers at the 1962 Spring Joint Computer Conference in San Francisco on May 1-3.

Delivering the keynote address at the opening session will be Dr. Edward Teller, professor of physics at large, University of California at Berkeley. Always a diverting and inspiring speaker, Teller has chosen to discuss "How to Educate a Machine!"

The only dining affair will be a luncheon on Wednesday, May 2, which will be addressed by Prof. Adriaan van Wijngaarden of the Mathematisch Centrum at Amsterdam, The Netherlands. A leading spokesman for computer development in Europe, Wijngaarden is currently a visiting professor at the University of California, Berkeley.

All technical sessions of the conference will be held at the Fairmont Hotel on Nob Hill. A special education program, designed to acquaint users of computers, will be held during the three days at the Mark Hopkins Hotel, adjacent to the Fairmont. This program was described in the April 1 issue of the **Grid**.

Sponsor of the conference is the American Federation of Information Processing Societies (whose members are ACM, AIEE, and IRE), with the cooperation of Simulation Councils, Inc.

Appearing with remarks at the opening session will be George A. Barnard of Philco, general chairman of the conference; Dr. Willis H. Ware of Rand Corp., chairman of the governing board of the sponsoring organization; and Dr. Richard I. Tanaka of Lockheed Missiles & Space Co. technical program.

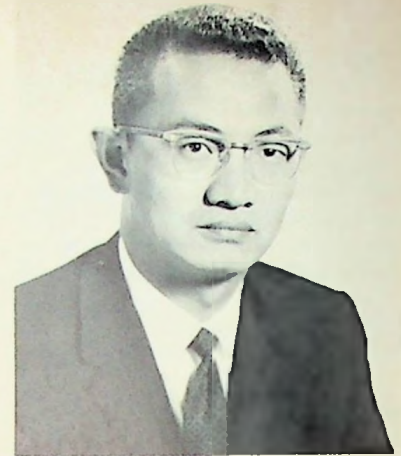
(Continued on page 8)



George A. Barnard
General chairman



Hewitt D. Crane
Vice chairman



Richard I. Tanaka
Chairman, technical program

MORE SJCC

Concerning the Technical Program

Dr. Tanaka has issued the following comment on the general character of the technical program:

"Perhaps the predominant aspect is the diversity of topics now pertinent to computer technology. They range from papers reporting basic technological developments to applications in business system-planning and to modeling of biological processes.

"Distinctive areas of specialized interest are difficult to define, and the

computer field itself seems to be developing into an interdisciplinary topic, encompassing not only the physical sciences but extending into such fields as sociology, medicine, psychology and so forth. Our program does not represent all of these areas, but it does reflect much of the breadth of interest now appropriate."

Thirty-three formal papers have been scheduled for the technical program, with a special session on "World Peace and the Role of Computers" being set for the afternoon of Thursday, May 3. Political scientists, behavioral scientists

and computer engineers will appear on a panel to be moderated by Louis Fein, Palo Alto consultant.

Women who will be in San Francisco while their menfolk are engaged in the conference can expect a round of pleasant diversions arranged by the distaff side of the conference planners.

A quartet of young ladies associated with the San Francisco offices of International Business Machines Corp. has come up with a ladies' program that will sample a number of the prime cultural and scenic attractions of San Francisco and its Peninsula.

section affairs

THE SLATE

This slate has been proposed by the Section nominating committee consisting of Donald A. Dunn, chairman; A. J.

Morris; and John V. N. Granger.

As provided in the Bylaws, additional nominations are hereby invited.

Section members will receive their

ballots early in May. These should be completed and returned promptly to permit the tellers to complete their work in time for the annual meeting.



Peter D. Lacy
—for Chairman

Vice president and director of engineering, Wiltron Co., Palo Alto. Senior Member IRE. University of Florida, BSEE 1942; Stanford, MS 1947; PhD 1952. Stanford microwave laboratory, research assistant and Sperry Gyroscope Fellow; Varian Associates, consultant; Hewlett-Packard Co., member of advanced development staff.



Charles Süsskind
—for Vice Chairman

Associate professor, electrical engineering department, University of California. Senior Member IRE. Cal Tech, BSEE 1948; Yale, MEng 1949, PhD 1951. Stanford, research associate and lecturer microwave laboratory, assistant to director; University of California 1955; USAF radar specialist. Sigma Xi, Tau Beta Pi.



Alan T. Waterman, Jr.
—for Secretary

Associate professor of electrical engineering, Stanford University; associate director, systems-technique laboratory; consultant. Senior Member IRE. Princeton University, AB physics; Cal Tech, BS meteorology; Harvard University, AM and PhD in engineering sciences and applied physics. AMS, AAAS, Sigma Xi, APS.



H. Richard Johnson
—for Treasurer

Vice president, Watkins-Johnson Co., Palo Alto. Fellow IRE, Cornell University, BSEE with Distinction 1946; Massachusetts Institute of Technology, PhD physics, 1952. Lecturer in electrical engineering, Stanford. Lecturer in engineering, UCLA; Hughes Aircraft Co., Culver City, research laboratories; MIT Fellowship.



Jack L. Melcher
—for Treasurer

President, HP Associates, Palo Alto. Senior Member IRE. University of North Carolina, BS and MS physics; Notre Dame University, PhD 1953. U.S. Navy mine countermeasures physicist; U.S. Rubber Co., Fellow in high-polymer physics, Notre Dame; Bendix Aviation Corp., missile division; Sylvania EDL; Melabs, co-founder, president.

PROGRAM

OPENING SESSION

Tuesday, May 1

Gold Room—10 a.m. to 12 noon.

Note: Addresses will be relayed via public address system to the Venetian Room in the event of an over-capacity audience.

Introduction:

Dr. Richard I. Tanaka,
Lockheed Missiles and Space Co.
Program Chairman of 1962 SJCC.

Opening Remarks:

George A. Barnard,
Philco Western Development Laboratories
General Chairman of 1962 SJCC.

Dr. Willis H. Ware,
Rand Corporation
Chairman of AFIPS Governing Board.

Keynote Address:

Dr. Edward Teller,
Professor of Physics at Large,
University of California, Berkeley, California.



Edward Teller
Keynote speaker

SPECIAL EDUCATION PROGRAM

A special orientation program about information processing for members of professional societies having an interest in the application of computers is being presented concurrently with the 1962 Spring Joint Computer Conference technical program. This program is designed to meet the needs of groups such as business and certified public accountants, documentation and information retrieval specialists, and systems and procedures analysts. Attendance is by invitation only.

Miss Margaret Conley is chairman, Miss Anne Neimi is assistant chairman, and the Misses Joy Gallagher and Barbara Taylor are members of the committee handling the social program for women.

Opening day—Tuesday, May 1—will find the morning hours centered about the Fountain Room of the Fairmont, the conference hotel, where the ladies will register and sip coffee.

In the afternoon there will be a motorcade, a special demonstration of computer logic tailored for the uninitiated, in the Room of the Dons at the Mark Hopkins Hotel across from the Fairmont on Nob Hill.

In the evening the ladies will join their escorts for the conference cocktail party in the Fairmont's Venetian Room.

Wednesday morning there will be a tour of Jackson Square, San Francisco's outstanding decorating center. Privileged visits to several of the nationally known establishments are arranged.

Luncheon at Yamato Sukiyaki House at the base of Nob Hill will follow. In the midafternoon there will be a sight-seeing cruise of San Francisco Bay aboard a chartered vessel.

Thursday—the final day of the conference—motor coaches will depart the Fairmont at 10 A.M. for Saratoga, via the scenic Skyline Drive. At Saratoga the ladies will visit the mountain winery of Paul Masson Vineyards for a wine-tasting and al fresco luncheon.

Leaving the hilltop, the touring party will go next to Paul Masson's Champagne Cellars in the valley for a demonstration of the art of champagne-making.

En route back to San Francisco the motorcade will stop for an hour at Sunset Magazine in Menlo Park to inspect the regional gardens, test kitchens, and architectural attractions of "the West's Own Magazine."

Personnel responsible for the 1962 Spring Joint Computer Conference are as follows: (General Staff) G. A. Barnard, Philco, chairman; Dr. H. D. Crane, Stanford Research Institute, vice chairman; R. A. Isaacs, Philco, secretary-treasurer; (Committee Chairmen) Dr. R. I. Tanaka, Lockheed Missiles & Space Co., program; J. E. Sherman, Lockheed Missiles & Space Co., associate; J. W. Ball, Pacific Telephone Co., exhibits; D. C. Lincome, Stanford Research Institute, exhibitors' program; R. G. Glaser, McKinsey & Co., Inc., local arrangements; W. O. Hamlin, Fairchild Semiconductor, printing and mailing; D. E. Eliezer, IBM Corporation, registration; E. T. Lincoln, IBM Corporation, publications; N. S. Jones, Friden, Inc., public relations; Miss M. G. Conley, IBM Corporation, ladies activities; and R. J. Andrews, IBM Corporation, special education program.

Tuesday, May 1, 2 p.m. to 5 p.m., Venetian Room

SESSION A

Study of Business Information Systems

Chairman:

Fred M. Tonge
Stanford University

Panelist:

C. B. McGuire, University of California, Berkeley
Richard L. Van Horn, The Rand Corporation, Santa Monica, Calif.

Organizations have always had information systems. The computer has focussed increasing attention on these systems by magnifying both their potential benefits and their directly attributable costs. Since the problems of constructing, using and improving these systems are largely ill-structured, optimizing techniques that have served in other areas cannot be transferred intact. There is much to learn about how to effect such systems and about how they affect the organization.

Within the framework of the study of business information systems we propose the following areas for specific discussion, to relate the formal papers and to explore their their implications.

- 1) What useful formal descriptions exist of business information systems, and what techniques are available for manipulating and extracting consequences from such formal descriptions?
- 2) What specific studies have been made of these systems, and what are their implications?
- 3) Of what relevance are disciplines such as information theory, theory of teams, feedback control systems theory?
- 4) What will be the impact of hardware and programming developments in such areas as display systems, pseudo-English input, etc?
- 5) What is the appropriate division of research between industry and the university?
- 6) How can we best profit from the ongoing diverse systems activities in industry?

Toward a General Simulation Capability

Michael R. Lackner

System Development Corporation, Santa Monica, Calif.

Simulation of a system by digital computer require

a model of the system which is intelligible to the student of the system while compatible with the limitations of the computer, translation of the model to computer code, movement of the model through time, recording the performance of the model.

SIMPAC, a "simulation package," incorporates coherent techniques and devices for the accomplishment of these objectives: modeling concepts for building a computer-compatible model, a vocabulary for encoding the model, a computer program for moving the model through time and recording its performance, and an output presentation program.



Isaacs

Ball

Lincome

Glaser



Hamlin

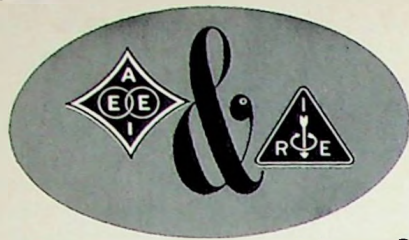
Lincoln

Jones

Andrews

(Continued on page 10)

Should



Merge?

meeting ahead

LAST CHANCE FOR GAS

Section Chairman Stanley F. Kaisel has urged a full turnout at the April 26 forum on IRE-AIEE consolidation to be held at 8 p.m. in the Physics Lecture Hall at Stanford University.

"It is extremely important to the Section and the IRE that members study the March and April Proceedings and supplements and come to the meeting prepared to express their views on the proposed consolidation," he said. "This will probably be the last opportunity before balloting." The Executive Committee will be heavily represented, as will be past chairmen and other leaders of the Section, Kaisel said.

meeting ahead

EVOLUTIONARY INFLUENCE

Towards the end of April (See Calendar, page 6), PGEC has a meeting scheduled to consider "List Processing & Practical Problems." The speaker will be J. Weizenbaum of the GE computer laboratory.

List processing is a programming technique developed originally by Newell, Simon, and Shaw for the solution of artificial-intelligence problems. The technique has been used to enable computers to play chess, prove theorems, evaluate recursive functions, etc. There is strong evidence that the concepts used in list processing will influence the design of future computing systems. Many of these ideas already have been applied in the design of the B 5000 and the KDF-9.

Weizenbaum will talk about some of the practical problems to which list process can be applied and will indicate the ways in which the list-processing concept probably will influence the evolution of future computer systems.

meeting ahead

THE SPACE ENVIRONMENT

"Experimental Biology in Space" will come under discussion at the April meeting of PGBME under detailed circumstances outlined in the Calendar, page 6. The speaker, Dr. Richard S. Young, is chief of the environmental biology branch of the Ames Research Center at Mountain View.

Young has been employed in the cancer research division of Lederle Labs, Pearl River, New York; and has also worked in the cancer research field in the pharmacology division of the Federal Food and Drug Administration, Washington, D. C. He was engaged in astrophysics at the Army Ballistic Missile Agency, Huntsville, Alabama; and has been chief of flight biology in the office of life-science programs at NASA Headquarters, Washington.

At Ames he is involved in the design and flight of basic biological experiments to determine the effects of the space environment on living systems—particularly at the cellular level—as well as the detection and study of extraterrestrial life. He is also engaged in research pertinent to the origin of life.

Young received his BA from Gettysburg College, Gettysburg, Penna.; and his PhD in zoology from Florida State University, Tallahassee. He holds memberships in Phi Sigma, Sigma Xi, AAAS, and the Society for Experimental Biology and Medicine.

meeting ahead

NEW SPACE TUBE

In mid-April, L. A. Roberts, PhD, of Watkins-Johnson will speak before PGSET on the subject, "A Traveling-Wave Amplifier and Power Supply for a Space-Vehicle Telemetry Transmitter." Particulars can be found in the Calendar, page 7.

A broad-band microwave amplifier, which will be described, is capable of delivering 12 to 14 watts of power output across the 2.0 to 2.4 gc telemetry band. This unit uses a highly efficient traveling-wave-tube amplifier to achieve this performance with an input r-f drive requirement of 3 to 6 mw. The equipment includes the power supply to operate the traveling-wave tube and contains telemetry circuits to monitor tube and unit performance before and during flight.

(Continued on page 12)



L. A. Roberts, PGSET speaker

MORE SJCC (Tuesday)

A model of an hypothetical business system has been implemented with the first version of SIMPAC for the purpose of studying management controls in a complex system. This paper discusses digital simulation and SIMPAC, and introduces modeling concepts which may lead to a set of simulation systems which would assemble models of varying complexity from descriptive statements and analyze the models prior to simulation.

A Non-Linear Digital Optimizing Program for Process Control

Raymond A. Mugele
IBM Corporation, San Jose, Calif.

A new program has been developed for optimizing a computer-controlled process. This program applies probing and restraint-following algorithms which permit solving the optimization problem in difficult cases. These cases include non-linear or discontinuous restraint functions, and non-convex domains.

The program requires relatively little storage for program and data, and no special modifications of objective or restraint functions. It is primarily applicable to some medium-sized digital computers now used in process control.

Various control strategies are compatible with this program. It can be used to generate an operator guide for a process operating in the steady state. It can also be used for optimizing the control of a process with perturbed inputs, i.e., in the transient state. It can also be interrupted, before completion, in order to determine the degree of improvement available, or to impose new restraints.

A Simulation of a Business Firm

Charles P. Bonini
Graduate School of Business, Stanford University

This paper describes a simulation model of a hypothetical business firm. The model was constructed to include not only the accounting and economic factors of costs, profits, sales, units produced, etc., but also psychological and behavioral concepts. Individuals in the firm have aspiration levels, feel pressure, and react in accordance with behavioral theory.

The purpose of the model is to study the effects of informational and organizational factors upon the decisions of a business firm. We have had limited knowledge of such variables as: the effects of tardy information, the effects of different distributions of information within the firm, the effects of differing degrees of centralization or decentralization, etc. A comprehensive model, such as the one proposed, is necessary to answer such questions.

Eight specific hypotheses involving changes in the organization and information system of the firm were formulated and tested using a factorial experimental design. The results of this experiment demonstrate the usefulness of this model as a research tool.

Tuesday, May 1, 2 p.m. to 5 p.m., Gold Room

SESSION B Theoretical Problems in Artificial Intelligence

Chairman:

Russell A. Kirsch
National Bureau of Standards
Washington, D. C.

Panelists:

Edward A. Feigenbaum, University of California, Berkeley,
and Rand Corporation, Santa Monica, California
Marvin L. Minsky, Computation Center, Massachusetts Institute of
Technology, Cambridge, Massachusetts
Norman Z. Shapiro, National Institutes of Health, Bethesda, Md.

The three papers in this session represent contributions to artificial intelligence from diverse sources. Ernst draws upon techniques related to heuristic programming to solve a problem in tactile and visual sensing and control of a real environment. Reiss draws from classical associationist psychology to provide models for machines that would exhibit association of ideas. Cannonito draws from mathematical logic to study the nature of fundamental limitations on the behavior of intelligent machines.

The papers and the subsequent discussion will be directed more to the specialist in artificial intelligence than to the specialist in the source disciplines from which the contributions derive. To the computer specialist this session will be of interest because artificial intelligence research makes essential use of computers in non-trivial ways and because some of the by-products of such research (most notably the design of programming languages) contribute directly to the further development of computers.

MH-1, a Computer-Operated Mechanical Hand

Heinrich A. Ernst
IBM Research Laboratory, San Jose, Calif.

MH-1 is a motorized and sensitized servomanipulator operated by the TX-O computer at the Massachusetts Institute of Technology. Unlike in a conventional digital control system, the computer in the MH-1 system is not used to process quantitative information. Its function is rather to perceive and appreciate the environment of the hand qualitatively. On this basis, the computer determines a reasonable course of action after a goal has been specified for the hand.

(Continued on page 12)

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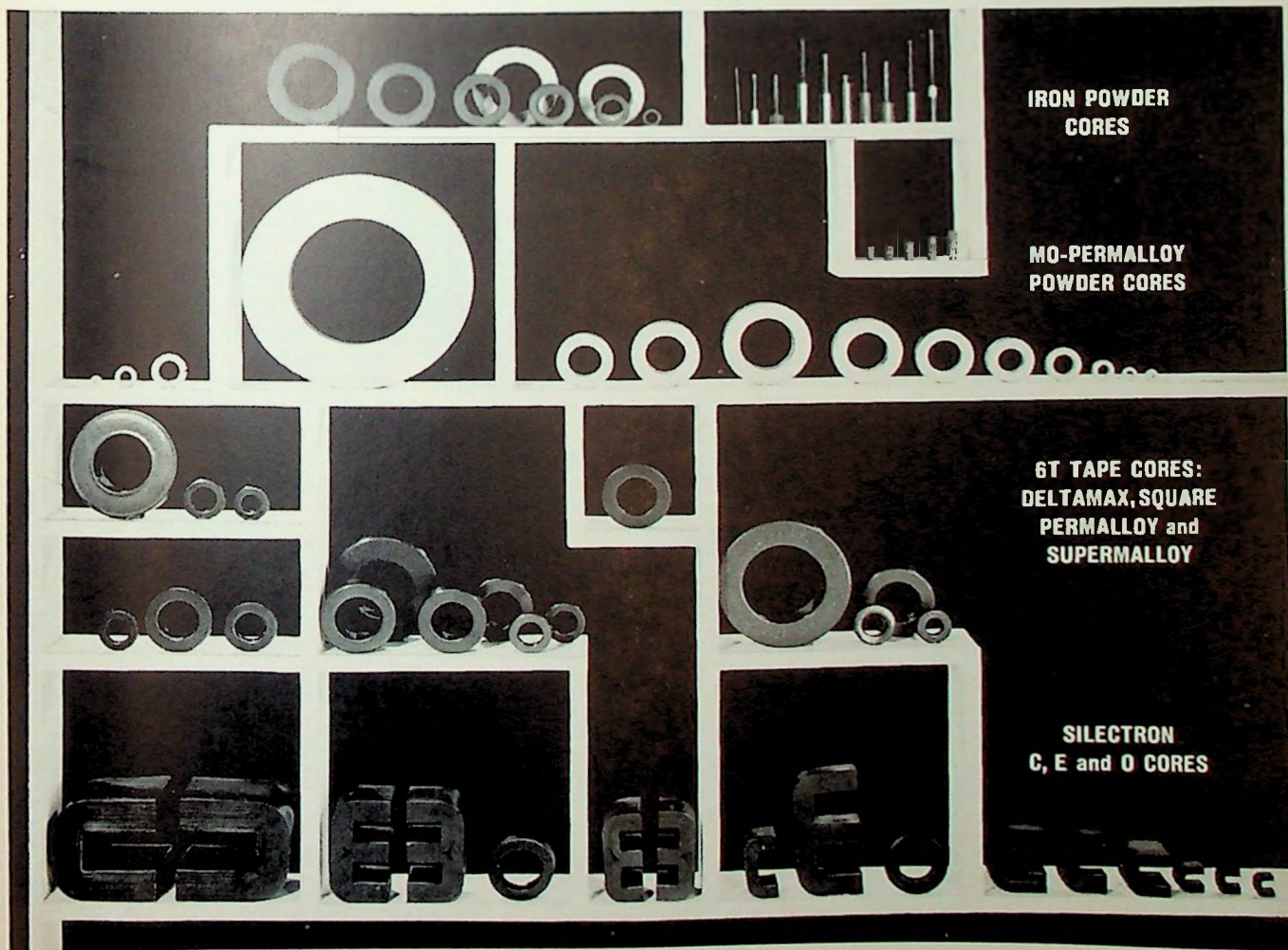
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MORE SPACE TUBE

The device that makes this equipment feasible is a high-efficiency high-reliability traveling-wave-tube amplifier. It employs periodic permanent magnet (ppm) focusing to achieve light weight and uses exotic permanent magnet materials to further reduce size and to achieve temperature insensitivity. The tube is operated at an overall efficiency (including heater power) of 22 per cent under conservative operating conditions. The tube is designed for long life and high reliability. Predicted life is 30,000 to 40,000 hours of continuous operation. The tube can perform during very large shock and vibration conditions with very low spurious a-m and f-m.

The power supply that operates the traveling-wave tube employs an efficient high-reliability switching regulator and high-voltage connector. These units operate from a 22 to 30 volt d-c line input. The entire unit fits into a compact enclosure designed to pressurize the system as well as to conduct the dissipated heat into the heat sinks.

meeting ahead

INDUSTRIAL REVOLUTION II

On Thursday evening, May 10, PGIT plans to hold its annual dinner meeting. Dr. Louis Fein, consultant, will address the Chapter on "Mind, Machine, and Soul." Details appear in the Calendar, page 6.

Fein, well known for his studies in the computer-related sciences, and in the field of Synnoetics, will tackle some aspects of the difficult questions connected with the human mind and the human psyche, in particular with our attempts to "explain" or understand these processes. Historically, mankind has contended that a) some phenomena (mind and soul, for example) are inherently "unknowable," and b) some phenomena are unknowable because of the limited mental capacity and perceptions of the knower.



Louis Fein, PGIT speaker

Today, one man's mental capacity can be augmented not only by the mental capacity of other men and organisms, but also by the capability of machines. The knower may now be such a combination—a synnoetic system. Thus a new set of issues—a subset of the traditional ones—has emerged for particular attention:

(1) Are the human intellect and psyche unknowable because of their inherently "unknowable" nature?

(2) Are they unknowable because of the limited mental capacity of synnoetic systems?

(3) If they are knowable, what form might their explanation take when we achieve such an understanding?

(4) Is it possible for a particular human being to know himself in accordance with Socrates' admonition? Can a human mind understand itself?

(5) Do machines with ever-increasing capabilities threaten man's dignity, sovereignty, self-esteem?

These intriguing questions go to the core of the efforts of many of us in the information-processing fields, although we often tend to overlook them in our absorption with technical details. Together with the related problems of men, machines and society that inevitably arise, the discussion of these questions by Dr. Fein promises an unusual and interesting evening.

meeting ahead

DIGITIZED DATA

The April Lecture (No. 2) in the Instrumentation System Seminar of PGI features Messrs. Gross and Thayer, and is detailed in the Calendar, page 6. Instrumentation systems measure, process, and record d-c voltage, a-c voltage, current, resistance, frequency period, time interval, and events occurring in a selected time interval. Transducers convert the unknown physical variables of temperature, pressure, acceleration, weight, displacement, velocity, stress, strain, and flow to these electrical signals so they can be handled by the instrumentation system.

Depending on the time constant of the variables being measured, accuracy required, and other factors, either an analog or a digital system will be selected. The April lecture covers only the digital instrumentation system.

The basic elements of a digital instrumentation system are as follows: Scanner, signal conditioning, analog-to-digital converters, auxiliary equipment, coupler, and digital recorder.

Emphasis will be placed in this lecture on the scanner, signal conditioning equipment, and analog-to-digital converters. Subsequent lectures will cover the remaining elements of the digital instrumentation system.

MORE SJCC (Tuesday)

Because of the automatic execution of these higher control functions, the system, by itself, in its attempt to reach that goal, behaves sensibly even in unexpected situations for which no explicit instructions have been given. For example, it makes reasonably successful attempts to resolve inconsistencies between the plan of action and the situation in the environment, it finds a way around obstacles hindering the hand, or it accepts help from a human assistant without fighting back, but it still resists unwanted interference. A film of MH-1 in action, demonstrating these properties, will be shown.

An Abstract Machine Based on Classical Association Psychology

Richard F. Reiss

Librascope Division, General Precision, Inc., Glendale, Calif.

Classical association psychology (circa 1750-1900) described, and proposed to explain, human thought processes in terms of a few kinds of forces operating on discrete entities called "sensations," "images," "ideas" etc. The classical theory was not given a precise, quantitative formulation and has been generally abandoned for a variety of reasons. However, the problem of developing artificial intelligence in digital machines provides new grounds for evaluating and perhaps extending association theory.

One method of evaluation is the synthesis by postulation of abstract "machines" which reflect the fundamental insights of association theory, and analyses of their behavior. In this paper a minimal machine is defined and certain aspects of its behavior are examined. It is restricted to a finite system of discrete objects coupled by two types of associative bonds, some of which are modified by passage of the objects through an "attention" register. The system grows in size by the admission of new objects via a "sensory" register. Although this "machine" constitutes an over-simplified interpretation of association theory, it does display some of the diverse behavioral potentialities of such systems.

The Gödel Incompleteness Theorem and Intelligent Machines

Frank B. Cannonito

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

This paper considers whether or not Gödel's Incompleteness Theorem implies that machines are incapable of operating as intelligent robots. The paper's view is that the theorem does not limit machines in this sense. To support this belief, the concept of a recursively enumerable set of integers is developed via the intuitively appealing properties of programs made up from basic instructions similar to the well-known initial functions of primitive recursion. Productive sets of integers are then introduced and after some remarks relating formal languages to sets of integers via the Gödel numbering technique, a formal axiomatic arithmetic language L is defined and the recursive enumerability of L 's set of theorems is asserted. The notions of ω -consistency and interpretation of L are then given and Gödel's Incompleteness Theorem is stated and interpreted vis-a-vis digital computers.

The paper then attempts to modify the concept of a program so that the theorem of De Leeuw, Moore, Shannon and Shapiro can be introduced to argue that nonrecursively enumerable sets of integers can be generated by the modified programs under suitable restrictions. This is regarded as removing the restrictions on the use of machines as creative robots, implied by the Gödel Incompleteness Theorem.

COCKTAIL PARTY

Tuesday, May 1

Venetian Room, 6 p.m. to 8 p.m.

Fee—\$4.50. Buy ticket with admission ticket at registration desks.

Attendance is limited at this activity. Tickets will be sold on a first come basis.

Wednesday, May 2, 9 a.m. to 12 noon, Gold Room

SESSION C

Digital Storage and Circuits

Chairman:

Jack I. Raffel
Lincoln Laboratory
Massachusetts Institute of Technology
Lexington, Mass.

Panelists:

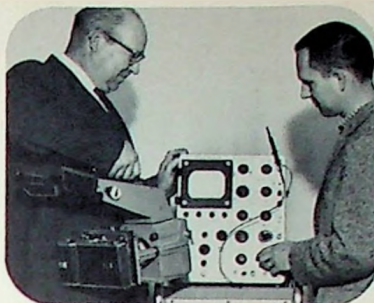
Kent D. Broadbent, American Systems, Inc., Inglewood, Calif.
Munro K. Haynes, Thomas J. Watson Research Center, IBM Corporation, Yorktown Heights, N. Y.

The session on digital storage and circuits will emphasize the continuing attempt on the part of component designers to perform more complicated functions faster and cheaper. Two of the papers are devoted to cryogenic associative memory work, the third to a technique for high-speed transistor logic. While they represent widely different ends of the component spectrum with respect to environment, switching speed, stage of development and familiarity, they, as well as all other developments, will be measured ultimately in common units of bits, dollars, and microseconds. It is hoped that this session will make some contribution to this difficult process of evaluation.

(Continued on page 14)



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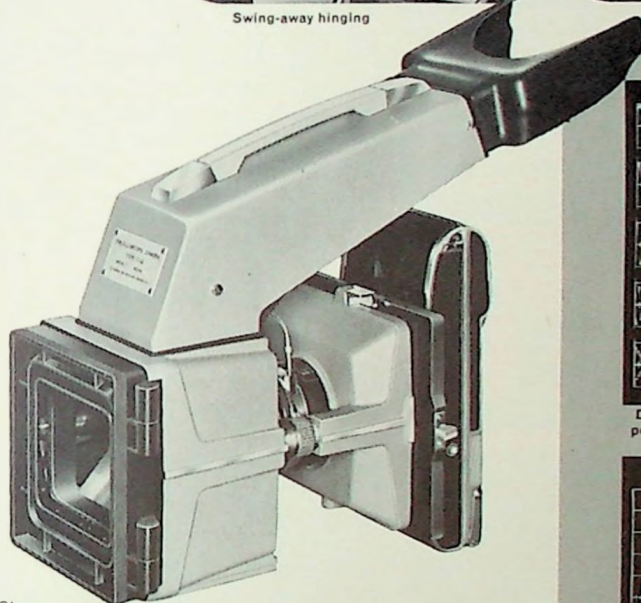
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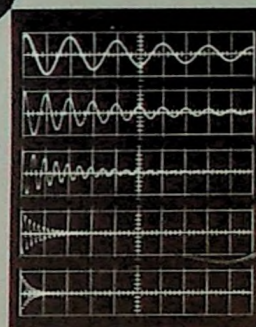
C-12-02 CAMERA . . . \$455

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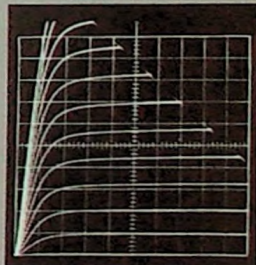
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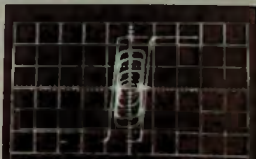
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RECEIVERS FOR VARYING CHANNELS

Dr. Thomas Kailath addressed the PGIT Chapter in February on the topic, "Receivers for Randomly Varying Channels." The meeting was held at Stanford Research Institute, and 40 attended.

The speaker showed how the concept of correlation detection of deterministic signals in additive gaussian noise can be extended to the detection of signals that are transmitted through time-varying channels, if the channel variations are such that the output signals are samples from a gaussian process. For this case the problem of defining an optimum receiver can be solved analytically, leading to explicit specification of receiver operations. The receiver considered is optimum in the sense of computing the a posteriori probabilities of the possible transmitted signals.¹

For simplicity of presentation, the channel considered was time quantized, and the added noise was taken to be white; the possible transmitted signals are a finite set of (time sampled) waveforms. The transmitting and receiving process is indicated in Fig. 1, where the

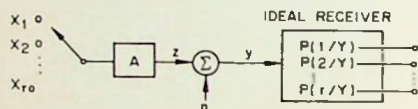


Fig. 1

x's are the transmitted waveforms, A is the time-varying transfer function of the channel that changes the x's into a corresponding (but time-varying) set of z's, and n is the white gaussian noise that combines additively with the particular z waveform present to form the receiver input y. The ideal receiver then computes, for each of the x's, the probability that the channel input started out as that x waveform.

In actuality it turns out that it is sufficient for the receiver to compute a set of quadratic forms,

$$\Lambda = (Y - Z), K_v^{-1} (Y - Z)$$

where Y and Z are vectors whose components are the time samples of the y waveform, and the means of the time samples of the z waveform, respectively. The K_v^{-1} is the inverse of the covariance matrix of the y samples, and the t on the first parenthesis denotes the transpose. In the calculation of the Λ for each of the x's, the vector of means, Z, and the covariance matrix, K_v , are different from different x's.

The equations for the Λ 's completely specify the receiver form; study of the receiver design is thus reduced to studying ways of implementing the calculations under various channel conditions. The most familiar case occurs when the channel is deterministic, i.e., is not varying at all; the important part of the cal-

culatation is then just $Z_i Y$, the classical cross-correlation operation. The receiver for this case is obviously a trivial extension of the receiver for the simple nondistorting channel. The effect of the known channel is taken into account by passing the stored sampled signals at the receiver, the X's, through a duplicate distorting channel to obtain the Z's to use in the cross-correlation.

A different case, however, is that of a completely random channel, so that knowledge of the transfer function of the channel is not available to the receiver and the Z's cannot be calculated. We might expect in this case that it would be close to optimum to estimate the Z's and to use these estimates in cross-correlating with Y. It turns out that this is, in fact, the optimum thing to do.² In this purely random-channel situation, the essential terms to be computed are $Y_i H Y$, where

$$H = K_z (K_z + N_i I)^{-1}$$

and the H matrices used in the calculations for different x's are different because the K_z matrices are different; the $N_i I$ matrix is the identity matrix multiplied by the (scalar) noise power spectral density. The H's can be regarded as estimating filters that operate on Y to produce the best mean-square estimates of the Z's, as indicated in Fig. 2.

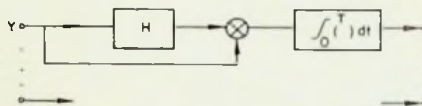


Fig. 2

The form of the receiver calculations can be rearranged to show the effects of the channel and of the transmitted signals more explicitly. This can be done by using

$$K_z = X K_x X_i$$

where the X matrix has elements that are the sample values of the x waveform being considered, and K_x is the channel covariance matrix. Using this in the previous form for the receiver calculation, and doing some further manipulation, it turns out that the receiver calculation can be written as

$$Y_i X F X_i Y$$

where the F matrix is in general different in the calculations for different x's. The corresponding receiver can be realized as shown in Fig. 3. The output of

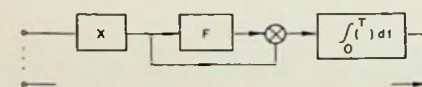


Fig. 3

F can be interpreted as the minimum variance estimate of the channel transfer function. The first filter, X, can be interpreted as strengthening the ex-

(Continued on page 16)

MORE SJCC (Wednesday)

A Superconductive Associative Memory

Paul M. Davies
Abacus, Inc., Santa Monica, Calif.

The general properties of an associative memory are explained, and their advantages relative to a random access memory discussed. Then a superconductive mechanism of such a memory is described which is based upon the cross film cryotron. The memory requires 5 cryotrons per bit and 9 cryotrons for a control module associated with each word. Any combination of bits of the word can be used as the key, and any number of records in the memory can be identified and read out as the result of a single association. The speed of various circuitry in the memory is approximated and some applications are suggested.

A Cryogenic Data Addressed Memory

V. L. Newhouse
General Electric
Research Laboratory
Schenectady, N. Y.

R. E. Fruin
General Electric Heavy Military
Electronic Dept.
Syracuse, N. Y.

A computer storage system which is addressed by content rather than location is described. The design has been verified by constructing and successfully operating a three-word module consisting of 81 crossed-film cryotrons on a six-inch by three-inch substrate.

Circuits for the FX-1 Computer

Kenneth H. Konkle
Massachusetts Institute of Technology, Lexington, Mass.

A set of circuits capable of 50 megapulse operation is described. Included are gated and mixing pulse amplifiers, a static flip-flop, a diode logic unit with current-steering amplifier, a passive delay line, and an active variable delay circuit; all of which are designed to operate with terminated 75 ohm transmission lines. Ten nsec. pulses and 20 nsec. flip-flop transition times are provided through use of very-high-speed MADT transistors. The circuits have been successfully employed in the FX-1, a small general purpose computer with high-speed magnetic film memory.

Wednesday, May 2, 9 a.m. to 12 noon, Gold Room

SESSION D
Man-Machine Cooperation

Chairman:
Douglas C. Engelbart
Stanford Research Institute
Menlo Park, Calif.

Panelists:
Frederick P. Brooks, Jr., IBM Corporation, Poughkeepsie, N. Y.
Richard S. Hirsch, IBM Corporation, San Jose, Calif.
Herbert Martin Teager, Massachusetts Institute of Technology, Cambridge, Mass.

Bringing the human into on-line association with the computer, to interact in real time, is a trend motivated by several goals. Computerized systems, with real-time missions, often need to utilize some of the still-unique human capabilities, such as pattern recognition and judgment. Here the goal is to get best possible system performance, and the problem in the man-machine relationships is to try to couple the man in the best manner to this end. This goal has prompted most of the man-machine work to date.

Another goal, still to be generally appreciated and pursued, is that of extending the individual human's self-directed problem-solving capability by means of more intimate cooperation with the computer. This session is concerned, relative to both goals, with the current possibilities and problems of real-time, on-line, man-computer cooperation.

On-Line Communication Between Men and Computers

J. C. R. Licklider
Bolt Beranek and
Newman, Inc.
Cambridge, Mass.

Welden Clark
Bolt Beranek and
Newman, Inc.
Los Angeles, Calif.

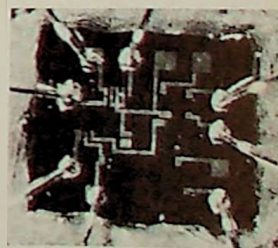
The paper first reviews briefly the main problems and existing techniques of on-line communication between men and computers, and then describes three current developments:

1. A time-sharing system that permits several operators with independent problems to use one computer simultaneously, each operator having sensibly continuous access to its facilities.
2. A set of programs and techniques to facilitate planning and design of buildings.
3. Techniques that provide pictorial displays of what is going on inside the computer and reveal basic characteristics of traced-operating programs.

The paper concludes with a brief discussion of man-computer communication problems that call for basic advances in concept and hardware.

(Continued on page 16)

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MORE RECEIVERS

pected signal waveform where it is expected to be large, and suppressing it where it is expected to be low, analogous to the maximal-ratio combining concept for diversity links.

Kailath discussed some other possible rearrangements of the calculations of the basic quadratic forms, one of which does away with the need for a multiplier. This form is obtained by using a matrix factorization to obtain the calculation in the form

$$(GX^T Y), GX^T Y$$

where the X^T matrices are somewhat different from the X matrices. This form of the calculation leads to the receiver configuration shown in Fig. 4. In this

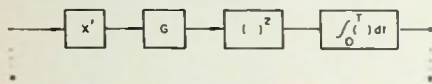


Fig. 4

case the filter X^T can be regarded as a matched filter for the x waveform, so that the filter output is approximately the impulse response of the channel; the filter G then modifies this by taking account of the a priori information about the channel, and the energy in the various parts of the channel impulse response is added up. This receiver form can also be interpreted in terms of diversity combiner action.³

The speaker emphasized that in receiver studies it is particularly important to try to glean a physical interpretation for the action of the receiver which has been obtained with all the assumptions that must be introduced for analytical tractability. The understanding so gained is usually a fairly reliable guide in suggesting what to do in practical situations, which inevitably differ in some respect from the analytical models.

References

1. Woodward, P. M., "Probability and Information Theory with Applications to Radar," Pergamon Press, London, 1953.
2. Kailath, T., "Correlation Detection of Signals Perturbed by a Random Channel," Trans. IRE, 17-6 (1960) 331.
3. Kailath, T., "Optimum Receivers for Randomly Varying Channels," Information Theory, Fourth London Symposium, Edited by Colin Cherry, Butterworths, London, 1961.

—FORREST F. FULTON, JR.

meeting review

BITS OF IVY

Meeting at SRI in mid-February, PGEC listened to W. H. Wattenburg, assistant professor of electrical engineering, who presented the plans of the University of California to expand the facilities and services of the computation center on its Berkeley campus. The objective is better service for that campus, as well as those at Davis and San Francisco.

Heart of the computing system will

be an IBM 7090 with two modules of 32,768 words of core storage each. One module will be used solely for a supervisory control program which will service all input-output operations and schedule the entire system. The other will be available for user programs. Unique to this system will be several terminals located in classrooms or research laboratories which will be directly connected to the computer for real-time entry problems.

Initially, these terminals will be modified typewriters, but eventually they may be card readers and punches or graphical devices. They will be connected to the computer via the IBM 7281 data communication channel. Ultimately, each academic department may have its own terminals so that no problems have to be physically carried to the computation center for entry to the system.

The system will also include microwave data links to other campuses so that problems too large for their own computing facilities may be quickly sent to Berkeley at rates up to 62,500 characters per second.

—E. C. SMITH, JR.

meeting review

"NEXT SLIDE PLEASE"

Arch Cassingham and Ralph Sims of Sylvania Electronic Systems-West demonstrated the art of "Making Visual Aids Effective"—their audience was the PGEWS chapter, at its February meeting held in the Sylvania EDL auditorium.

Cassingham's emphasis was on staging, the most vital and neglected aspect of visual presentations. He showed through examples what to do and what to avoid in preparing visual aids and in using equipment.

One of the worst offenses is commit-

(Continued on page 18)



Prof. Adriaan Wijngaarden
SJCC luncheon speaker

MORE SJCC (Wednesday)

Solution of Non-Linear Integral Equations Using On-Line Computer Control

Glen J. Culler
Ramo-Woolridge, a Division
of Thompson Ramo-Woolridge
Canoga Park, Calif.

Robert W. Huff
University of California
Radiation Laboratory,
Berkeley, Calif.

This paper contains results from some computer experiments performed as part of a study concerning more effective utilization of computers as research tools for scientific problems. A display and analysis console permitting direct control of the computer was used to solve a non-linear integral equation occurring in the Bardeen-Cooper-Schrieffer theory of superconductivity. This equation gives the energy gap in a superconductor a function of energy after three physical parameters have been specified. In each case, the method of solution was constructed by the problem solver through direct interaction with the computer, the strategy of solution of each stage being based on information obtained from the computer in the course of the solution process. Thus, characteristic features of the problem and the pitfalls involved were discovered and controlled during the process of solution.

According to the parameter values specified, the problems ranged from very easy to quite difficult, and thus provided a basis for testing our approach. Extension of this technique to other digital equations, to more general one-dimensional problems, and to a wide class of physical and mathematical problems appears entirely feasible.

Are the Man and the Machine Relations?

Burton R. Wolin

System Development Corporation, Santa Monica, Calif.

As environments requiring control have become more complex, and the speeds of events in those environments have increased, there has been a trend to use computers to supplement or replace men or the functions they have traditionally performed.

The decision as to how to use computers in systems has been influenced by beliefs about what men can and cannot do or should and should not do.

Additionally, attempts to employ computers have frequently failed because not enough has been known, either about the function, or how to program the computer to perform the function.

A research program is described which has two objectives. First, to study the behavior of men in complex environments to find out what they can and cannot do well, and what factors limit or extend their effectiveness. Second, to study the behavior of men to determine how they perform complex functions, using the men as analogues of general-purpose computers, so that computers can be better programmed to perform such functions when it is necessary to do so.

A brief description of the computerized laboratory in which the research is being done, and how the laboratory is being used, is included.

CONFERENCE LUNCHEON

Luncheon Address:

Professor A. van Wijngaarden

Mathematisch Centrum, Amsterdam, The Netherlands

Wednesday, May 2

Tonga Room, Fairmont Hotel, 12 noon

Fee—\$4.50. Buy ticket with admission ticket at registration desks

Attendance is limited at this activity. Tickets will be sold on a first come basis.

Wednesday, May 2, 2 p.m. to 5 p.m., Venetian Room

SESSION E Data Analysis and Model Construction in the Study of the Nervous System

Chairman:

Belmont G. Farley
Lincoln Laboratory
Massachusetts Institute of Technology
Lexington, Mass.

Panelists:

T. H. Bullock, UCLA
M. H. Goldstein, Jr., Massachusetts Institute of Technology
Josiah Macy, Jr., Albert Einstein College of Medicine, New York City

The complexity and non-linearity of the problems encountered in the study of the nervous system make necessary the use of the most capable available tools for progress toward their solution. Problems arise both in processing experimental data, and in constructing theoretical models. The theme of this session is the application of advanced analog and digital techniques to analysis and synthesis of experi-

(Continued on page 18)

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Ralph S. Sims and Arch Cassingham, speakers at PGEWS February meeting

MORE VISUAL AIDS

ted when a slide presentation is not planned. Some of the weakening results are: the speaker is continually interrupting his talk to say, "Next slide, please"; slides get out of order, upside down, or backwards with no hope for correction; when lighting is improper, the audience cannot take notes as slides are shown; the screen may be the wrong size for the seating arrangement; it's difficult to back up to a slide previously shown — a duplicate should have been made. All of these things draw the audience's attention toward the errors in preparation and away from the speaker's subject.

Ralph Sims discussed the steps needed to prepare effective visual aids. Flip charts, slides, and motion pictures are effective means of communications if properly planned and made. With the aid of slides, Sims then described the steps from raw material assembly to completed visual aid. He emphasized the need for stating the prime objective of a visual aid before starting.

For example, rendered illustrations made for an instruction manual are not automatically suitable for use in a slide presentation. He demonstrated this point by showing tables of information and air-brushed drawings which were not recognizable beyond the first row of the audience. This brought out other requirements on lettering sizes. Slides can contain only a few items of information and the lettering must be readable by the last row of the audience.

Both speakers are employed by Sylvania Electronic Systems-West at Mountain View. Arch Cassingham joined Sylvania electronic defense laboratories in 1954 and has worked in still and high-speed photography, motion pictures, and printing. He developed the photographic and reproduction facilities at Sylvania and is now supervisor of photography, reproduction. Ralph Sims is a native of Atlanta and studied art at the Atlanta Art Institute and at Santa

Ana College. He joined Sylvania EDL in 1957 and is now senior illustrator at Sylvania reconnaissance systems laboratories. He is a member of the National Society of Art Directors.

—PAUL JENSEN

meeting review

SEARCH FOR AN INPUT

Approximately 30 heard about, "Sensory Deprivation & Instrumentation Research," when they attended the late February meeting of PGBME. John K. Dupress, director of technological research of the American Foundation for the Blind, New York, made the presentation.

The speaker defined sensory deprivation as partial or total loss of hearing and/or vision which results in limited communication with the environment. For individuals, the major problems that arise are: direct access to the printed word and graphic forms, mobility (foot travel), and for the deaf-blind, direct access to the spoken word.

Of the 360,000 blind persons in the United States, approximately 30 per cent are totally blind. There may be as many as 700,000 additional persons who function as though blind in the performance of certain important tasks. There are about 6,000 deaf-blind, of whom approximately 50 per cent have such severely impaired hearing that no commercial hearing aids are useful.

In the past 50 years, nine reading machines and 20 mobility devices have been taken to the working prototype stage. There have been three attempts to process speech and convert it into a form that could be perceived by the deaf-blind through cutaneous sensation. The major design characteristics of these devices were outlined.

In spite of this fairly extensive research and development effort, none of these devices has proved satisfactory. Dupress listed the following reasons for

(Continued on page 20)

MORE SJCC (Wednesday)

mental phenomena observed in both animal and human nervous systems. Emphasis will be placed on problems and methods peculiar to the study of biological systems, but an attempt will be made to assess the present status of the field and relate it to others.

Problems In the Study of the Nervous System

Belmont G. Farley
Lincoln Laboratory, Massachusetts Institute of Technology,
Lexington, Mass.

A survey is given of the main experimental and theoretical difficulties encountered in the study of the nervous system. These difficulties are illustrated by specific examples of the uncertainties still existing in knowledge of the behavior of neurons, both individually and in groups, and in the interpretation of experimental observations. Concepts of the reduction of data from electrophysiological experiments are discussed and compared with those in physical experiments. Some theoretical problems are similarly treated. Examples of analog and digital computers having both special and general-purpose features which have been used to attack these problems are given, with a brief discussion of some of the results.

Neural Analogs

Leon D. Harmon

Bell Telephone Laboratories, Inc., Murray Hill, N. J.

Information processing in the nervous system is receiving increasing attention by researchers in the communications sciences. One of the most prolific areas of activity has been neural modeling. Simple electrical and mathematical models were described over half a century ago, in recent years there has been a growing array of chemical, electronic, mathematical and computer-simulated analogs.

Two quite different kinds of neural modeling have resulted. In one category the intent is to simulate the complex parameters of the biological original closely in order to consider functions of the nervous system, hopefully to supplement neuro-physiological research. In the second kind of neural modeling the idea is to explore the single-element logical behavior or the self-organizing properties of ensembles of relatively simple quasi-neural elements.

It is the purpose of this paper to emphasize the differences between these two approaches, to review briefly some of the main streams of activity in neural modeling, and to show, by way of example, the results of one particular line of investigation — the work dealing with real-time electronic neural analogs.

The Caudal Photoreceptor of the Crayfish: A Quantitative Study of Responses to Intensity, Temporal and Wavelength Variables

William R. Uttal

IBM Research Center, Yorktown Heights, N. Y.

This paper describes the results of a study which has been made of the caudal photoreceptor of the crayfish. Pooled pulse potentials evoked by photic stimuli were recorded from the ventral nerve cord and these data digitized and recorded on magnetic tape. A digital computer was then used to analyze the data and recognize certain specific features. The coding of the nerve action potentials, as a function of the stimulus dimensions, was investigated and it was determined that the stimulus amplitude-response magnitude relation was a power function with the same exponent as that found in human perception. Furthermore, the spectral luminosity curve was determined to coincide with that of the human eye.

The similarities of these two functions suggest a common photochemical medium which thus allows a detailed study to be made of these human perceptual processes in a highly reduced model preparation.

A Theory and Simulation of Rhythmic Behavior Due to Reciprocal Inhibition in Small Nerve Nets

Richard F. Reiss

Librascope Division, General Precision, Inc., Glendale, Calif.

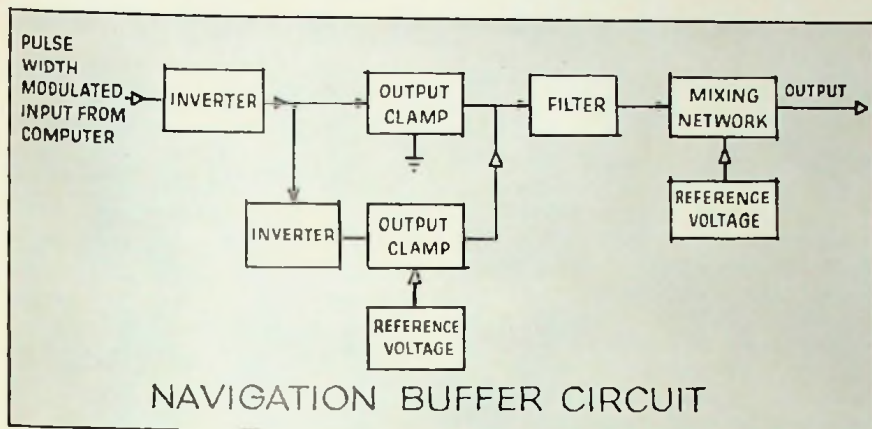
An elementary theory predicts that neurons which inhibit each other, and which suffer "fatigue" with repeated firing, can produce alternate bursts of pulses, a "multivibrator" effect, under certain conditions. Fragmentary physiological evidence suggests that reciprocal inhibition does occur in sensory and muscle control systems, and may in particular explain rhythmic behavior of the sort seen in alternating reflexes responsible for animal locomotion.

On the basis of a specific conceptual model of signal processing in neurons, analog and digital simulation models have been constructed and used to explore the multivibrator effect. The effect is rather easily produced with model neurons operating in either "coincidence" or "relaxation" modes, and is facilitated within limits by asymmetric parameters.

The reported simulation experiments are restricted to reciprocal inhibition of just two neurons and indicate that a neuron coupler, with a few sensory inputs and proprioceptive feedbacks, could provide an economical control system for alternating reflexes or for synergistic muscle groups which time-share a common load. Such a system could rapidly adapt to varying loads and would require minimal control from higher nervous centers. The exploration of many other possible functions for two (and more) multivibrator effects in small nerve nets has only begun.

(Continued on page 20)

SKIRMISH OVER A COMPUTER-TO-INERTIAL-PLATFORM INTERPRETER



What is the best way to implement the digital-to-analog conversion circuitry required to convert binary incremental signals from a digital computer to precise d.c. voltages for gyro torquing in an airborne tactical data system? This was a problem faced by Litton data systems engineers.

Several engineers who had participated in the development of an earlier navigation buffer employing the digital servo technique were strongly inclined towards playing it safe by adopting an identical approach. To permit the navigation system to sustain the longer flights required under the new program, they proposed engineering greater accuracy into the existing buffer. Somehow, they felt, the additional requirements for lesser weight and volume could also be met. Preliminary investigation revealed that this scheme would require at least 20 pounds of hardware.

Feeling that a better way could be found, other engineers studied alternate approaches and finally proposed a scheme for generating d.c. gyro torquing voltages scaled according to width-modulated pulses linearly related to computer word length. This approach appeared to hold promise of an accuracy of at least 1 part in 4000 (0.025%), which was specified for two of the required eight signals (six for the inertial subsystem; two for the cockpit display system). The pulse width modulation/demodulation method also appeared to require far less hardware than would the digital servo technique because of the elimination of heavy electromechanical components.

Skeptics were quick to point out that the specified precision would be impossible to obtain in view of errors inherent in pulse-width modulation, delays and rise times in the precision switch, switch offset volt-

age, reference supply voltage, filter capacitor leakage and stability, filter lags, drum speed variation, and signal line ground currents.

Undaunted, the advocates of the new method pressed ahead, conducted detailed studies and laboratory investigations to nullify all objections and verified the complete feasibility of their proposed scheme.

Now functioning as part of a tactical data system installed in a carrier-based aircraft, this eight-signal navigation buffer is packaged on five 3" x 3" cards and two small assemblies. Weight and volume are about one-fifth of that required for a digital servo type of buffer. More recently, new packaging techniques have enabled reduction of the buffer unit by an additional 40% to two cards and two assemblies without degrading accuracy.

Litton management recognizes the value of results stimulated by healthy controversy. Security and proprietary restrictions preclude our discussing current activities, but new programs offering many new technical challenges are now being conducted. And Litton continues to encourage an environment in which engineers can propose and pursue other than safe approaches to problems. If you've been frustrated in your attempts to follow through on new approaches to digital data handling and display functions, write Harry L. Laur, Litton Systems, Inc., Data Systems Division, 6700 Eton Avenue, Canoga Park, California, or telephone DIamond 6-4040.

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failure: 1) inability to select the proper information from the environment, 2) unsuitable coding forms for perception by the human, and 3) an attempt to find a substitute for vision or hearing without taking advantage of remaining sensory channels and human-trained capabilities.

Dupress believes that it is this lack of human engineering and a sufficiently broad interdisciplinary approach with appropriate basic research preceding the design of devices, that have led to failure.

Dupress also pointed out that the blind and deaf-blind have problems that are common to others. For example, the military is interested in non-visual object detection. Industry and government are interested in machine processing of printed characters. The problems of the partially sighted are similar to those of normally sighted persons under conditions of temporary deprivation.

In the final analysis, the problems of blind and deaf-blind will be solved best when appropriate data is machine sensed and processed for introduction directly into the central nervous system. The other alternative is successful organ transplants.

A basic and applied sensory-aids program is underway is the present time in the electrical and mechanical engineering departments of Massachusetts Institute of Technology. Dupress hopes that a similar program will be underway soon in the Stanford area.

—JAMES C. BLISS

meeting review

HUB WITHOUT FILM

The speaker for the March meeting of PGMIL was Morton Tolson, senior research engineer at the Satellite Test Center, Sunnyvale, California, with the subject being "The Satellite Control Facility and the Satellite Test Center." Tolson is a member of a Lockheed group under special contract to the Air

Force for technical support to the 6594th Aerospace Test Wing and is employed in the requirements evaluation and integration branch.

Tolson presented a description of the network of tracking stations; the Satellite Test Center; the satellite orbital control concept; and the ground equipment required to track, receive radio telemetry data, and command the satellite.

In describing the Satellite Test Center, emphasis was placed upon the test controller's functions and the equipment and support facilities available to him. A typical satellite pass was described as seen from the central control room at the Satellite Test Center, which operates as the hub of all station activities around the world.

After hearing about all the various functions controlled and the associated equipment throughout the entire system, you can be sure the audience was wishfully anticipating Tolson would show some juicy movies of said installations—no such luck! The presentation was limited to unclassified slides since satellites controlled by Sunnyvale are all highly classified. However, the talk was still interesting. —JOE WETTSTEIN

lecture review

RESONANT RAINDROPS

Professor A. W. Straiton, University of Texas, introduced his talk, "Propagation Characteristics of Millimeter Radio Waves," by reviewing the advantages: tremendous bandwidth and narrow antenna beams—and potential uses: short-range radar, space communications, and detection of the earth's oxygen from space. This was Lecture No. 2 in the PGAP/PGED/PGMTT Spring series. The principal effects to be considered, he said, are atmospheric absorption, sky temperature absorption, and scattering by raindrops and refraction.

Absorption

Energy is absorbed by energy transferred to molecular rotation in the na-

(Continued on page 22)



PGMIL group at coffee includes Joe Wettstein; Jerry Dover; Morton Tolson, speaker; Charles Antony; and Boyd Norris

MORE SJCC (Wednesday)

Wednesday, May 2, 2 p.m. to 5 p.m., Gold Room

SESSION F Computer Systems

Chairman:

James H. Pomeroy
Thomas J. Watson Research Center,
IBM Corporation
Yorktown Heights, N. Y.

Panelists:

Erich Bloch, IBM Corporation, Poughkeepsie, N. Y.
Howard R. Nonken, Burroughs Laboratories, Paoli, Pa.
Herbert Martin Teager, Massachusetts Institute of Technology,
Cambridge, Mass.

Faster computer systems can usually be expected from faster technology, but there are other areas where improvement is needed and can be obtained. Some of these are described.

The processes themselves can be defined in new ways which make solution of many problems more convenient. The use of content-addressed, or "associative" memories can greatly speed up and simplify the searching operation characteristic of many non-numerical problems. Final results can often be presented to the user in visual displays conveying the essential information compactly and in minimum time; the example described primarily concerns maintenance but has implications for operational results as well.

The Maniac III Arithmetic System

Robert L. Ashenburt

Institute for Computer Research, University of Chicago, Chicago, Ill.

Unlike most computers, for which there is a formal distinction between "fixed-point" and "floating-point" numbers, the University of Chicago Maniac III computer handles all numbers in a single format (exponent and coefficient, with the coefficient in general not normalized). This permits several types of arithmetic to be defined, which differ in that results are adjusted (coefficient scaled) according to different rules. For example, a "floating-point" operation adjusts the result according to a "significant digit" criterion, while a "specified point" operation adjusts the result to the exponent of the first operand. Normalized arithmetic and a fourth type called "basic" are also available. Since the format for operands is the same for all these types, they can be processed by the various arithmetics without intermediate conversion, thus adding a dimension of flexibility to the computing process.

This paper discusses the arithmetic rules in some detail showing how consistent conventions for rounding, adjustment of zero and formation of low-order parts are established. The trapping system used for the detection of anomalous results is also described.

An Organization of an Associate Cryogenic Computer

Robert F. Rosin

Department of Electrical Engineering, University of Michigan
Ann Arbor, Mich.

This paper is concerned with the organization of a computer built entirely of cryotrons and operating with an associative (content addressed) memory in which the location of words stored or retrieved is determined by all or part of the contents of the words.

Since cryogenic circuitry is used throughout, the speed of the machine is relatively uniform in both memory and other functions. Thus, the traditional balance of operation time is changed from that existing in more contemporary devices. Moreover, the problem of hardware maintenance has changed due to the very cold environment which must exist for the machine to operate.

A design approach to these and other considerations is evolved which includes putting more logic than usual into the memory and eliminating the necessity for a distinct instruction location counter, address decoder, etc. Problems considered include multi- and parallel processing, indexing and indirect addressing, input-output processing and self-monitoring functions.

Integration and Automatic Fault Location Techniques In Large Digital Data Systems

Donald W. Liddell

U. S. Navy Electronics Laboratory, San Diego, Calif.

A digital computer, if used with proper programming techniques, can be a powerful tool during the processes of physical integration of complex digital data processing systems. After system integration as such has been completed, the same techniques may be used to provide performance monitoring and daily calibration status data for all or any part of a system.

Investigation of such programming techniques during system integration of the Developmental Navy Tactical Data System (NTDS) at USNEL produced results which indicated the possibility of using the computer for automatic fault location in the system. Some progress has been made in this area, and a program which allows the NTDS computer to identify a failing logic card associated with its own memory

(Continued on page 22)

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- You are supported by good secretarial, administrative, drafting, technician, and writing staffs.
- You have high-quality test equipment for your own use.
- Your purchasing department can secure an electronic component, if available in the area, and place it in your hands the same day.
- You can get fabrication work from your desk to the start of actual construction in one day.
- The company is located where you can get to and from work without developing traffic nerves.
- You have an office in which to concentrate on your assignments without needless distractions.
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PGAP post-meeting discussion centers around A. W. Straiton, speaker

—Ray Egan photo

MORE PROPAGATION

tural atmosphere. The absorption is due almost entirely to oxygen and water vapor although the effects of other gases can be detected. In the laboratory, water vapor exhibits two resonant lines at 22.2 kmc and 180 kmc, but most of the absorption in the atmosphere is due to spillover of lines at infrared wavelengths. The theoretical technique dates from 1945 and says that the absorption at the resonant frequency is constant regardless of gas pressure and that the line width is proportional to pressure.

Experiments show that these assumptions are not exactly correct. These measurements in the atmosphere have been made by noting path loss on different days, noting the vapor content of the air each time, and plotting the attenuation factor versus water-vapor content. This procedure separates the absorption due to oxygen, which is about 0.78 db per mile, from the water-vapor attenuation, which gives a total attenuation of about 1.5 db per mile with 20 grams of water vapor per cubic meter. The data appears to fit a theoretical curve having one line width for lower frequencies, and another a curve corresponding to a wider line width at higher frequencies; it cannot be covered with one theoretical curve.

The absorption due to oxygen occurs as a multiplex of 21 separate lines between 5 and 6 millimeters and a single line at 2.5 millimeters. Professor Straiton stated that oxygen absorption is influenced by the presence of water vapor and that they hoped to measure this relationship in the future.

Temperature

The total attenuation through the atmosphere can be evaluated by measuring the apparent temperature of the

sun at various elevation angles. It varies linearly inversely with the secant of the elevated angle to approximately 5000K when observed directly overhead. Furthermore, the sky temperature is observed to be about 280K when observed at near grazing incidence, indicating almost complete absorption, and about 100K for vertical observation of a clear sky. The temperature of a heavy cumulus cloud is usually observed to be about 280K; the temperature of lighter clouds is correspondingly less.

Raindrops

Rain attenuation is customarily plotted as attenuation constant versus rainfall rate. Correlation of measured and calculated attenuation is quite good when calculations are made using measured drop size distributions. Straiton then showed a curve of the scattering cross section of a single water drop against the drop diameter. He stated that the attenuation measured at 176 kmc can be small compared to the attenuation measured at 4 or 8 millimeters and stated that this may be due to the drop sizes approaching the resonant values.

Refraction

A curve of angle deviation versus reverse angle was presented, for optical observations at 4.3 millimeters, of the sun's position. The deviation was seen to be considerably greater at the millimeter wavelengths for near grazing incidence and to be nearly the same for each wavelength at more nearly vertical angles. Straiton also presented some experimental data indicative of ducting, which indicated that 8.6 millimeter waves are trapped by a duct to a greater extent than 3.2 centimeter waves, but that 4.3 millimeter waves are

(Continued on page 24)

MORE SJCC (Wednesday)

logic and switching circuitry has been successfully demonstrated. The final objectives of this approach are to provide facilities to perform on-line performance monitoring and automatic fault location, reduce to a minimum the external test equipment required for a system, and eliminate insofar as possible the high degree of training presently required in the system maintenance technician.

Wednesday, May 2, 2 p.m. to 5 p.m., Peacock Court
(Mark Hopkins Hotel)

SESSION G Analog Applications and Techniques

Chairman
Vernon L. Larrowe
Institute of Science and Technology
University of Michigan
Ann Arbor, Mich.

Panellists

Arthur D. Bridgman, *Sylvania Electronic Defense Laboratories, Mountain View, Calif.*
P. J. Hermann, *Dept. of Aerospace Engineering, Iowa State University*
Hans E. Messinger, *Hughes Aircraft Company, Culver City, Calif.*
James E. Wolfe, *Analog Computer Laboratory, General Electric Company, Philadelphia, Pa.*

The modern electronic analog computer, when intelligently programmed, is capable of solving accurately many engineering problems which arise in current technological research and development.

The papers scheduled for presentation at this session represent a sampling of the many applications of the analog computer to contemporary problems. They are intended, not only to introduce ideas and stimulate thinking, but also to serve as valuable references for persons engaged in solving similar problems on electronic analog computers.

The Use of Computers in Analysis

Walter J. Karplus and Ladis D. Kovach
Department of Engineering, University of California
Los Angeles, Calif.

The computer is recognized as an important engineering design tool permitting the student to test the efficacy of a large number of design hypotheses to determine an optimum design. The application of automatic computers to courses in methods of analysis, however, has not been clearly defined.

This paper gives a number of specific examples of the utilization of computers in engineering analysis. Foremost among these examples are two categories of computer utilization: 1) The application of computers to aid the student in the visualization of dynamic or mathematical phenomena, and 2) The opening up of new approaches to the explanation of system behavior—approaches which are out of reach of conventional analytical methods.

Analog Simulation of Particle Trajectories in Fluid Flow

Vance D. Norum
Space-General Corporation, Glendale, Calif.

Marvin Adelberg and Robert L. Farenkopf
Space Technology Laboratories, Inc., Redondo Beach, Calif.

This paper presents a detailed account of the analog simulation of particle trajectories in a two-dimensional fluid flow field governed by Laplace's equation. A conductive surface is used as a direct analog of the two-dimensional fluid flow field in conjunction with an electronic analog computer to determine the trajectories of particles in the presence of fluid flow. Emphasis is placed on the concept of accuracy of the particle trajectories as well as error criteria by which trajectory accuracy can be judged, and on the sources of error inherent in their determination.

A detailed error analysis is presented in which a suitable error model is derived and certain inaccuracies in the computing equipment are assumed in order to predict their effect on the particle trajectories. An example is presented to illustrate the types and magnitudes of errors that exist in a typical problem. The analog simulation is also used to obtain trajectories in a potential flow field distorted by the presence of a cylinder and the results are then compared to a similar case obtained by other authors using a different approach. These results were comparable, with suitable explanations for the difference.

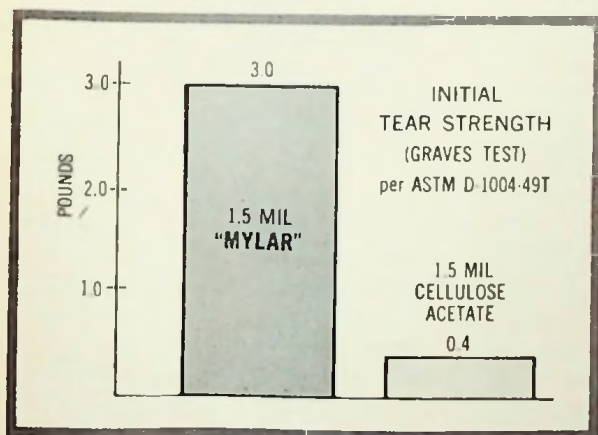
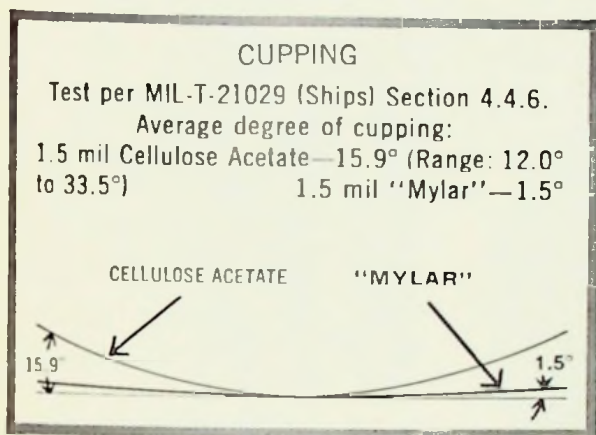
The Application of Finite Fourier Transforms to Analog Computer Simulations

Eric Liban
Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y.

An analog computer technique for the solution of certain classes of boundary value problems of partial differential equation based on Finite Fourier Transforms is presented, which requires considerably less computer components than conventional finite difference methods. The derivation of the Finite Fourier Transform method is briefly stated and then applied to analog computer simulations of heat transfer equations with linear and nonlinear boundary conditions.

(Continued on page 24)

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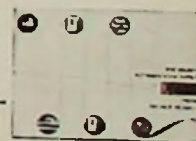


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MORE PROPAGATION

not trapped as well, and this is believed to be due to the water surface roughness. The effect of atmospheric turbulence was also mentioned and a curve comparing signal fluctuations at 3.2 centimeters and 4.3 millimeters was presented. This indicated about a 5 to 1 greater degree of fluctuation for the higher-frequency signals.

—PETER KENNEDY

meeting review MONKEY DATA

A scenario in three parts, describing some automated behavioral experiments, was presented to the March meeting of the PGBME. The topic of discussion was DADTA (Discrimination Apparatus for Discrete Trial Analysis) and associated experiments. The meeting represented an excellent example of the beneficial results to be gained from the interdisciplinary exchanges characteristic of the PGBME.

The first speaker, Dr. Karl Pribram of Stanford Medical School, recalled that two years ago he made a plea at a PGBME Meeting for some help in automating behavioral testing of monkeys. The problem essentially was how to present multiple stimuli to monkeys in a way that eliminates spatial effects, how to reward the animal, and how to record the data in a form suitable for computer processing. The vast number of trials necessary for statistically significant results meant that automatic equipment was necessary. In addition, an automatic machine would greatly facilitate comparisons between the mental abilities of normal animals and animals with brain lesions, in order to better understand brain functioning.

The second speaker, Gerald Pressman of SRI, described the equipment that

was designed and built to answer Pribram's plea. The display of cues is presented through an array of 16 clear plastic windows by means of replaceable projection units behind each window. The subject makes his choice by touching the window which trips a microswitch. If the correct choice was made, the reward is dropped into a tray in the center of the panel. Up to 12 cues may be presented at one time, and 12 different symbols are available. (At present these are the numerals 1-9, a red disk and a green disk.) The cues disappear and then reappear in different positions after each trial, thus eliminating spatial effects.

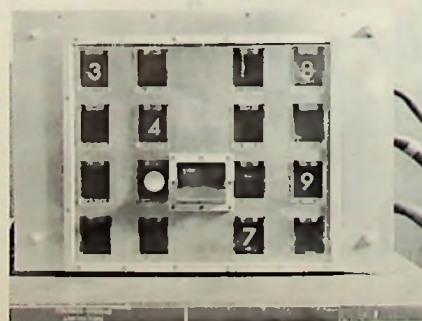
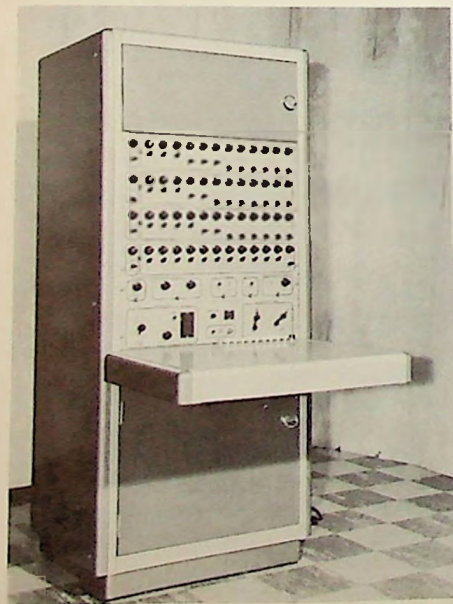
The control console, which may be located up to 50 feet from the display unit, enables the operator to set up four different displays. The display programs are changed automatically when the preset learning criterion is achieved. This criterion may be a certain number of consecutive rewards, or a certain percentage of rewards. Additional controls on the console permit selection of the "mode" of reinforcement; for example, a group of symbols selected in a certain sequence, or a group of symbols selected in any sequence, are two possible reinforcement modes.

The subject's response is recorded on punched paper tape. The symbol selected, the position of the symbol, and the result of the choice are recorded each time a selection is made.

The third speaker, Dr. Dan Kimball of Stanford Medical School, described some recent experiments that have been performed with the DADTA. The first experiments with the machine involved teaching monkeys to discriminate between numbers. It was found that an average of 250 trials was necessary to teach a normal monkey to discriminate between a 6 and a 4. With the machine, 50 trials could be performed in seven minutes. The quick reinforcement provided by the reward mechanism was considered to enhance this learning.

Once the animals could distinguish between the numbers, an experiment
(Continued on page 26)

Left, human control console; below, simian control console. Note gastro-
nomic reward output in latter



MORE SJCC (Wednesday)

Analog Simulation of the Re-Entry of a Ballistic Missile Warhead and Multiple Decoys

L. E. Fogarty and R. M. Howe
University of Michigan, Ann Arbor, Mich

The basic problem considered here is the computation of the re-entry trajectory of a single ballistic missile warhead as well as the trajectories of a number of decoys which originate from the warhead trajectory. Suitable three-dimensional equations of motion are presented for a re-entry vehicle with arbitrary drag coefficient, mass, and area, and the analog computer circuit for solving these equations in real time is given. Then a method of using several such circuits to compute simultaneously the trajectories of multiple targets with variations in all three initial velocity components as well as variations in ballistic coefficient is presented.

Thursday, May 3, 9 a.m. to 12 noon, Venetian Room

SESSION H Information Retrieval

Chairman:

Jack Goldberg
Stanford Research Institute
Menlo Park, Calif

Participants:

Charles P. Boorne, Stanford Research Institute, Menlo Park, Calif
R. K. Wakerling, Lawrence Radiation Laboratory, University of California, Berkeley, Calif

Two basic tasks in an information retrieval system presently requiring human judgment are the establishment of the indexing categories and the indexing of incoming items. There have been numerous suggestions for the mechanization of the latter task, using semantic or statistical analysis. One of the papers at this session will describe a statistical method for establishing the categories themselves, by analysis of the text of a representative body of items. The method might also be useful in mechanizing item indexing in a so-called probabilistic indexing and retrieval system.

Machine retrieval has been proposed for more than just library service. A second paper discusses the possibilities of a mechanized retrieval system at the center of a very complicated technical and human organization—the hospital. The paper illustrates the complexity of the problem, and the diversity of techniques which the system designer must employ.

The Construction of an Empirically Based Mathematically Derived Classification System

Harold Borko

System Development Corp., Santa Monica, Calif.

This study describes a method for developing an empirically based, computer derived classification system. Six hundred and eighteen psychological abstracts were coded in machine language for computer processing. The total text consisted of approximately 50,000 words of which nearly 6,800 were unique words. The computer program arranged these words in order of frequency of occurrence. From the list of words which occurred 20 or more times, excluding syntactical terms such as *and*, *but*, *of*, etc., the investigator selected 90 words for use as index terms. These were arranged in a data matrix with the terms on the horizontal and the document number on the vertical axis. The cells contained the number of times the term was used in the document. Based on these data, a correlation matrix, 90x90 in size, was computed which showed the relationship of each term to every other term. The matrix was factor analyzed and the first 10 eigenvectors were selected as factors. These were rotated for meaning and interpreted as major categories in a classification system. These factors were compared with and shown to be comparable but not identical to the classification system used by the American Psychological Association. The results demonstrate the feasibility of an empirically derived classification system and establish the value of factor analysis as a technique in language data processing.

The Storage and Retrieval of Physiological and Medical Data in a Modern Hospital

Paul C. Tiffany

Aerospace Corporation, El Segundo, Calif.

As an introduction, this paper considers some of the problems of data handling in a modern hospital. Next, the needs of the users of the data are considered. The principal area of interest is directed toward the hospital function which deals with the storage and retrieval of the clinical record after the patient's hospitalization. An estimation is made of the large amounts of terms used in medicine, and of two currently employed schemes for the indexing of diseases and operations. A description is made of a storage and retrieval system which allows the medical researcher to examine and browse through clinical records or abstracts of the records. The paper concludes with observations on the need for applied research and system development to acquire pilot systems for the storage and retrieval of physiological and medical data.

(Continued on page 26)



Said Isaac Newton:

"Every particle of matter attracts every other particle with a force directly proportional to the product of their masses and inversely proportional to the square of the distances between them."

Until recently, the thrust which propelled rocket vehicles into their coast stage, prior to orbiting, was provided by booster stages. The fuel carried by the satellite stage was used only to inject itself into orbit.

Now, however, a scientist at Lockheed Missiles & Space Company has evolved a Dual Burning Propulsion System which allows higher orbits and heavier payloads. With this system, the satellite vehicle fires immediately after the late booster stage burns out, thus augmenting the begin-coast speed. Later the satellite stage is re-started to provide orbit injection.

An even more recent development by Lockheed is a triple-burning satellite stage. This will permit a precise 24-hour equatorial orbit, even though the vehicle is launched a considerable distance from the equator.

These principles have made possible the early development of the MIDAS satellite. Moreover, they substantially increase the altitude and payload of the DISCOVERER series. Lockheed, Systems Manager for these programs and for the POLARIS FBM, is pursuing even more advanced research and development projects. As a result, there are ever-widening opportunities for creative engineers and scientists in their chosen fields.

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MORE TRIAL ANALYSIS

was started to determine whether discrimination between two symbols presented simultaneously and a sequential discrimination involved different neural networks. Impairment in the ability to perform these tasks after hippocampus lesions can be used to indicate the function of this brain area.

While these experiments are still in progress, it has been found that normal animals can learn to hit a 1 and then a 5 in sequence after an average of 1300 trials.

Hippocampal animals learn at a much slower rate.

The chief advantages of DADTA are:

- 1) A large number of trials can be performed in a short period of time,
- 2) Excellent control is obtained over the stimulus, response, and reward conditions, and
- 3) More analysis can be performed on the results.

—JAMES C. BLISS

lecture review

TRANSMISSION AT 140 KMC

The principal speaker at Lecture No. 3 of the PGAP/PGED/PGMTT series was Dr. Alan J. Simmons of TRG, who discussed, "Millimeter Wave Antennas and Transmission Lines" at Stanford University.

Simmons pointed out that with generators now readily available at wavelengths down to about 3 mm, and shorter wavelengths available through the use of frequency multipliers, the advantages of these very-high-frequencies in terms of small component size, increased information bandwidth, and better angular resolution are within the state of the art.

So far as antennas are concerned, the emphasis is on optical types. Maintaining tolerances is the principal problem. Five-foot-diameter paraboloids have been spun with $\pm 1/32$ wavelength tolerances at 8 mm, and 1-ft-diameter dishes have been spun with $\pm 1/32$ wavelength tolerances at 2 mm. A 10-ft casting has been machined on a vertical boring mill with the same tolerances at 4 mm.

Lens antennas become practical at these frequencies since they do not become excessively heavy. A pair of 6-in.-diam lenses make a good transmission line at 2 mm. The measured loss over a 40-ft path was 6 db.

Non-optical type antennas, which have been used with some success, are electro-formed slot arrays, Purcell arrays, and leaky-wave inductive-grid antennas.

Colin Hackling of Sylvania presented some data on a 6-ft-long Foster scanner
(Continued on page 28)

MORE SJCC (Thursday)

Thursday, May 3, 9 a.m. to 12 noon, Gold Room

SESSION I Programming and Coding Part 1

Chairman:

Bernard A. Galler
Computing Center
University of Michigan

Participants:

Richard W. Hamming, Bell Telephone Labs, Murray Hill, N. J.
Edwin L. Jacks, Data Processing Section, General Motors, Inc., Detroit, Mich.
Alan J. Perlis, Computation Center, Carnegie Tech, Pittsburgh, Pa.
Francis W. Wagner, North American Aviation Company, Los Angeles, Calif.

The most striking feature about programming today is the variety of problems on which work is being done. We normally think of activity in programming as being concerned with sub-routines, translators, or system development, but as we shall see in the papers presented here, there are other areas under active investigation.

Two of the papers are concerned with new developments in the languages which we use in expressing algorithms. The very existence of these papers testifies that the topics which concern them must inevitably be provided for in computing languages. Two of the papers deal with new requirements on operating systems. As problems become more complex, we find that we must consider the implications of dynamic storage allocation, and these two papers are pointing up some of the different approaches to the problem.

The fifth paper in this session is also concerned with the complexity of future problems, but from a different point of view. Here we need to examine the methods used to determine when a program is working correctly. The trend toward putting the burden more squarely on the "shoulders" of the computer continues, and, of course, it must.

Fact Compiler Segmentation

Martin N. Greenfield

Manitowish-Honeywell EDP Division, Wellesley Hills, Mass.

The manner in which the Fact Compiler handles segmentation of programs is described. Programs are divided into many interdependent segments in order to optimize the use of core storage. For instance, the internal storage required to handle a tape file (buffers, labels, controls) would be one segment. This segment would be operated upon by other processing segments. Each of the segments may be activated or released independently as required. Each of the segments is relocated at execution time. Segments in memory may be subsequently moved by the monitor in order to fit additional segments in core. The monitor has the ability to organize the required rearrangement. A hardware error detection feature is used to make the currently operating segments sensitive to the absence of a segment about to be addressed. This provides an efficient linkage to the monitor enabling it to activate the segment.

A General Test Data Generator for Cobol

Lt Richard I. Sauder

Wright-Patterson Air Force Base, Ohio

Program checkout procedures are often hampered by the nonavailability of adequate test data. To reduce this problem, a Test Data Generator is currently being developed to operate in conjunction with the Cobol Compiler implemented by the Air Force Logistics Command. The system not only builds data items conforming to descriptions given in the Data Division of the associated Cobol Source Program but also inserts in these items necessary data relationships and requirements to test various branches of the Cobol object program. The generator is labelled "general" inasmuch as the method of expressing these data requirements is designed to be as hardware independent as the Cobol compiler employed to build the program being tested. This paper discusses both the utilization and the method of operation of the Data Generator.

Data Structures that Generalize Rectangular Arrays

Samuel A. Hoffman

Kettelle & Wagner, Paoli, Pa.

A class of data structures, useful in data processing, is defined. These are called generalized structures. A formal method of describing a generalized structure is given. It is shown how a compiler program, once given such a description or descriptor, can allocate contiguous storage and determine the appropriate form of the storage mapping function which will relate suitably referenced positions in the structure with positions in the linear storage. The suitable referencing of data in the structure is accomplished by reference

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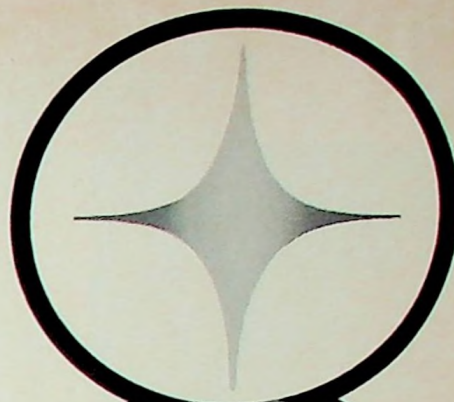
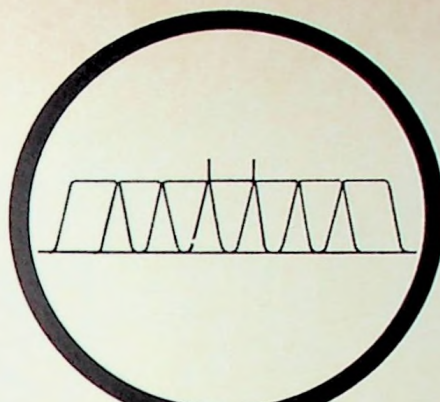
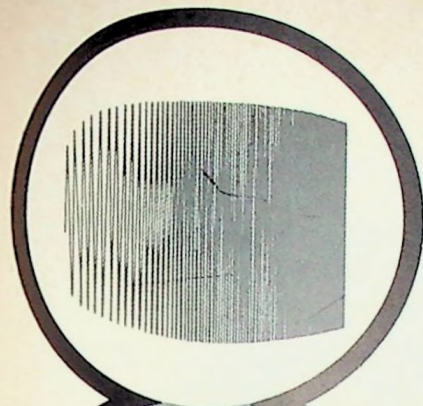
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(Continued on page 28)



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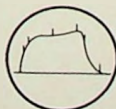
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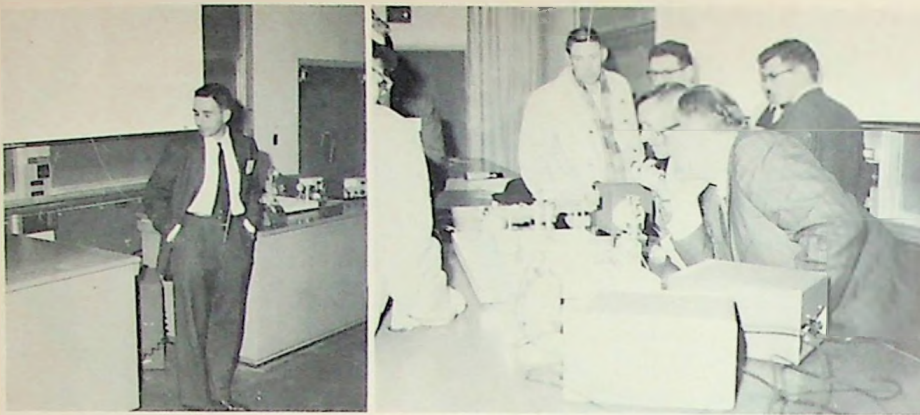
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grid — 27



Alan J. Simmons, speaker at PGAP/PGED/PGMTT lecture No. 3, and crowd examining demonstration equipment described below

MORE TRANSMISSION

designed for high-frequency operation and referenced an article in the October 1959 PGMIL Transactions. A 0.2 deg beam with 19-db side lobes was achieved with a 5- to 8-db insertion loss.

Simmons then discussed the types of transmission line that are appropriate to the millimeter wavelength range. In general, the attenuation in standard TE_{10} mode waveguide increases about as the $3/2$ power of the frequency. In comparing different transmission-line modes the loss is roughly inversely proportional to the perimeter of the field.

Hence, most of the transmission lines that are being used at millimeter wavelengths use modes where the field is allowed to expand over a relatively large area. Among these are circular waveguide in the TE_{11} mode, H-guide, image line, Goubau wire, and beam modes. The line that has been developed to the greatest extent at that time is the TE_{11} mode. Using a 2-in.-diam guide, BTL has achieved one mile transmission paths at 50 kmc with 3-db loss.

The image line and Goubau wire use a metal conductor with a thin layer of dielectric serving to trap a surface

(Continued on page 30)

MORE SJCC (Thursday)

expressions; these are defined and it is shown how, at run time, they are operated upon by the storage mapping function

The class of structures, the descriptors, the form of the storage mapping function and the reference expressions are all shown to be direct generalizations of the corresponding considerations for n-dimensional rectangular arrays.

Finally, an Algol program for the Burroughs 220 computer is briefly described. The program simulates the functions that a compiler, upon receiving a descriptor, would perform in forming the storage mapping function, and the processing that would be carried out at run time when a reference expression is presented

Thursday, May 3, 2 p.m. to 5 p.m., Gold Room

SESSION I Programming and Coding Part 2

Chairman: Same as Part 1

Panelist: Same as Part 1

An Experimental Time-Sharing System

Fernando J. Corbato

Massachusetts Institute of Technology Computation Center
Cambridge, Mass.

Time-sharing a digital computer is subject to two common interpretations. One can mean using different parts of the hardware at the same time for different tasks, or one can mean several persons making use of the computer at the same time. The first meaning, often called multiprogramming, is oriented towards hardware efficiency in the sense of attempting to attain complete utilization of all components. The second meaning of time-sharing, which is meant here, is primarily concerned with the efficiency of persons trying to use a computer. Computer efficiency must still be considered but only in the perspective of the total system utility.

The motivation for time-shared computer usage arises out of the slow man-computer interaction rate possible with the bigger, more-advanced computers. This rate has changed little (and become worse in some cases) in the last decade of widespread computer use. The desired performance of a time-shared computer will be discussed as well as specific hardware, programming and usage problems. The operational characteristics of an experimental time-sharing programming system prepared for an IBM 7090 will be described. Consideration will be given to the design compromises and to the future avenues of improvement.

A Programming Language

Kenneth E. Iverson

Thomas J. Watson Research Center, IBM Corporation
Yorktown Heights, N. Y.

The paper describes a succinct problem-oriented programming language. The language is broad in scope, having been developed for, and applied effectively in, such diverse areas as microprogramming, switching theory, operations research, information retrieval, sorting theory, structure of compilers, search procedures, and language translation. The language permits a high degree of useful formalism. It relies heavily on a systematic extension of a small set of basic operations to vectors, matrices, and trees, and on a family of flexible selection operations controlled by logical vectors. Illustrations will be drawn from a variety of applications.

Thursday, May 3, 2 p.m. to 5 p.m., Venetian Room

SESSION J World Peace and Role of Computers





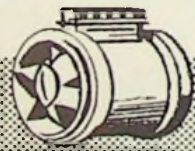


Chairman:

Louis Fein
Consultant
Palo Alto, California

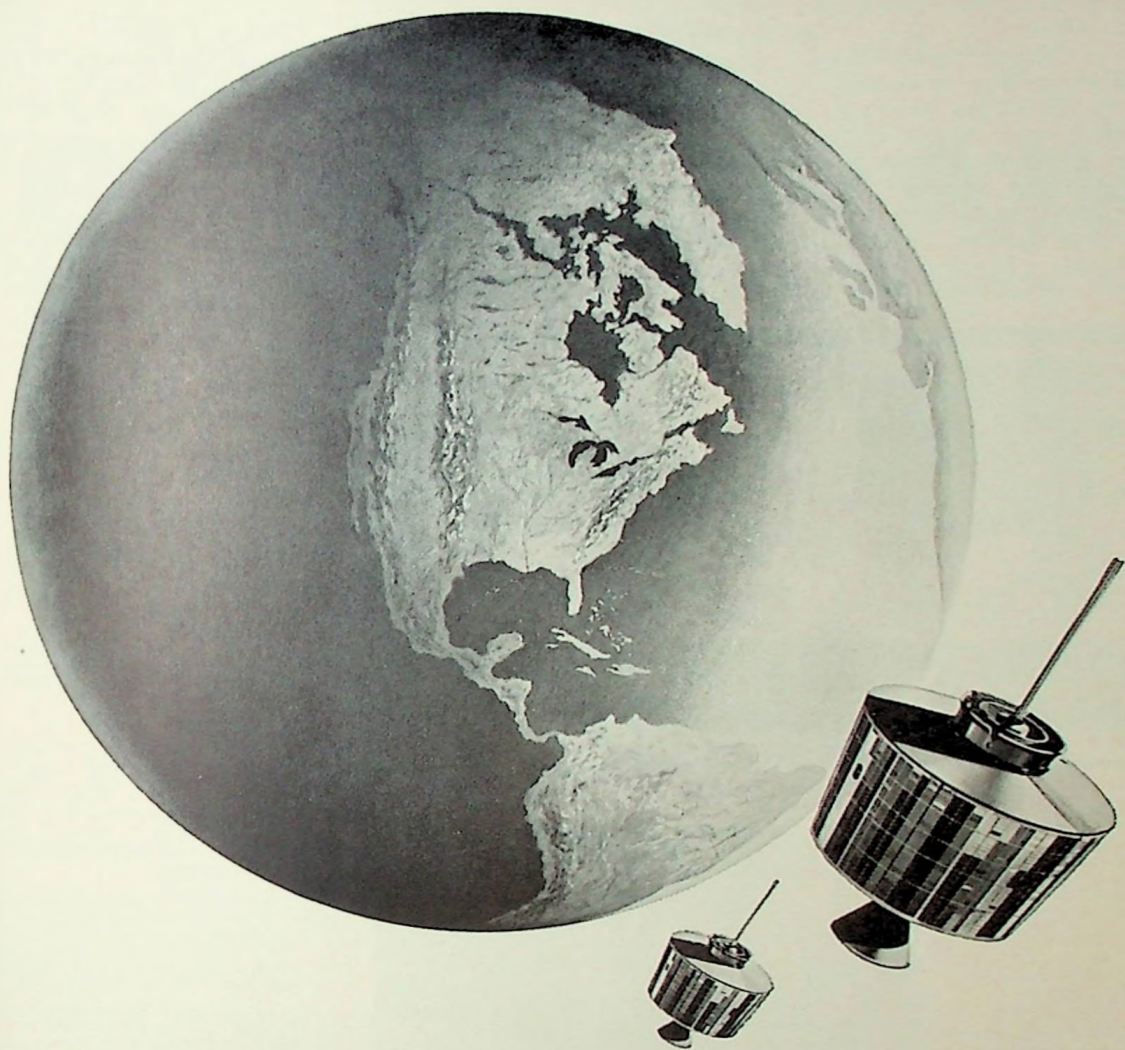
Panel Discussion

"Peace and the Role of Computers" defines the theme of this panel discussion by experts in the area of sociological and political research. Replacing man with computers for making humanistic decisions is a novel and intriguing area which has capabilities and limitations that are largely unknown. The objectives of this discussion will be to explore ways in which computers can help peace gamblers and other peace researchers in performing their tasks and solving their problems; and also bring to light what measures can be taken by professional computer people to further this application

(Continued on page 30)

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wave where only a very small percentage of the field is inside the dielectric. The H-guide uses a thin slab of dielectric guiding a surface wave, with two metal plates restricting the extent of the field in the H-plane.

For all of the surface-wave-type lines the biggest problem is the transition from the typical TE_{10} rectangular-guide-generator output to the desired mode. These transitions are generally long and somewhat inefficient. The beam waveguide, also due to Goubeau, uses a series of dielectric lenses, the first collimating a beam from a small

horn, with each succeeding lens located in the near field of its predecessor and restricting the divergence of the rays. Such lines have been built at 23 kmc with a 1-meter spacing between lenses, yielding a loss of 0.05 db per meter.

Simmons' talk concluded with a demonstration of millimeter wave equipment using a 70-kmc generator, ferrite isolator and modulator, directional coupler, frequency meter, attenuator, horn, paraboloid, and a TE_{10} rotary joint. By using a frequency doubler to generate 140 kmc, a transmission path between two 2-in. lenses was established.

—FRANK L. HENNESSEY

MORE SJCC (Thursday)

of machine to man's problems.

Subjects to be discussed are:

(1) Identifying necessary and sufficient conditions (economic, political, sociological, psychological, cultural, military, religious, moral, ethical, ideological, legal and semantic) for preventing major international conflicts—conflict for whose resolution nations seriously consider all-out nuclear war as an acceptable instrument, (2) generating alternative models of society whose most important property is that they meet these necessary and sufficient conditions, (3) generating alternative routes of getting from our present world condition to a no-major-conflict condition of society.

In the event of conflict, peace research concentrates on (4) generating alternative non-destructive conflict-resolution policies and strategies, and (5) generating detailed ways of implementing these policies in practice.

Papers will be integrated with a continuity of subject matter from paper to paper. The format and content of the session may be considered as a very small scale model of the whole process of analyzing important sociological problems and solving them with the aid of computers.

Thursday, May 3, 2 p.m. to 5 p.m., Peacock Court
(Mark Hopkins Hotel)

SESSION K DDA and Hybrid Computation

Chairman:

Harold K. Skramstad
Naval Ordnance Laboratory
Corona, California

Panelists:

Robert M. Barnett, *Avco Research Center, Moffett Field, Calif.*
W. N. McLean, *North American Aviation, Los Angeles, Calif.*
Fred Shaver, *National Aeronautics and Space Administration,
Marshall Space Flight Center, Huntsville, Ala.*

The Digital Differential Analyzer or DDA is a special purpose digital computer of the incremental type which has the ability to solve differential equation problems with high efficiency. Programmed in the manner of analog computers, but free of analog limitations on precision, they are being increasingly used in real-time simulation and control, due primarily to the order of magnitude increases in speed attainable in recent years.

The first paper "Design of a One-Megacycle Iteration Rate DDA" describes a new DDA of exceptionally high speed. The second paper "DDA Error Analysis Using Sampled Data Techniques" is a thorough analytical study of the errors produced in DDA's in which a conceptually simple error theory is evolved.

The third paper "Hybrid Techniques for Optimization Problems" describes a hybrid technique, combining analog and digital hardware, for minimizing a function dependent on the solution of a set of differential equations, by means of a systematic search procedure in parameter space.

Design of a One-Megacycle Iteration Rate DDA

R. E. Bradley, Design Engineer
J. F. Genna, Project Engineer

Hazeltine Technical Development Center, Inc., Indianapolis, Ind.

This paper discusses the special design features of a digital differential analyzer (DDA) which operates at a rate of one million iterations per second. SPEDAC (Solid-state Parallel Expandable Differential Analyzer Computer) features parallel organization of the integrators, serial-parallel arithmetic within the iteration cycle, 26-bit word length, and the integral inclusion of a multi-function digital function generator. The computer is programmed in analog computer fashion by means of plug board interconnection of the integrators.

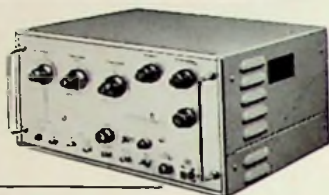
To achieve a one-megacycle iteration rate, the arithmetic circuits operate at a six-megacycle clock rate. Trapezoidal

(Continued on page 32)

... This company owned and operated by Charles V. Litton, was located in San Carlos prior to moving facilities to Brass Valley, Calif., in 1953.

—From a news item in the *San Mateo Times*, March 27, 1962.

Closer to the source of supply, no doubt.—Ed.



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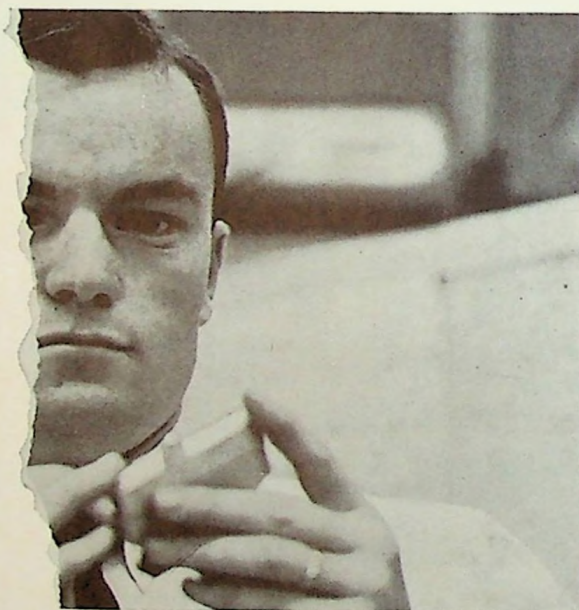
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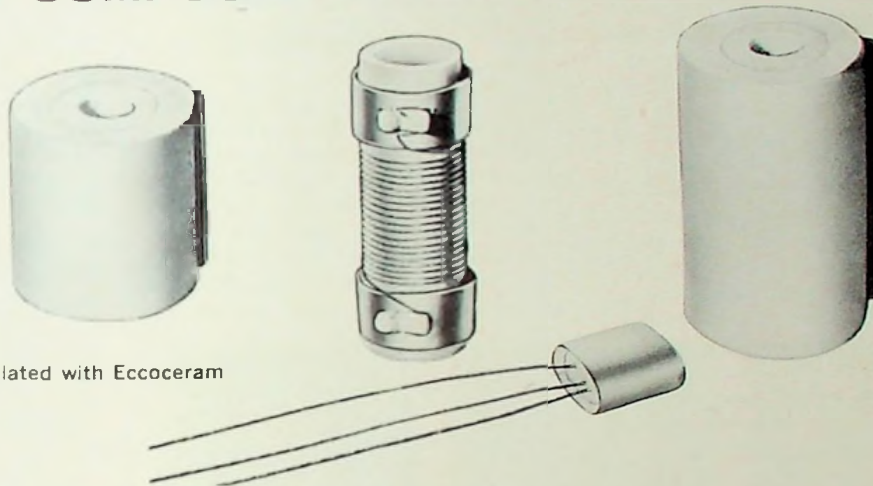
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TWO ROUTES TO THE MILLIMETER WAVES

Early in March Dr. Paul Coleman of the University of Illinois presented the final talk in a series of four lectures on millimeter waves. This group of tutorial lectures, presented at Stanford University, was jointly sponsored by the PGAP, PGED, and PGMTT. Coleman confined his talk to methods other than the usual vacuum-tube systems, for these devices were covered in an earlier lecture in the series.

There are only two known schemes for generating millimeter waves, the classical system using electron-beam interaction and the quantum technique employing different energy states in a medium. Both systems present the same four problems: maintaining signal coherence, producing a characteristic frequency, containing the field, and converting energy from one form to another.

Several quantum techniques are currently being examined. The laser offers some interesting possibilities, one of which is to beat signals from two of them together in a nonlinear medium to obtain the difference frequency. It should also be possible to obtain interferometer modes from a laser. The biggest problem in using the usual maser system is the difficulty in producing the necessary pump frequency, but some of these could be optically pumped to a higher energy state. Both NH_3 and HCN can produce harmonic frequencies through quantum processes when pumped with fields of the order of 10 kv/cm. The interferometer modes of a laser can also be used to bunch an electron beam traveling at an angle to the plane wave in the laser. An experimental device of this type, operating in the low microwave region, has produced four milliwatts output power with 600 milliwatts of driving power.

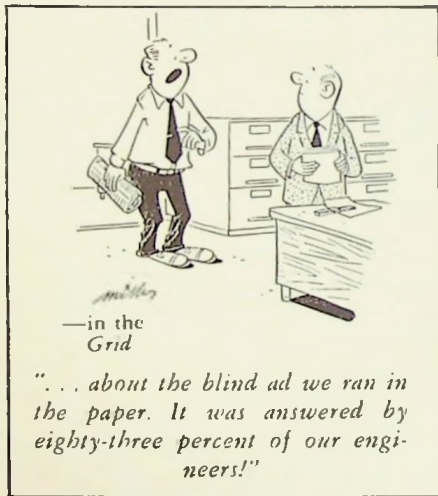
The Cerenkov effect offers considerable promise as a source of millimeter wave power. Typical configurations include a beam passing through a hole in

a medium or a beam passing through a hole in the center of two concentric media. In the latter case, one of the media can be dispersive or both can be non-dispersive. Very high interaction resistance can be obtained by passing the beam through a plasma. Ferrites also give very high resistance at resonance, but the interaction resistance is low at any other point.

Coherent radiation can be obtained when a bunched beam is decelerated or when it passes through a second medium (transition radiation). It is possible to bunch a beam at eight millimeters and either of these schemes should produce harmonics through the thirtieth. The simplest deceleration scheme involves directing the electron beam against a metal plate such as the collector of an ordinary vacuum tube. Transition radiation can be obtained by passing a beam through a thin sheet of plastic. Experiments show that a 1/4-mil thick Mylar sheet will withstand a megavolt beam for about one hour.

All of the devices described employ aperture outputs and the power can be transmitted through lenses or other optical systems. A major problem at this time is the detection of millimeter power and much work remains to be done in this area.

—R. J. PRICKETT



MORE SJCC (Thursday)

integration is performed. Initial conditions and function generator breakpoints and slopes are stored as parallel words in a multiplane magnetic core memory. The use of a parallel memory is exploited to permit direct parallel communication and hybrid operation with external large-scale general-purpose digital computers.

DDA Error Analysis Using Sampled Data Techniques

Don J. Nelson

University of Nebraska, Department of Engineering, Lincoln, Neb

The Z or W-Transforms may be combined with matrix techniques to analyze errors in digital differential analyzers. This analysis demonstrates how errors in the solution of linear differential equations with constant coefficients can be simply determined and how solutions to these equations can be developed, the accuracy of which is limited only by round-off.

Hybrid Techniques Applied to Optimization Problems

Hans S. Witsenhausen

Electronic Associates, Inc., Princeton, N. J.

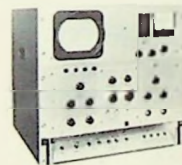
A hybrid system is described consisting of a general-purpose analog computer and a specially designed digital expansion system (DES). One of the functions of this expansion is to act as an intelligent operator of the analog high-speed computing capability. To this end, the expansion contains logic building blocks (essentially flip-flops and gates) interconnected on a patch-panel. Switching commands are transmitted from the DES to analog gates, memory units and mode control. Comparators transmit quantized information from the analog to the DES.

Application of this simplest capability of the hybrid approach is illustrated for the optimization problem, stated as follows:

A function dependent on the solution of a set of differential and/or algebraic equations containing adjustable parameters is to be minimized by systematic search procedures in parameter space. Among the applications are model building, process optimization and matching of boundary conditions. One possible procedure has been selected for illustration and its hybrid implementation is carried out for the general n-parameter case. Exploratory runs determine approximate partial derivatives from which a quantized direction is determined. Steps are taken in this direction until lack of improvement forces a redetermination of partials. The techniques of programming the DES and the hybrid interconnections are emphasized.

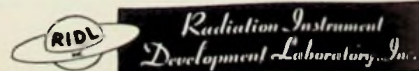
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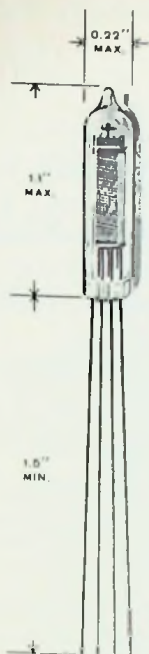
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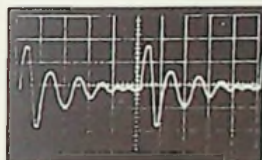
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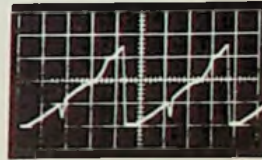
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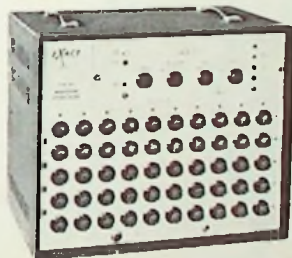
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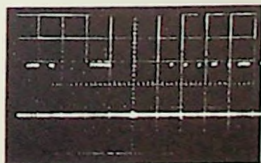
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The Type 200 with Type E 100 increment plug-in generates a sequence of 100 separate voltage levels or increments. The main feature of the "E" unit is the ability to generate a program of 100 voltage levels.

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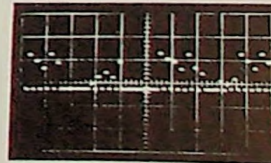
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LETTERS TO THE EDITOR

Palo Alto, Calif.

Editor, the Grid,
Dear Sir:

I'm glad to see that you are determined to keep sex out of the **Grid** at any cost. See photo caption, page 12, March 15 issue.

Sincerely yours,
Bill Patton

To sharp-eyed reader Patton, the Sigmund Freud Award (conscious division) for 1962 to date. To the Grid composing and proofreading departments, a joint citation for the Sigmund Freud Award (unconscious division).—Ed.

Editor, the Grid
Dear Sir:

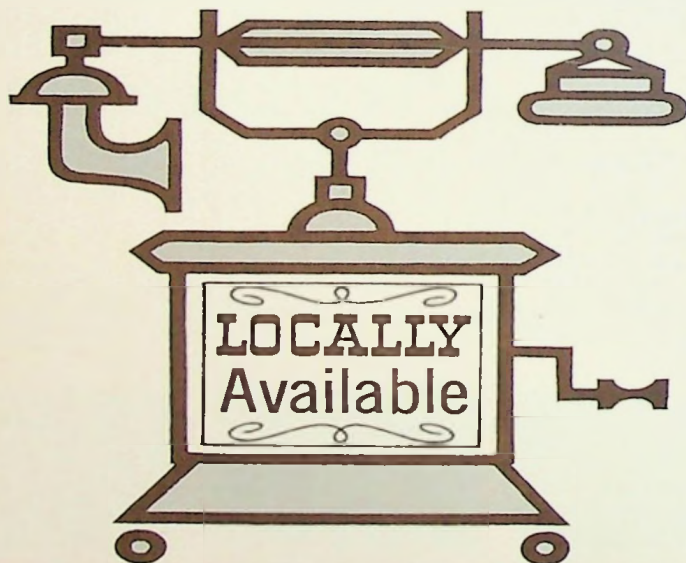
I'd like to suggest that, instead of merging with the AIEE, the IRE should

break up into specialized groups—not necessarily exactly along the lines of the professional groups, as these overlap each other in many cases. The AIEE might also break up in a similar way, those groups having common interests with IRE groups merging with those groups.

In this way, we can avoid the conflicts between the IRE and the AIEE as to who owns which field, and the conflicts within the IRE and within the AIEE too. We should remember that it is a false dilemma to ask to which organization the field of magnetohydrodynamics belongs; it is not a proper IRE nor AIEE field. The IRE is trying to include too much, e.g., writing and speech!

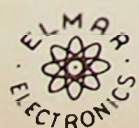
It seems perfectly reasonable for the IRE, AIEE, or some combination (preferably having at least a grammatical name) to coordinate and assist the groups mentioned above. But it should not drain from them **any** technical papers, written or oral; I can see no legitimate purpose in a technical meeting attended by 100,000 people nor a journal that weighs several pounds that would not be better served by something more specialized.

Not all the fields encompassed by the AIEE and IRE can be accurately categorized as engineering, and, if a merger
(Continued on page 36)



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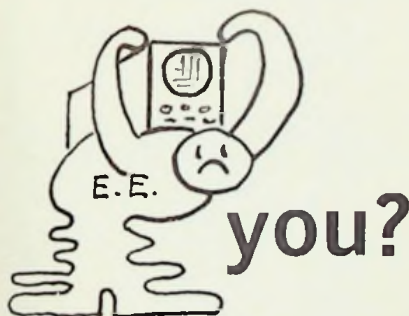
A degree in Physics or Engineering is required. Advanced degrees are preferred. In addition, a minimum of 3-5 years of systems experience is desired. Emphasis is placed on a willingness to become suitably familiar with a wide range of technological areas to evaluate their implications upon systems performance.

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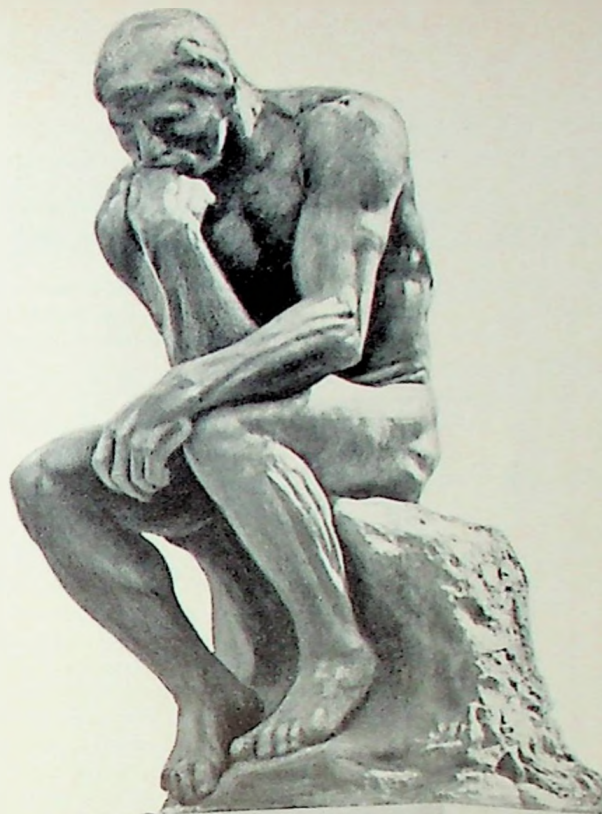
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MORE LETTERS

of some sort is to take place, it would seem appropriate to recognize this fact in the name of the new institute, e.g., Institute of Radio Science, Electrical Engineering, Etc. (IRSEEE), which is much easier to pronounce than IEEE.

Sincerely yours,
Nelson M. Blachman

Palo Alto, Calif.
February 27, 1962

Open Letter to Members
Dear Sirs:

Is it possible, that in debating the only issue presented to them—to merge or not to merge—the members of the IRE and of the AIEE are considering a pseudo-solution to their problems? Indeed, will an all but irrevocable decision to merge both institutes best serve the present and near future interests of the memberships and of their professions? May a merger leave fundamental problems urgently requiring solution virtually unaffected and perhaps raise more difficult questions than it settles? Is the frantic activity to produce a constitution and bylaws and to solve the "mechanical" problems of merging giving us a false sense of accomplishment?

Have the present memberships' interests, objectives, and problems been de-

liberately ascertained? By what means? Was the sampling method and the interrogation procedure soundly selected? With what confidence are the results stated?

What reorganization possibilities were considered by the leaderships? Were they all considered in light of how they might best meet the needs of the members and their profession as determined by a sound sampling and interrogation plan? By what criteria were all but one plan—to merge the IRE and the AIEE—eliminated from further consideration?

Should not the IRE and AIEE separately and jointly, find out what is needed before presenting organizational issues for all but irrevocable decisions to their members? I suggest that they stop preparing a constitution, bylaws, and other agreements for a merged IRE AIEE, and start (with the aid of professional help) an objective study and evaluation of the present and near-future purposes, objectives and interests of their members, and ascertain how well or poorly the present organizational structure, policies, and practices are serving these purposes and interests, and attaining these objectives. Only after this is done, should each organization separately and jointly (again with the aid of professional help) select alternative organizational struc-

tures and put them to a referendum. Indeed, I would suggest that the presentation of each such issue to the members be accompanied by a statement of how the alternatives were arrived at, and of the chain of reasoning used to show how they might serve the already identified purposes, objectives, and interests of the members . . .

Determinations such as these will reveal what is right and what is wrong with the IRE and AIEE now, and what should be done in the future. It may indeed turn out that to merge or not to merge is truly the key issue. If that be so, the investigation might seem to have engendered an unwarranted delay. This delay will have been all to the good, however, for it will have shown how the merged organization should function—and why . . .

I suggest, therefore, that the IRE and AIEE, first separately and then together, plan and carry out a program, preferably with as much outside professional help as is needed, to determine the purposes, interests, and objectives of their members; to evaluate the present organizational structure, policies, and practices in the light of these purposes, interests, and objectives; and then to present to both memberships the issues and the alternatives together with their rationale.

Very truly yours,
Louis Fein
Senior Member, IRE

P.S. . . . Although I am not a member of the AIEE, I serve on its Computer Systems subcommittee. I have observed that in the computer-related fields there is little difference between IRE and AIEE members' qualifications, interests, and biases, or between the subject matter of their publications and meetings. The overlap is complete, except that the computer standardization committees of the two groups are at odds.—L.F.

Dear Mr. Fein:
Your "Open Letter" of February 27 to IRE and AIEE members raises many interesting points, any one of which is sufficiently stimulating to provoke a lively discussion, and, all of which, it seems to me in summary, relate to the kind of organization wanted and needed by the individual members of both societies. . . . The belief is universally shared among us that the IRE is now a good society which performs a useful service for its members, but not a perfect one; that it has evolved during its 50-year life to its present form in response to members' needs which represent a very large number of inputs over a long-time base.

The proposed merger of IRE and AIEE, it appears to us, is a logical evolutionary step toward the goal of a better society. In our opinion, the IEEE, if it comes into being, will leave much to be desired and accomplished. Needs must be met as they evolve and change, and we feel basically that the future officers, directors, and members will, with the IEEE, have a more flexible and viable structure with which to meet those needs than will be the case if IRE and AIEE remain separate . . .

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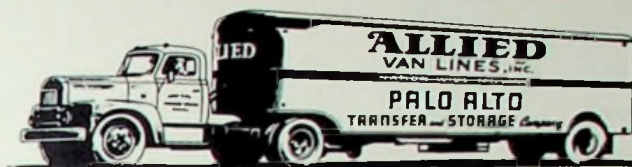
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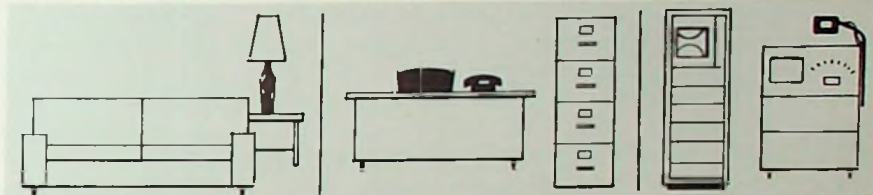
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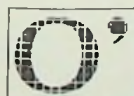
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MORE SWINGS

Recent appointments at the reconnaissance systems laboratory of **Sylvania Electronic Systems** include: **William D. Barkhau**, marketing manager; **Donald A. Peterson**, engineering specialist; and **George C. Bryne**, senior engineering specialist.

Adam Lender is now associated with **Lenkurt Electric Co's** advanced development laboratory. Lender moved to Lenkurt Electric from the International Telephone and Telegraph Federal Laboratories in Nutley, N. J.

Premmco Inc. announces the addition of distribution facilities under the name **Premmco Distributors**, Alameda, for Heli-Coil Products and other fastener and associated tooling items.

Implementing this new service, **Richard A. Teel**, formerly liaison engineer with Douglas Aircraft, and **D. Edmund Knight**, formerly with Raymond Kimball Company, have joined the Premmco local staff.

A grant of nearly \$1,300,000 from the National Science Foundation will purchase a 15-mev Van de Graaff tandem accelerator for use in an expanding program of low-energy physics research at **Stanford University**.

Under the direction of **Walter E. Meyerhof**, the accelerator will be employed to study the forces that bind particles of the nucleus together.

Carad Corporation has appointed **Robert W. Rowe** to the post of chief engineer. Since November of 1957 Rowe has served as chief engineer of Pulse Engineering, Inc.

Hewlett-Packard Company has announced the election of three new members to its board of directors: **E. E. van Bronkhorst**, secretary and treasurer of the company; **Robert M. Brown**, San Francisco attorney; and **Russel V. Lee**, M.D., Palo Alto physician.

Eitel-McCullough, Inc., has announced 1961 profits of 24 cents per share. Net sales for the firm in 1961 were slightly in excess of \$27,000,000, compared with 1960 net sales of \$28,308,038.

John M. Phelps has been named vice president of operations of **Granger Associates**. Phelps retired from the Navy last year and joined the firm in November as assistant to the president.

Three new members have been added to the technical staff of the research and development laboratory of **Fairchild Semiconductor**. **Edward Duffek** and **Arthur E. Lewis** will serve in the chemistry section. **Everett Guthrie** has joined the microwave physics section.

The appointment of **David B. Kennedy** as sales manager of the equipment sales department for the western development laboratories of **Philco Corporation** has been announced. Prior to joining Philco a year ago as sales engineer in the antenna systems department, he was with D. S. Kennedy & Co., Cohasset, Mass.

Fairchild Semiconductor has appointed **Christopher F. Coburn** to the new post of international marketing manager. He was most recently district sales manager for Rheem Semiconductor in Mountain View.

CITI, of Soest, Netherlands, has been appointed exclusive sales representative in The Netherlands for **Beckman & Whitley, Inc.**, photoinstruments, it was announced recently by the San Carlos company.

wescon news

SCIENCE-FAIR JUDGES

William R. Luebke, Eitel-McCullough, Inc., has been appointed chairman of the Section committee charged with the responsibility of judging exhibits for the Section at the Ninth Annual Bay Area Science Fair, leading to participation in the Wescon Future Engineers Show. Other members of the committee are: **John L. Putz**, G.E. microwave product section, alternate chairman; **Robert DeGrasse**, Microwave Electronics; **John Grigsby**, Applied Technology; **Malcolm McWhorter**, Stanford electronics laboratory; and **Howard Poulter**, Hewlett-Packard Co.

Actual judging was scheduled to take place on April 6 before the Fair is officially open to the public. Selectees for participation in Wescon will be announced at a later time.

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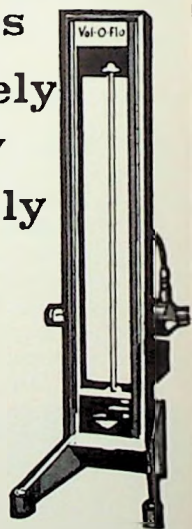
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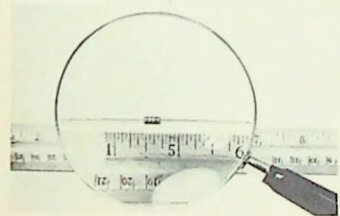


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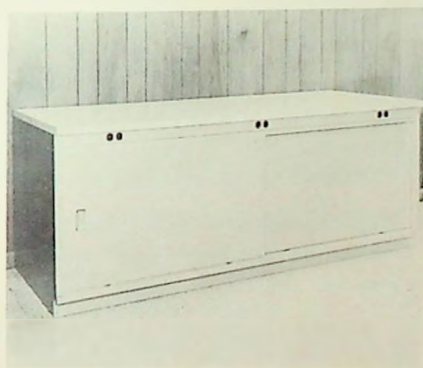


MINIATURE INDUCTOR

Commercial production of a new line of tiny r-f inductors is announced. Known as the Type 09 Mini-Stab, it has a body diameter of 0.095 ± 0.003 , with a length of 0.250 ± 0.010 . Inductance values from $0.10 \mu\text{h}$ to $100 \mu\text{h}$ are available. Inductance tolerance is ± 10 per cent, with a distributed capacitance of $0.5 \mu\text{mf}$ to $2.0 \mu\text{mf}$. The rated current, based on 90C ambient and 35C maximum temperature rise, ranges from 165 to 1660 ma.

Other features include rugged construction, standard color coding, electrical stability, and stock availability. The Type 09 Mini-Stab is designed to meet the applicable requirements of MIL-C-15305.

Jeffers Electronics Division of Speer Carbon Company, Inc., DuBois, Penna. Representatives are Long & Associates, 505 Middlefield Road, Redwood City, Calif. (EM 9-3324)



LAB FURNITURE

New series of modular laboratory work stations features flush-type sliding doors and 6-in. sectional shelving on adjustable racks. Moderate cost units are applicable for electronic laboratories and clean rooms. Available in three standard colors and with an assortment of top surface materials and configurations, the equipment will accommodate integral electrical outlets and standard accessories such as drawers, service bearing standards, overshelves, exhaust hoods, etc.

Leitch-Huard Corp., Stark & Commercial St., Manchester, N. H.



THICKNESS GAGE

A new beta backscatter gage, the Betascope, based on an original development of the Boeing Company, provides accurate thickness readings of ultra-thin coatings in the low micro-inch range.

The base-coating combinations that can be measured run into the thousands. Among the coatings that have successfully been measured with this gage are: Gold on printed circuit boards; silver on copper; rhodium on nickel; metallic oxides on Mylar, glass, and other substrates; etc.

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501 Laurel, San Carlos; LY 1-2626; 1317 15th St., Sacramento; GI 2-8901		510 So. Mathilda Avenue, Sunnyvale; RE 6-6733		4135 El Camino Way, Palo Alto; DA 1-6383	
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825 San Antonio Road, Palo Alto; DA 6-1493		Stone Associates, Carl A.....	42	Van Groos Company.....	33
Palo Alto Transfer & Storage Co.....	37	800 N. San Antonio Road, Palo Alto; DA 1-2724		Veneto Restaurant.....	46
Peninsula Lithograph Co.....	26	Stone & Associates, Jay.....	42	Walter Associates.....	42
Premmco, Inc.....	42	349 First Avenue, Los Altos; WH 8-4563		Box 790, Menlo Park; DA 3-4606	
2406 Lincoln Ave., Alameda; LA 3-9495				Western Electronic Associates.....	42
				485 Ramona Street, Palo Alto; DA 5-4569	
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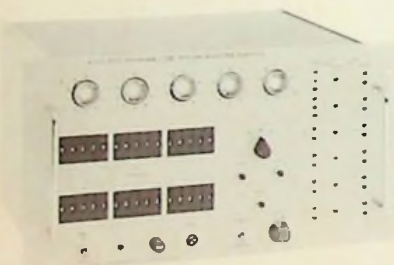
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events of interest

IRE MEETINGS SUMMARY

April 24-26—**Symposium on Mathematical Theory of Automata.** Engineering Society Building auditorium, UN Plaza, New York, N. Y. No exhibits. Program: symposium committee, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N. Y. Proceedings: Microwave Research Inst., 55 Johnson St., Brooklyn 1, N. Y.

May 1-3—**Spring Joint Computer Conference.** Fairmont Hotel, San Francisco. Exhibits: John Ball, Pacific Telephone Co., 3240 Arden Way, Sacra-

mento. Program: Richard I. Tanaka, Lockheed, Dept. 58-51, Palo Alto.

May 3-4—**International Congress on Human Factors in Electronics.** Lafayette Hotel, Long Beach, Calif. No exhibits. Program: John W. Senders, Minneapolis Honeywell Regulator Co., 2600 Ridgeway Rd., Minneapolis 40, Minn.

May 24-26—**Seventh Region Conference.** Olympic Hotel, Seattle, Washington. Exhibits: Century 21 Fairgrounds. Program: T. G. Dalby, 3220 99th N.E., Bellevue, Washington.

NON-IRE LOCAL EVENTS

April 16—**Women's Association of the Electronic Industry.** Caravan Inn, 4375 El Camino Real, Mountain View. Dinner: 7:00 p-m (social hour, 6:30 p-m). Speaker: William J. Swanson, Irving Lundborg & Co., who will speak on investments for the career woman. The talk will be followed by a tour through the stock broker quarters in the Stanford Barn. Reservations: Virginia Thompson, Dalmo Victor, LY 1-1414, Ext. 242.

April 19—**Northern California Section, American Society of Lubrication Engineers.** "New Concepts in Lubrication" by Douglas Godfrey, California Research Corp. Spengers Fish Grotto, University Ave., Berkeley. Dinner: 7 p-m (social hour, 6 p-m). No reservations required.

April 25-29—**Western Space Age Industries and Engineering Exposition/Conference.** Cow Palace, San Francisco.

May 27-June 2—**University of California Extension,** fifth annual leadership laboratory in human relations and supervisory skills. Ojai Valley Inn, Ojai. Information: University of California Engineering and Physical Sciences Extension, UCLA, Los Angeles 24.

May 28-30—**First Annual Convention of the American Association for Contamination Control.** Jack Tar Hotel, San Francisco. Registration and exhibits: Donald M. Petersen, Central Vacuum Corporation, 3008 E. Olympic Blvd., Los Angeles 23, California.

PAPERS CALLS

April 20—1000-word summaries, author and title for National Symposium on Space Electronics and Telemetry (Miami Beach, Oct. 2-4). Send to: Dr. Joachim Muehlner, Lockheed Missiles & Space Co., Bldg. 204, Plant 2, P.O. Box 504, Sunnyvale, Calif.

May 1—150-word abstracts, five copies, and two copies of either completed papers or 750-word summaries for National Electronics Conference (Chicago, Oct. 8-10). Send to: Dr. Thomas W. Butler, Jr., E.E. Department, University of Michigan, Ann Arbor, Mich.

May 15—800-word abstracts, ten copies, and biography of author for 9th National Symposium on Reliability and Quality Control (San Francisco; Jan. 22-24, 1963). Send to: Leslie W. Ball, Boe-

ing Co., P.O. Box 3707, Seattle 24, Washington.

June 1—50 word abstract for 15th Annual Conference on Engineering in Biology and Medicine (Chicago, Nov. 4-7). Send to: Program Committee, P.O. Box 1475, Evanston, Illinois.

June 1—350-word summary with subject, title, and biographical note, all in triplicate, for 2nd Canadian IRE Symposium on Communications (Montreal, Nov. 16-17). Send to: Allan B. Oxley, chairman technical program, Box 802, Montreal, Quebec.

June 11—400- to 500-word abstracts in triplicate and 50-word summaries for NEREM (Boston; Nov. 5-7). Send to: I. Goldstein, Raytheon Co., Box 555, Hartwell Road, Bedford, Mass.

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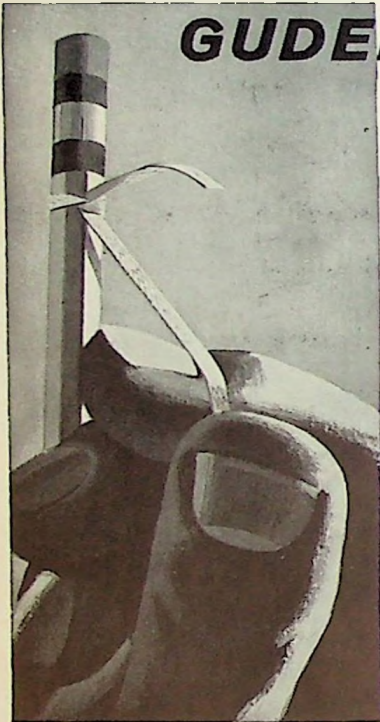


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| B. J. Jones | B. Wolfe |

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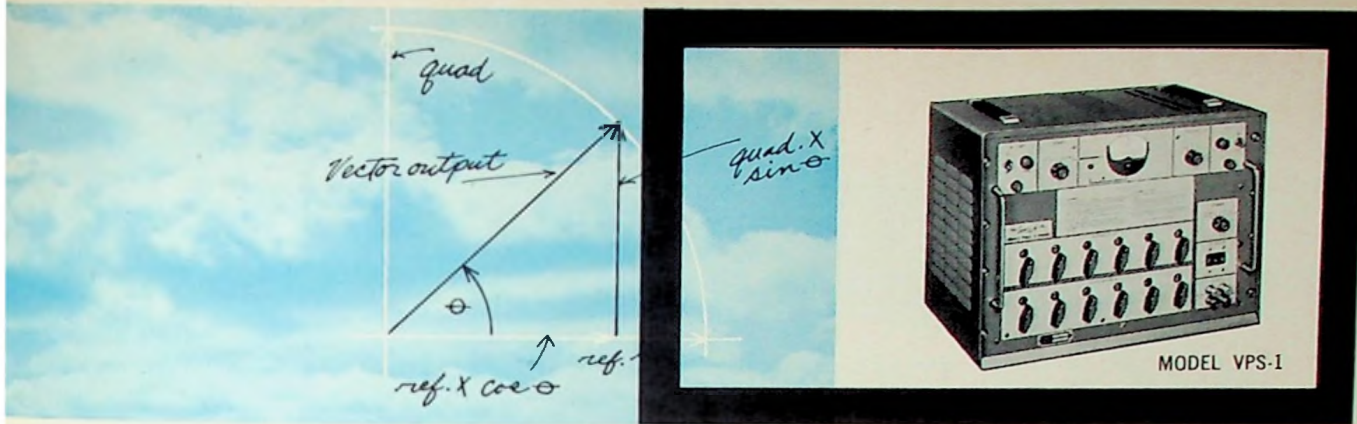
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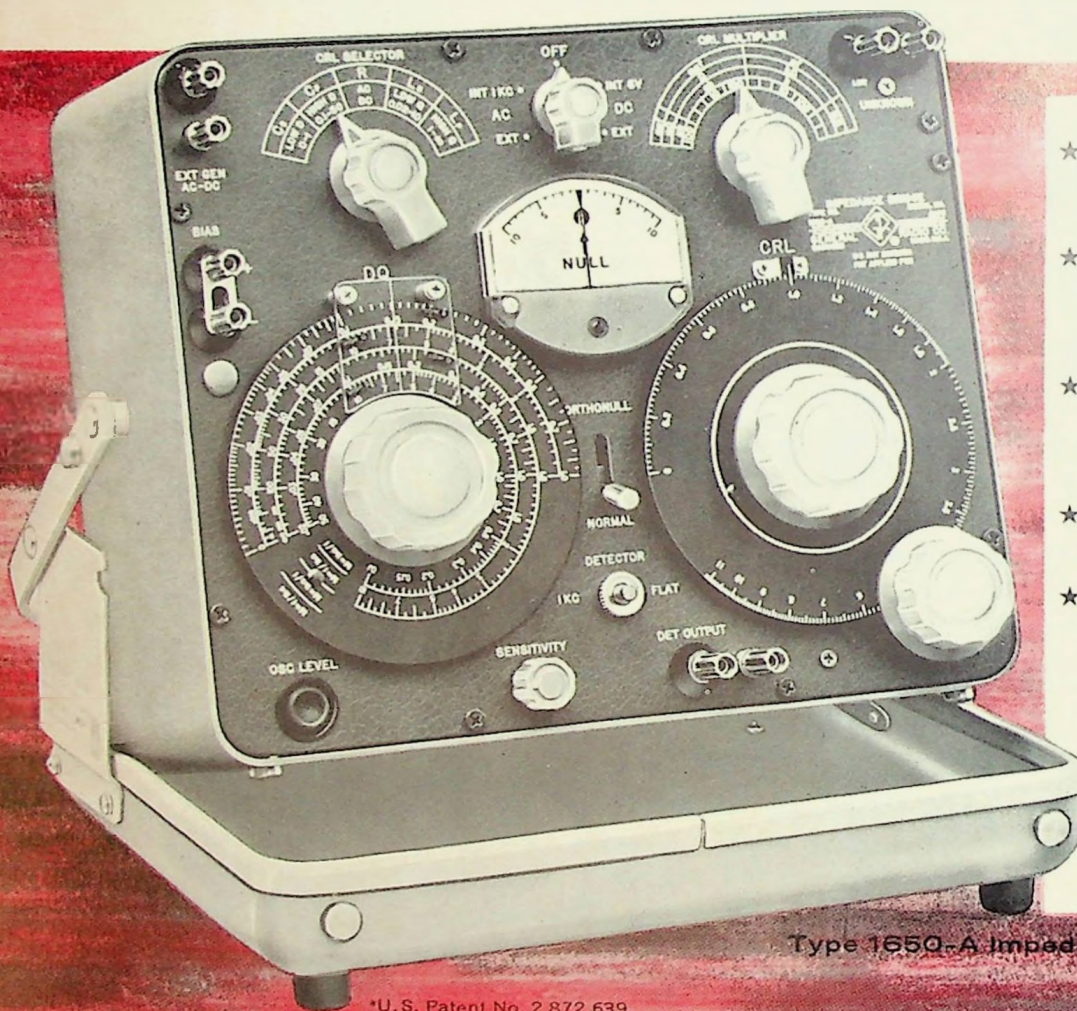
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