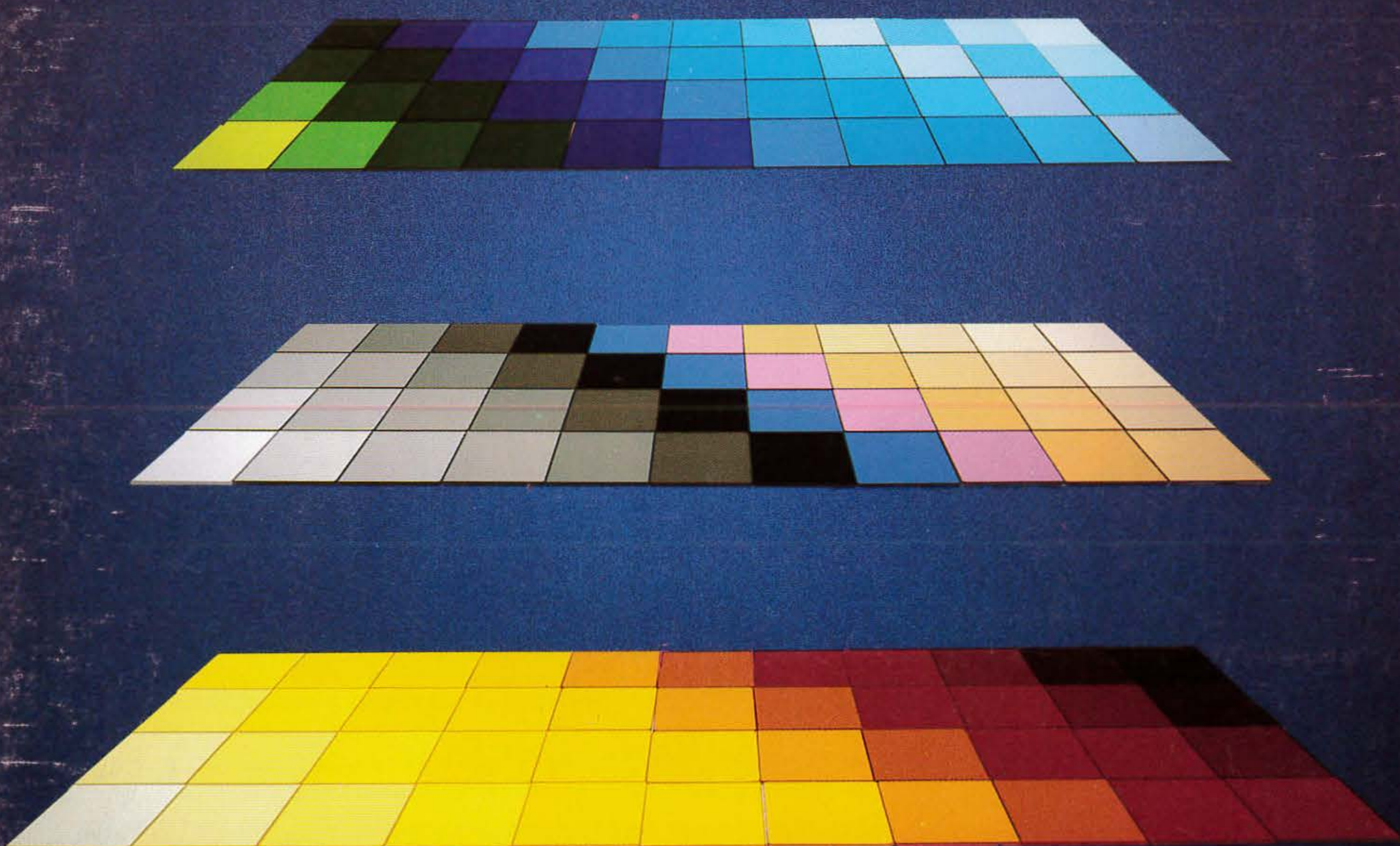
THE OFFICIAL JOURNAL OF THE SOCIETY FOR INFORMATION DISPLAY

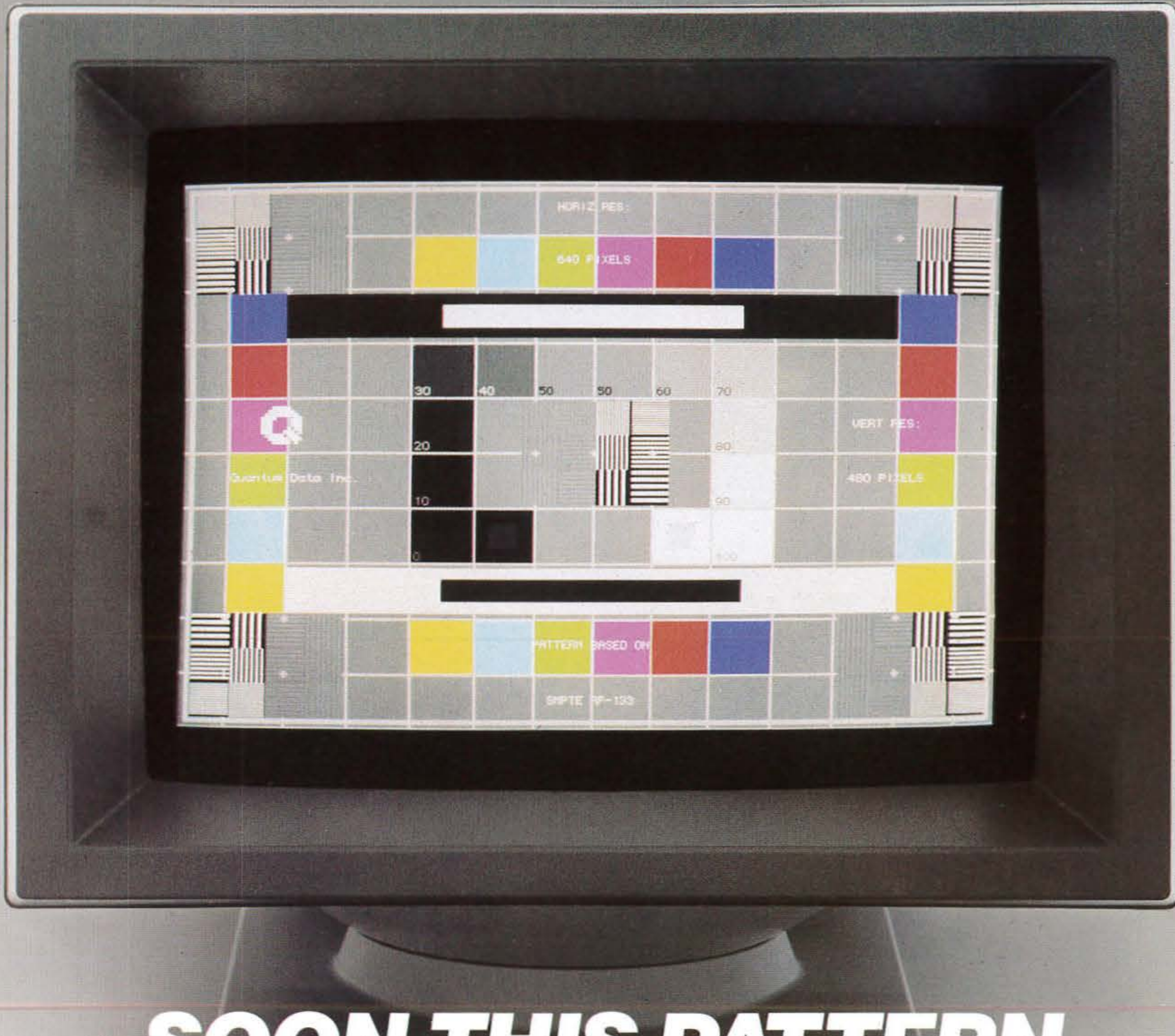
INFORMATION DISPLAY

JUNE 1986



SID AWARD: 'BEST PAPER'

DETERMINING MEDICAL CRT RESOLUTION



SOON THIS PATTERN WILL HELP SAVE LIVES.

This test pattern* was developed to assist in the design and evaluation of video monitors in medical diagnostic applications. It accurately differentiates the minute changes in gray tones that indicate potential life and death problems in CAT-scan images, for example.

The test is one of many available on disk for use on the OPIX™ Imager—an extraordinary microprocessor-based video signal generator.

This pattern will self-scale to any monitor size and signal timing to provide you with an exacting standard for correlation.

With OPIX you can make certain that every display you use in your end-products will ship out with precisely the performance you designed in.

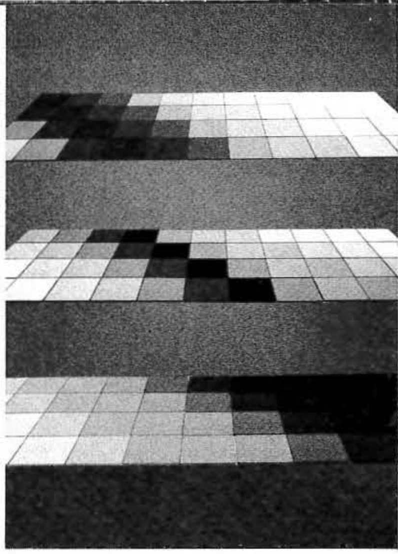
Whether you're involved in the design, evaluation or testing of life-saving displays, or video applications where high-resolution and precision analog requirements are equally critical, the OPIX Imager offers results no ordinary signal generator can approach.

Ask for an OPIX brochure. Contact: Quantum Data, 455 E. Kehoe, Carol Stream, IL 60188 Telephone: (312) 668-3301; Telex: 206725

*Based on the recommended practice of the Society of Motion Picture and Television Engineers (SMPTE RP133).

QUANTUM DATA®

For information circle Reader Service #1



THE OFFICIAL JOURNAL OF THE SOCIETY FOR INFORMATION DISPLAY

INFORMATION DISPLAY

JUNE 1986 VOL. 2 NO. 6

Cover photo: Solid glass absorption filters, in more than 100 colors, enable design engineers to customize information display devices used for analysis, detection, attenuation, or sensing: *Hoya Optics, Fremont, CA.*

FEATURES

American Federation of Information Processing Societies

DEPARTMENTS

INFORMATION DISPLAY (The Official Journal of the Society for Information Display) is edited for corporate research and development management; and engineers, designers, scientists, and ergonomists responsible for design and development of input and output display systems used in various applications such as: computers and peripherals, instruments and controls, communications, transportation, navigation and guidance, commercial signage, and consumer electronics.

Editorial covers emerging technologies and state-of-the-art developments in electronic, electromechanical, and hardcopy display devices and equipment; memory; storage media and systems; materials and accessories.

NATIONAL

JULY 20-24: 1986 ASME International Computers in Engineering Conference and Exhibition, Hyatt Regency Chicago, Chicago IL. Contact: Dr. David Dietrich, Swanson Analysis Systems Inc., PO Box 65, Houston, PA 15342 (412/746-3304)

JULY 22-24: Fourth International Conference on Optical Storage for Large Systems, The New York Hilton, New York, NY. Contact: Judith P. Hanson, TOC Conference Coordinator, Technology Opportunity Conference, PO Box 14817, San Francisco, CA 94114-0817 (415/626-1133)

JULY 28-30: 1986 Summer Computer Simulation Conference, MGM Grand Hotel, Reno, NV. Sponsored by the Society for Computer Simulation. Contact: SCS, PO Box 17900, San Diego, CA 92117 (619/277-3888)

AUGUST 4-8: Information Display Systems Engineering Short Course, UCLA Extension, Los Angeles, CA. Contact: Short Course Program Office, UCLA Extension, Department of Engineering and Science, 10995 Le Conte Avenue, Room 637, Los Angeles, CA 90024 (213/825-5010)

AUGUST 4-15: Human Factors Engineering Summer Conferences, University of Michigan, Ann Arbor, MI. Contact: Richard W. Pew, Chairman, College of Engineering, University of Michigan, 300 Chrysler Center/North Campus, Ann Arbor, MI 48109-2092 (313/764-8490)

AUGUST 11-15: 5th National Conference on Artificial Intelligence, Philadelphia, PA. Sponsored by the American Association for Artificial Intelligence. Contact: Lorraine Cooper, AAAI, 445 Burgess, Menlo Park, CA 94825 (415/328-3123)

AUGUST 11-15: Picosecond Electronics—Principles of Electronics & Optical High-Speed Processes Short Course, University of California, Santa Barbara, CA. Contact: J. Weisman, UCSB Extension, Santa Barbara, CA 95106 (805/961-3697)

AUGUST 17-22: 30th Annual International Technical Symposium on Optical and Optoelectronic Engineering, Town and Country Hotel, San Diego, CA. Sponsored by The International Society for Optical Engineering (SPIE). Contact: SPIE, PO Box 10, Bellingham, WA 98227-0010 (206/676-3290)

AUGUST 18-22: ACM SIGGRAPH '86, Dallas, TX. Sponsored by Association for Computing Machinery/Special Interest Group Graphics (ACM SIGGRAPH). Contact: ACM, 11 West 42nd Street, New York, NY 10036 (212/869-7440)

AUGUST 24-28: 3rd International Congress on Advances in Non-Impact Printing Technologies, The Fairmont Hotel, San Francisco, CA. Sponsored by Society of Photographic Scientists and Engineers and the Society for Imaging Science and Technology. Contact: Executive Director, SPSE, 7003 Kilworth Lane, Springfield, VA 22151 (703/642-9090)

SEPTEMBER 8-10: NCC Telecommunications, Philadelphia, PA. Contact: AFIPS, 1899 Preston White Drive, Reston, VA 22091 (703/620-8900)

SEPTEMBER 14-20: FIBER LASE '86—Technical Conference on Fiber Optics, Optoelectronics, and Laser Applications in Science and Engineering, Hyatt Regency Cambridge, Cambridge, MA. Contact: SPIE International Society for Optical Engineering, PO Box 10, Bellingham, WA 98227-0010 (206/676-3290)

SEPTEMBER 15-19: IEEE Computer Society Tutorial Week, Boston '86. Contact: Tutorial Week Boston '86, IEEE Computer Society, 1730 Massachusetts Avenue, NW, Washington, DC 20036-1903 (202/371-0101)

SEPTEMBER 16-18: IEEE International Symposium on Electromagnetic Compatibility, Town and Country Hotel, San Diego, CA. Contact: H.K. Mertel, EMACO Inc., 7562 Trade Street, San Diego, CA 92121 (619/578-1480)

SEPTEMBER 23-24: Electronics and Aerospace Systems Conference—EASCON '86. Shoreham Hotel, Washington, DC. Contact: Dr. Arvid G. Larson, Vice President, Analytic Disciplines Inc., Suite 400, 2070 Chain Bridge Road, Vienna, VA 22180 (703/893-6140)

"Wrong opinions and practices gradually yield to fact and argument . . ."

— John Stuart Mill

One of the less publicized Government announcements earlier this year concerned the National Security Agency's intent to replace the existing coding system now widely used by Government agencies, high-tech companies, and banks, among others, to protect their most sensitive computer data.

In a recent New York Times article, NSA's deputy chief for information security, Harold E. Daniels, said the agency had "determined it is in the US interest to introduce new cryptographic algorithms into commercial communications networks." The reason given for this action, according to the Times article, is that apparently NSA (the nation's largest intelligence agency) fears "the current system for making computer data unintelligible is growing increasingly vulnerable to cracking by foreign governments, terrorists and sophisticated thieves."

Unlike the existing standard system (devised about 10 years ago by the National Bureau of Standards and IBM) whose major elements have been widely publicized for some time, the new algorithms "will not be publicly available. Instead, they will be buried in computer chips manufactured to NSA specifications, and encapsulated so that any effort to read the code with sophisticated equipment would destroy the chip," says the Times article.

But, the proposed changes, to be phased in at Government agencies and corporations beginning in January 1988, obviously will greatly increase the Government's role in private communications, and, according to the article, potentially "give NSA easy access to much private information that currently the Government cannot intercept without extraordinary effort."

According to a security consultant quoted in the article, "You could interpret it as an effort to increase security, or you could interpret it as a power play."

Or you could interpret it as an intrusion on privacy.

* * *

And, while the government ordinarily does not have the authority to impose use of such a system on the private sector, its adoption by Federal agencies would certainly create problems for commercial and industrial operations dealing with such agencies if their systems did not conform to the Government's.

The biggest problem of course, is that the existing standard is in widespread use. And semiconductor and computer manufacturers for some time now have been building it into the chips and computers used in security systems such as, for example, bank teller machines. Because the new standard would be incompatible with the current one, its implementation most certainly would necessitate the installation of totally new equipment to replace existing systems. And, because NSA intends to limit distribution of the new equipment, it's going to be more expensive to manufacture.

As one industry specialist said in the Times article, "It's not easy to switch horses, and it's not clear that we need to."

Is the private sector once again about to buy a $1000 hammer, or $600 ashtray, for another Government agency?

Joseph A. MacDonald
Editorial Director

INFORMATION DISPLAY (ISSN 0362-0972) is published monthly by MetaData Inc., 310 East 44 Street, New York, NY 10017, Telephone: 212/687-3836

Subscription: US & Canada - $36 one year, $64 two years, $90 three years; Elsewhere - $72 one year, $128 two years, $180 three years. Single copy: US & Canada - $3.00; Elsewhere - $6.00.

Events

SEPTEMBER 23-24: NEPCON Southwest, Dallas, TX. Contact: Janet Schafer, Show Mgr., Cahners Exposition Group, Cahners Plaza, 1350 E. Touhy Avenue, PO Box 5060, Des Plaines, IL 60017-5060 (312/299-9311)

SEPTEMBER 28 - OCTOBER 2: ASIS '86, Chicago, IL. Contact : American Society for Information Science, 1010 Sixteenth Street, NW, Washington, DC 20036 (202/659-3644)

SEPTEMBER 29 - OCTOBER 3: 30th Annual Meeting of the Human Factors Society, Dayton Convention Center, Dayton, OH. Contact: HFS-86, PO Box 31190, Dayton, OH 45431-0190.

SEPTEMBER 28 - OCTOBER 3: International Industrial Electronics Conference—IECON '86, Hyatt Regency Hotel, Milwaukee, WI. Contact: Dr. Richard C. Born, Rexnord Inc., 5101 West Beloit Road, Milwaukee, WI 53214 (414/543-2704)

SEPTEMBER 28 - OCTOBER 3: 1986 Applied Superconductivity Conference, Hyatt Regency—On the Harbor, Baltimore, MD. Contact: Lahni N. Blohm, Executive Administrator, ASC86, Code 6630C, Naval Research Laboratory, Washington, DC 20375 (202/767-3246)

SEPTEMBER 30 - OCTOBER 3: WESCON—Western Electronic Show & Convention, Los Angeles, CA. Contact: Dale Litherland, Electronics Conventions Inc., 8110 Airport Blvd., Los Angeles, CA 90045 (213/772-2965)

INTERNATIONAL

JULY 1-3: 16th IEEE Fault Tolerant Computing Symposium, Vienna, Austria. Contact: Professor H. Kopetz, Institut for Praktische Informatick, Technische Universitat Wien, Gubhausstrasse 30/100, A-1040 Wien, Austria (0222/56-01)

AUGUST 19-21: Second International Symposium on Human Factors in Organizational Design and Management, Vancouver, BC, Canada. Held in conjunction with Expo '86. Contact: Hal W. Hendrick, HF Dept. ISSM, University of Southern California, Los Angeles, CA 90089-0021.

AUGUST 20-22: 1986 International Conference on Solid State Devices and Materials, Tokyo Prince Hotel, Tokyo, Japan. Contact: Prof. Takuo Sugano, Dept. of Electrical Engineering, University of Tokyo, Hongo, Bunkyo-ku, Tokyo, 113 Japan (03/812-2111)

AUGUST 22-23: Human Factors in Motion Expo '86—XIX Annual Meeting of the Human Factors Association of Canada, Vancouver, Canada. Contact: Ulrika Wallersteiner, Ergo Systems Canada, 535 Robin Hood Drive, West Vancouver, BC, Canada V7S-1T1 (604/926-0166)

AUGUST 25-29: 11th International Conference on Computational Linguistics: COLING '86. Sponsored by Association for Computational Linguistics (ACL). Contact: Prof. Makoto Naga, Dept. of Electrical Engineering, Kyoto University, Sakyo-ko, Kyoto, 606, Japan.

AUGUST 27-29: 1986 IEEEC Workshop on Language for Automation, National University of Singapore, Singapore. Contact: Dr. S.E. Chang, Illinois Institute of Technology, Armour College of Engineering, Dept. of Electrical Engineering, Chicago, IL 60616.

SEPTEMBER 1-5: IFIP '86—10th World Computer Congress, Dublin, Ireland. Sponsored by International Federation of Information Processing. Contact: IFIP Congress '86, c/o AFIPS, 1899 Preston White Drive, Reston, VA 22091 (703/620-8900)

SEPTEMBER 7-10: 4th International Conference on Molecular Beam Epitaxy, University of York, England. Contact: B.A. Joyce, Philips Research Laboratories, Redhill, Surrey, England (0283/785544)

SEPTEMBER 8-10: 1986 ACM Conference on Research and Development in Information Retrieval Systems, Pisa, Italy. Sponsored by Consiglio Nationale delle Riceche. Contact: L. Rossi Bernardi, C.N.R. Piazza A. Moro 7, Roma, Italy.

SEPTEMBER 10-16: International Congress of Photographic Science 1986 (ICPS), University of Cologne, Cologne, West Germany. Co-sponsored by SPSE and Deutsche Gesellschaft fur Photographie (DGPh). Contact: Executive Director, SPSE, 7003 Kilworth Lane, Springfield, VA 22151

SEPTEMBER 14-18: 43rd Conference and Congress of the International Federation for Documentation, Montreal, Quebec, Canada. Sponsored by the Canada Institute for Scientific and Technical Information of the National Research Council of Canada. Contact: 43rd FID Conference and Congress, C.P. 1144, Succursale Place Desjardins, Montreal, Quebec, Canada H5B 1B3.

SEPTEMBER 15-18: EURO MICRO '86—Twelfth Symposium on Microprocessing and Microprogramming, Venice, Italy. Contact: Fausto Distante, Deputy Conference Organizing Chairman, Politecnico di Milano, Instituto di Electronica, 1-20133 Milano, Italy (39/2-236-7241)

SEPTEMBER 15-20: INTERCOMM '86—The International Communications Exposition & Conference for Science and Technology, Beijing Exposition Center, Beijing, China. Sponsored by the Chinese Association of Science and Technology (CAST) and the China Computer Society (CCS). Contact: INTERCOMM, Cahners Exposition Group, 7315 Wisconsin Avenue, PO Box 70007, Washington, DC 20088 (301/657-3090)

SEPTEMBER 22-25: XII International Symposium on Discharges and Electrical Insulation in Vacuum, Hotel Shoresh, Shoresh, Israel. Contact: Prof. S. Goldsmith, Faculty of Exact Sciences, Tel-Aviv University, Tel-Aviv, Israel (03/420303)

SEPTEMBER 23-26: HCI '86—People and Computers: Designing for Usability, York, England. Sponsored by the British Computer Society. Contact: HCI '86, Conference Dept., The British Computer Society, 13 Mansfield St., London W1M OBP, UK.

6TH INTERNATIONAL
DISPLAY RESEARCH
CONFERENCE

TOKYO, JAPAN

SEPT 30 - OCT 2

PAPERS ON DISPLAY

Information Display is soliciting original articles that cover all aspects of display technology and applications—display systems, sensing and imaging instrumentation, printing technologies, input/output devices, interactive graphics, storage media, and human factors engineering.

Notes for contributing authors and specifications for submitting manuscripts can be obtained from the Editor of ID. Address all inquiries and submit contributed articles to: The Editor, Information Display, 310 East 44th Street, #1124, New York, NY 10017.

Integrated imaging systems key to information management

"Integrated systems that combine imaging and computer technologies, such as artificial intelligence, hold the key to improving information management tools in the future," according to John A. Lacy, Vice President/ General Manager, Marketing/Business Information Systems Div, Kodak.

Participating in a panel discussion on "Microfilm and the Future," Lacy told a group of executives at an International Information Management Conference last March, "Systems integration puts the pieces of several technologies together in a way that the strength of each storage technology is maximized, and the weaknesses minimized.

"Microfilm, today," said Lacy, "is part of a broader marketplace that includes computers, copiers, and a full range of business products. This market is estimated at $258 billion, with the micrographics segment alone accounting for as much as $3 billion and growing at a rate of about 10% each year."

Lacy told his audience, "Integrated imaging systems present significant new opportunities ... Microfilm input is fast, duplication is equally fast, and microfilm can be stored for archival purposes for 100 years or more. The new Kodak Image Management System (KIMS) has already integrated such traditional separate functions as storage, retrieval, manipulation, and transmission. And," Lacy said, "newer techniques, such as optical discs, fiber optics, laser scanners, and artificial intelligence will make further gains in integrating data processing, word processing, and image processing."

EASTMAN KODAK CO., Rochester, NY (716/724-1336)

Circle Reader Service # 107

Artificial vision device processes television images

Researchers at the National Bureau of Standards (NBS) are testing a prototype computing device for machine vision systems that continually processes images from a television camera—at previously unheard-of-levels of performance.

According to its inventor, Dr. Ernest Kent, the device—called a Pipelined Image Processing Engine (PIPE)—is a comparatively low-cost computing "engine" that handles the vast number of calculations necessary to pre-process a television image so that it can be understood by a computer. PIPE does not actually recognize the image it is working with, rather it handles all the analysis needed to recognize specific features of the image—for example, texture, shade, the presence or absence of an edge, and motion—at each point in the picture.

A standard black-and-white digital video camera sends numbers corresponding to the levels of gray in a 256 × 256 point "frame" 60 times a second. For each point in each frame, PIPE can be programmed to do mathematical computations on not only the point itself, but also on its relationship to surrounding points in neighborhoods of varying sizes.

The current prototype PIPE performs approximately 450 million 8-bit operations per second, outpacing even supercomputers at its particular task. PIPE features include a multiple instruction-stream multiple datastream (MIMD) facility that allows it to perform different types of analyses on the same

Circle Reader Service #5

frame, depending on the nature of each point, and the ability to do a wide variety of motion-analysis, and stereo operations. Other features include a sophisticated, graphics-oriented programming capability and a high-speed interface system that organizes the results of PIPE analyses in a convenient form in the memory of another computer.

The device is expected to have applications in a wide variety of advanced image-sensing equipment where continuous, "real-time" processing is necessary—ranging from artificial "eyes" for robots and robotic devices to improved medical diagnostic tools. Prototype versions of PIPE were developed and built for NBS by Digital/Analog Design Associates Inc., New York, NY.

NATIONAL BUREAU OF STANDARDS, Gaithersburg, MD (301/921-3181)

Circle Reader Service # 103

R&D mini-program scheduled for NCC

Scientific and highly technical presentations on information processing have been grouped together in a one-day "mini-program" within NCC '86, scheduled for June 16-19 at the Las Vegas Convention Center and Hilton Hotel.

R&D Day, Thursday, June 19, will address state-of-the-art research and new developments in such areas as:

- Software reliability models
- Non-chronological sequential simulation
- Networks; self routing, fault tolerant, diagnosable
- Parallel probablistic computing
- Multiple processor systems
- Computational complexity.

There will be over 100 Conference Sessions this year at NCC '86 dealing with all areas of computing; artificial intelligence; networking; management; personal computing and office management; education and societal issues; and, software and hardware. Over 500 major manufacturers from around the world will exhibit their products at the show.

THE AMERICAN FEDERATION OF INFORMATION PROCESSING SOCIETIES, Reston, VA (800-NCC-1986)

Circle Reader Service # 108

High-technology industries continue growth momentum

Latest studies by the Dept. of Commerce, Electronic Industries Association (EIA), and the Computer and Business Equipment Manufacturers Association (CBEMA), show high-technology equipment sales posted major increases in 1985 and will register rapid growth in 1986.

Figures released by EIA indicate that 1985 factory sales of electronic equipment in the US reached a record high of over $184 billion, an increase of approximately 4.3% over 1984. While overall sales in 1985 finished on an upbeat note, employment in the electronics industry for 1985 was off by approximately 4.4%, and electronic products suffered a trade imbalance of more than $12 billion (exports accounted for about $31 billion, while imports were in excess of $43 billion).

Specific market segments showing increases in sales for 1985 included: Computers and industrial electronics, $73.2 billion, a 7.2% increase; consumer electronics, $19.5

billion, a 10.4% increase; and communications equipment, \$52.3 billion, a 10.2% increase.

Commerce Dept. studies predict that telecommunications computer equipment and semi-conductors will be the fastest growing industries in 1986—even though the labor force may decrease, because of new technologies combining resources and facilities. And, fiber optics revenues are expected to grow at a 20% rate, to \$1.1 billion, even though there may be possible competition from various foreign countries, according to the Commerce Dept.

CBEMA predicts that business and professional microcomputers will grow approximately 21.5% from 1986 to 1990, attributing this surge to advances in technology, such as supercomputers, chip density, speed and processing, and fiber optics.
AFIPS WASHINGTON REPORT, Reston VA (703/622-8900)

Circle Reader Service # 105

Non-impact printing Congress features equipment exhibition

The Third International Congress on Advances in Non-Impact Printing Technologies will feature, for the first time, an exhibition of printers, components, and consumable products for printers.

Sponsored by the Society of Photographic Scientists and Engineers, the Congress will explore a wide range of non-impact technologies and the requisite materials consumed by these processes. An extensive seminar program is scheduled for August 25-28, at the Fairmont Hotel in San Francisco, CA, to examine a variety of technologies, including xerography, ionography, stylus writing, ink-jet, thermography, and laser printing. The exhibition is co-sponsored by Computer Graphics World magazine, and Laser Focus—the magazine of Electro-Optics Technology.
SOCIETY OF PHOTOGRAPHIC SCIENTISTS AND ENGINEERS, Springfield, VA (703/642-9090)

Circle Reader Service # 106

Graphics workstations market will quadruple by 1990

A recently completed study from Standard Resources Inc.—Graphics Workstations and Terminals—forecasts that the worldwide market for graphics workstations and terminals will reach \$40.4 billion in 1990, up from \$9.7 billion in 1984; with the engineering workstation segment growing at an annual rate of 36.7%, as compared to 20.8% for the business graphics portion.

The graphics software market is expected to grow from \$405 million in 1984 to over \$2.7 billion in 1990, but there will be a radical shift in the type of software sold during this period. In 1984, 85% of the software sold was for use on mainframes or minicomputers. The rapid acceptance of micro computers for graphics applications, however, will force the mainframe/mini software segment to drop to 45% in 1990, when microbased software will account for 55% of the total sold.

The study contains a listing of 500 graphics workstations and terminals, including price, manufacturer, display size, features, and technology used. Price: \$1,995.
INTERNATIONAL PLANNING INFORMATION INC., Redwood City, CA (415/364-9040)

Circle Reader Service # 104

Science center provides EMP testing capabilities

The EMC Science Center, Inc., recently inaugurated testing of electrical and electronic equipment under conditions simulating high altitude nuclear explosions. Tests include application of free-field electromagnetic pulses (EMP) varying from 2,500 through 60,000 volts per meter, to desk-top-sized equipment; and 200,000 volts per meter or more, to smaller equipment. Pulse waveforms can be produced with a wide variety of shapes, rise times, and decay rates.

The new EMP test facility complements the Center's capability for direct and indirect drive testing for EMP susceptibility using equipment developed at the Center. MIL-STD-461C EMP tests through 100 MHz can be conducted, including direct and indirect capacitive and inductive coupling tests of cables, and wires. Direct drive tests of cables, connector pins, semiconductors, circuits, components and subsystems can also be conducted using state-of-the-art injection networks.

EMC Science Center also custom designs induced surface current test fixtures to measure transfer impedances of cable shields and connectors. A free brochure describes the EMP test services.

EMC SCIENCE CENTER INC., West Conshohocken, PA (215/825-1960)

Circle Reader Service # 102

Image processing growth triggers industry changes

Exponential growth in capabilities and complexities is setting the trend in image processing systems, with the 1985 market estimated at $414.8 million climbing to $1.58 billion in 1990, according to a recent study by Frost & Sullivan (New York, NY). And, the study points out, hand-in-hand with this 30.6% per year growth, the industry is experiencing a number of important changes. The most significant is the shift in the identity of the highest tier of the image processing industry—where systems are designed with specific applications in mind. At this level, image processing systems are becoming identified with the applications or with the user industry.

The study cites emerging trends that include: specialized hardware for each phase of the image processing task—with new phases constantly being added; industry movement toward an increasing amount of specialized processing and data manipulation; user movement toward component-type image processing; and user demands for faster computing power at lower cost.

The 316-page report divides the market into six major application areas, ranking the artificial vision segment as number one, with 1985 sales of $113.7 million rising to $687.4 million by 1990. Printing and publishing ranks second, with $84.1 million in 1985 growing to $234.4 million by 1990. This segment, the report predicts, will be eclipsed by the graphic arts segment (now third) with $76.1 million, rising to $256.4 million in 1990. Other areas include medical (non-diagnostic), remote sensing, and geophysical.

The report overviews the market, the technology, and the competitors within the industry. Price: $1,700.

FROST & SULLIVAN, New York, NY (212/935-3190)

Circle Reader Service # 101

LCD panel to be built for flight simulator

The Avionics Laboratory of the US Air Force's Wright Aeronautical Laboratories (Dayton, OH) has awarded a $1.5-million contract to McDonnell Aircraft Co. (St. Louis, MO) to build an LCD cockpit simulator display screen for fighter aircraft.

The Panoramic Cockpit Control and Display System, measuring 200 sq. in., will be a single, flat-screen LCD mounted behind the instrument panel. The LCD will control a bright projected light source to provide self-illumination of the display screen and will incorporate the most current technology including computer interface, touch screen, verbal command interface, and animated displays among others.

The display system which will be used only for flight simulation, will allow a pilot to perform such functions as terrain following or terrain avoidance, as well as detecting and avoiding threats or tracking targets. Actual flight screens will be available early in the 1990s.

MCDONNELL AIRCRAFT CO., St. Louis, MO

Circle Reader Service # 109

JOIN S.I.D. TODAY

Carroll Touch Inc., Round Rock, TX, has signed a large volume production contract with Teledyne Controls, Los Angeles, CA, for scanning infrared touch input systems. Teledyne Controls will incorporate the touch units in a digital air/ground communications system it has developed for commercial airliners. The touch-activated Interactive Display Unit (IDU) will provide commercial airline pilots with quick, reliable communications with their ground terminals by means of automatic digital data link equipment.

GTE, Stamford, CT, has received a contract from Nippon Telegraph and Telephone Corp. (NTT), Tokyo, to conduct basic research in the area of molecular electronics—specifically, to synthesize and study novel organic molecules designed by GTE scientists that have specific chemical and electronic properties. Produced in a thin film, only a single molecule thick, the molecules are designed so that they can be deposited on a metal electrode with each molecule oriented in the same direction. Methods of depositing the films, which are less than 100 angstroms thick (about one ten-thousandth the thickness of a human hair), are currently being developed at GTE laboratories. Results of the study will provide scientists with information on the feasibility of using single molecules to make prototypes of microminiaturized integrated circuits.

Hartman Systems, Huntington Station, NY, has obtained an approximately $6-million contract to provide display units to Grumman Melbourne Systems Div., Melville, NY. The contract calls for 45 19-in., full MIL qualified color graphic displays and 38 12-in. monochrome tabular displays to be used in the Joint (Air Force/Army) Surveillance Target Attact Radar System (Joint STARS), to provide a common airborne radar attack control system for air-and surface-launched strikes against second-echelon forces.

Zenith Electronics Corp., Glenview, IL, has named Hoy Y. Chang president, Zenith/Inteq Inc., a wholly owned Zenith subsidiary based in Herndon, VA. Chang will have direct responsibility for all Zenith/Inteq operations, including the design and marketing of "Tempest" high-security microcomputers and peripherals. Before joining Zenith Data Systems Corp., in 1981, as vice president, Chang was with Burroughs Corp., in Detroit.

FORMTEK (Formative Technologies Inc.), Pittsburgh, PA, a producer of computer-based editing and management systems for engineering drawings has signed a contract with Bell of Pennsylvania for a statewide network of FORMTEK's Integrated Raster Scanning Technology (FIRST) systems—consisting of optical scanners, plotters, interactive workstations, and FORMTEK's turnkey drawing revision and management software. Bell is using the FORMTEK equipment to automate the records management associated with outside plant engineering; and develop specialized software that will automatically generate work orders as existing drawings are updated to indicate work to be performed. Installation of all equipment and software is scheduled for completion in 1987.

JULY ISSUE

SID 86

SHOW ROUND-UP

Low-cost imager permits real-time 3-D analysis

Digital imaging in recent years has caused a major revolution in diagnostic radiology, medical physics, and bioengineering. Standard mainframes and microcomputers have been adapted for research and development in these fields, while a number of dedicated computers have been configured specifically for clinical use.

When researchers at Manitoba Cancer Treatment and Research Foundation decided to set up a digital imaging research facility, however, they found that available systems were either too expensive or they were not sufficiently versatile for their needs. They solved the problem by assembling their own digital imaging system using inexpensive, off-the-shelf components.

The system, called DICOM-8, is capable of real-time video image manipulation, has comprehensive processing functions, and provides display facilities capable of presenting isometric, volumetric, stereoscopic, parametric, and dynamic images. The low-cost mobile unit permits viewing volumetric information acquired in the form of multiple parallel axial slices such as in CT, SPETC, MRI, and Ultrasound.

DICOM-8 consists of a Z80-A microcomputer that controls Matrox video imaging boards and peripherals such as floppy disks, a printer, a VDT and a video monitor, a modem, and a light pen. Each display unit provides a 512 x 512 x 8-bit image plane having standard interlaced monochrome video signals. Multibus architecture and the popular CP/M operating system are used to ensure widespread acceptance and compatibility.

Real-time multiplane image manipulation required in-house development of a pipeline ALU with shift functions. Nine serial and four parallel I/O ports permit interfacing to peripherals, with remote data transfer at rates up to 19.2 kbaud under the RS-232 standard. To keep costs to a minimum, data is stored on floppy disks, although both Winchester and video disks can be added to the basic system for increased capacity. Both composite NTSC and RGB RS-170 video outputs are provided for display on standard monitors.

Software for the system consists of a comprehensive library of subroutines called through a hierarchical structure. The upper level, suitable for use by operators with no programming experience, consists of dedicated applications packages and a general-purpose interactive menu. The FORTRAN subroutine library is readily accessible by programmers and fully documented by callable HELP files.

At the lower level, many routines are in Assembler for greater efficiency. Look-Up Tables (LUTs) are used for real-time data mapping and pseudocolor display, and their selection, generation, and modification are under direct user control. Standard image files are defined for compatibility throughout the system, using headers for automatic addressing, control, display, and history.

Response time is kept low by limiting the number of viewing angles and by maximum use of hardware for image processing. In many applications this approach is quite adequate, and the use of much more expensive computers would not be justified.

(Continued on page 16 . . .)

(Developed from *Pseudo 3-D Imaging With The DICOM-8*, by S. Shalev, J. Arenson, R. Kettner, Department of Medical Physics, Manitoba Cancer Treatment and Research Foundation, Winnipeg, Manitoba, Canada—SPIE Medical Imaging and Instrumentation '85, April 21-23, 1985, Boston, MA.)

(. . . continued from page 14)

Normal display with the DICOM-8 is a 512 x 512 x 8-bit image converted to a color composite NTSC standard or RGB RS-170 video standard and viewed on a color monitor. Pseudo-color is controlled by three independent 8-bit Look-Up Tables (LUTs). The image on display may be one that is stored in either plane A or plane B, or an image being acquired via the digitizer, or an arithmetic or logical manipulation of these. An independent alphanumeric overlay may also be displayed.

Stereoscopic images are made by storing a pair of stereo views in the two image planes. By applying green and red LUTs to the respective planes, swapping the input sources on consecutive vertical retrace periods, and viewing the monitor with colored eyeglasses, one observes a 512 x 256 3-D image. Toggling between frames with a fixed sequence results in a halving of the vertical resolution but guarantees a 30Hz refresh rate. By either randomizing the frame accessed or swapping after every second field, full resolution is maintained at the expense of increased flicker.

Volumetric imaging is made possible by constructing a pseudo 3-D image from a series of axial sections. First, successive 2-D images are mapped onto the image plane through a 2-D binary mask, each new image being offset both horizontally and vertically to yield an oblique projection. Second, the color or intensity, or both, of each successive image is modified to provide increased depth perception. It is usually most effective when the image is darker at the back and lighter at the front, giving the impression of a light source close to the viewer. Third, a frame is drawn around the image, defining the 3-D volume, the direction of the oblique projection and the position of any geometrical cuts that have been specified.

The mask is presently limited to binary values to reduce image construction time to a minimum. For a zero pixel in the mask , no data transfer occurs and the previous value written in the image plane remains. This is equivalent to defining overlapping data as "transparent." For a unit pixel in the mask, successive data overwrite the image plane. Clearly, semi-transparency could also be stimulated by using non-binary mask values. The mask initially is set to unity, and the viewer may then define rectangular areas on each slice where the mask is to be zeroed, hence defining geometrical cuts into the volumetric data set. These cuts appear as "holes" in the pseudo 3-D image, permitting the visualizaton of internal structure.

The viewer has interactive control over the selection of geometrical cuts, the specification of tissue ranges to be transparent, and the degree of shading with increasing depth. In addition, one of eight possible oblique views—right/left, up/down, front/back—may also be selected. The selection of completely arbitrary angles of view would require much more computation, and has very little clinical significance in most cases.

Determining medical imaging CRT resolution, not a simple procedure

Rapid advances have been made in medical imaging systems during the past twenty years, as electronic computers opened up entirely new applications for radiologists in such imaging areas as computerized tomography, ultrasound, digital radiographic imaging, and nuclear magnetic resonance, to name a few.

Many of these methods for determining body abnormalities use digital computer techniques to manipulate electronic signals and generate visible images of the scanned areas. The resultant analog diagnostic images are either displayed on television-like display monitors for direct viewing, or on imaging cathode-ray tubes for photographic hard-copy.

While modern electronic diagnostic systems have attempted to force the cathode-ray tube to mimic imagery that was previously produced by the X-ray machine, the results are often unfortunately less than ideal. Yet, to make a correct diagnosis, the medical user quite naturally is concerned about the optimum quality of image presented by the viewing monitor or the photographic hard-copy.

Size and linearity of the display are especially critical, as proportions must be shown realistically for an accurate diagnosis. X-ray film offers a continuous gray tone from opaque to transparent, and therefore many shades of gray are important in evaluation of medical data. Differential contrast is also important; that is, one must be concerned with less than 100% modulation (from full black to full white) of detail. In X-ray situations, one is concerned with very subtle shading or modification that may occur at any film density. It is also equally important that resolution be uniform over the entire picture area.

Cathode-ray tubes, for one thing, typically have good center resolution, but somewhat poor corner resolution. And, there is concern with stability in the image. Television displays have generally been designed for use by the human visual sense. That sense is quite adaptable, and does not demand absolute stability of black level, for instance. Subtle shifts in centering, size and linearity have not been considered critical.

That is not the case in today's medical imaging equipment. And, of course, an X-ray display cannot tolerate any transient ringing, streaking, or other masking effects that might be acceptable in a conventional television system.

Determining the system's resolution, then, is not a simple matter—especially for medical equipment. System resolution performance is the sum of component performances: the display, the video camera, and the video processing equipment.

Resolution is not a simple consideration; if specifications are to be meaningful, a full description of performance must be detailed.

Display resolution

Due caution must be observed in technique to obtain valid results. The older, traditional means of resolution testing has been to view a test chart such as the EIA Resolution Chart (Electronic Industries Association) with a TV camera and then observe the results on a television-type monitor. This supposedly gives an overall system resolution response figure in "TV lines," based upon how far down the test chart wedge one can define the alternately black and white elements. Unfortunately, this has led to the "before and after martini" readings due to the nature of the visual sense and its wide range of accommodation, not to mention psychological conditioning.

Other than the human problems, it is necessary to separate camera limitations from display device limitations; obviously a limited camera signal will cause the display device to appear to perform poorly. Recently, the problem has occurred from the other extreme. Electronic generators and computers can develop extraordinarily fast signals, allowing monitor performance to appear better than might be achieved in ordinary application.

The advent of computer displays has changed the traditional rules for resolution analysis. Previously, a television signal originated in a camera; cameras

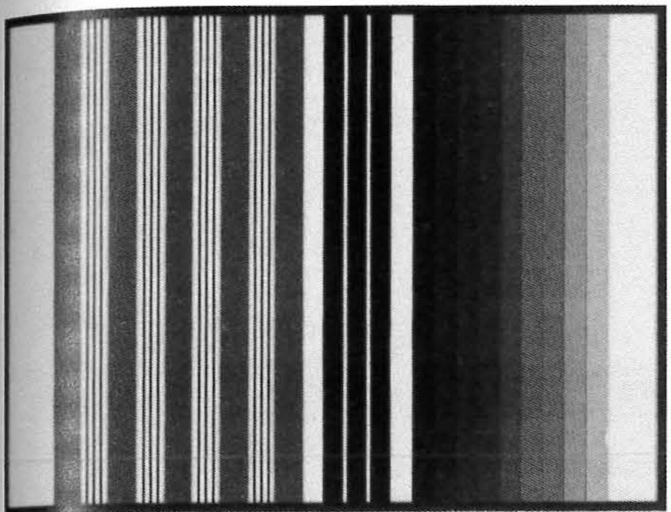


Fig. 1: Typical combination test pattern.

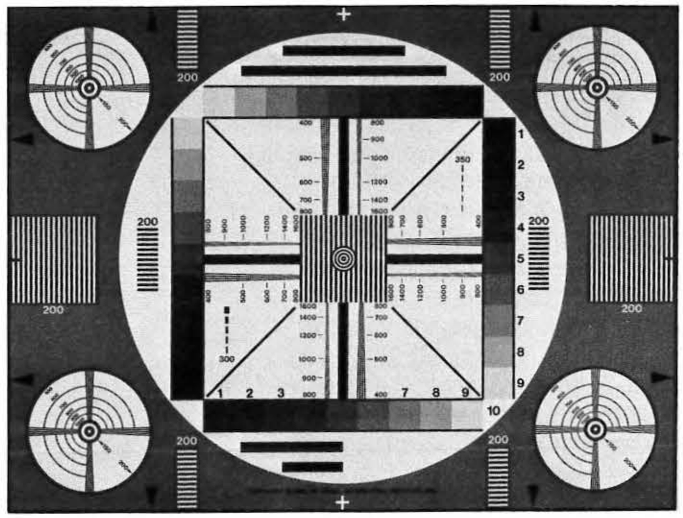


Fig. 2: Typical resolution chart (EIA).

produce signals with less perfect resolution response than digital systems, many of which can develop full 100% contrast at all data rates. Therefore, a computer display can appear to have sharper detail due merely to the greater modulation presented to the input.

It becomes apparent that the first step in resolution evaluation is a complete definition of the signal to be used for the measurement. It is recommended that the signal be a square wave, 100% contrast (full black to white) over the full range of performance expected, ideally with a rise and fall time no more than 1/10 the pulse period.

Technical realities force some compromise as rise and fall times of less than 10 nsec and rep rates in excess of 30 mHz are difficult to achieve in a composite video format.

Better quality signals can be developed electronically than can be obtained from a television camera. A calibrated wedge pattern, however, is difficult to generate electronically. In most cases, a conventional square wave signal calibrated in steps of 100 line resolutions is adequate. The pattern may be presented in continuous or burst modes, as convenient for best detection of data from the display surface.

What is a good resolution? The human eye is quite adaptable, so much so that a specific set of data is impossible to describe visual performance. Most often reference is made to the "Just Noticeable Difference" (JND), a psychophysical determination. Since the eye is believed to have a 2% limit of detection in the foveal area, it may be assumed that display modulation must be at least 2% to produce visible detail. This becomes a complex consideration.

The 2%, roughly speaking, is the level of minute detail that can be interpreted in a complex pattern containing various degrees of contrast—coarse, medium, and fine. And the question "2% of what?" needs consideration. A 2% signal modulation into a cathode-ray tube does not assure a 2% brightness variation on the screen. Results may be different in a display that contains only fine detail.

Care must be taken to not develop a pattern or viewing condition that falsely enhances detail; display of high resolution modulation only might give a misleading indication of performance. Also, brightness and contrast must be adjusted properly to assure that all viewing conditions are properly considered. This leads to combination patterns, which can give greatest assurance of display performance.

As the "proof of the pudding is in the taste," display quality should be analyzed directly from the viewing surface under realistic operating conditions. "Eyeball" examination is not dependable. If visual analysis is used, it must be done carefully and must be related to a more exacting laboratory confirmation.

A quick overview of display performance can be obtained more accurately with a combination pattern that includes appropriate Resolution Detail, Gray Scale, and a Black Reference segment, to establish an appropriate visual field. (Fig. 1) The input signal must be monitored closely, since the display is totally dependent upon the input quality. Full 100% contrast is the most desirable reference, because it is easily repeatable. Results, however, must be related to actual input signal conditions to be encountered.

The result of visual analysis has to be observation of the finest detail (fastest rep rate) visible on a square wave pattern for horizontal resolution and visibility of scanning lines for vertical resolution. The visual sense is not able to provide more detailed quantitative information.

A display is so complex to analyze scientifically that rather elaborate instrumentation is required.

Camera resolution

Resolution evaluation for a television camera is straightforward—view a test chart and inspect the resulting signal. There are many possible limitations and complications, however, that may produce poor results.

The quality of the test chart is most significant in this procedure. The EIA Resolution Chart is the one most often used. (Fig. 2) It consists of horizontal and vertical wedges for resolution. While the chart provides a good overview, testing is limited to wedge locations at the center and corners.

Many reproductions of the chart are available, some of which do not provide good wedges. Wedge line work must be straight, of continuous taper, and the black-and-white segments must be of equal width throughout the wedge. Artwork, as on a printed chart, usually provides full white to black contrast. Photographic transparencies, even large ones, often do not. If the contrast is not on the chart, it will never be produced. Chart quality must be carefully controlled.

The camera lens may also be a source of limitation. The user must verify that the lens does have adequate resolution capability to pass the finest resolution image from the chart without distortion or limitation. The chart should be brightly illuminated to permit the smallest lens aperture (largest "f" number) possible. Illumination must be sufficient to develop a suitable signal-to-noise ratio in the camera signal. If possible, the signal-to-noise ratio should be checked to be at or better than specification before resolution tests are performed. Only under these conditions can resolution tests be considered meaningful.

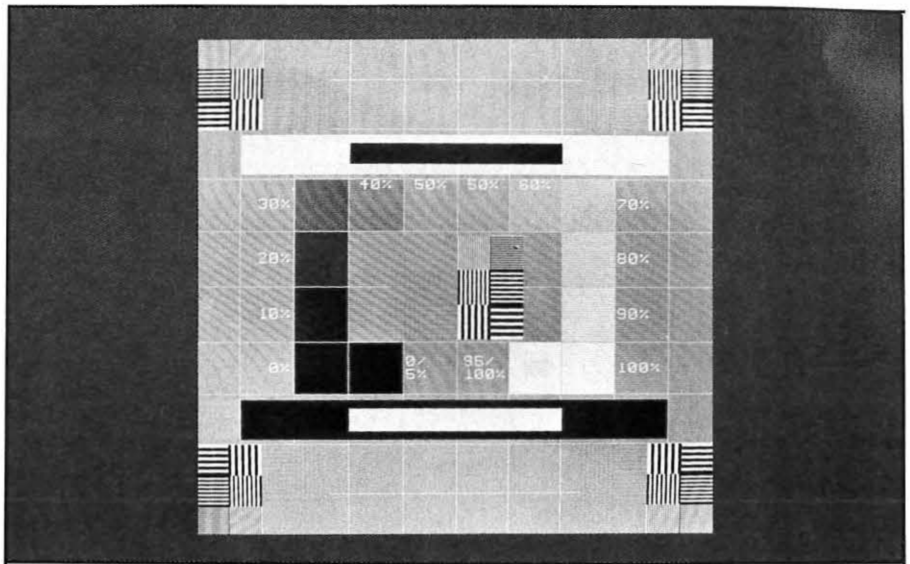
The problem of using wedges in vertical resolution, complicated by the raster structure, certainly applies to television cameras. There is no convenient readout point in the television signal to assess how well the scanning line structure is formed by the pickup device.

A typical camera tube contains a photosensitive surface. When light strikes this surface it is altered—either in resistance, voltage charge, or electron emission. When the electron beam passes any given spot, the material is, to varying degrees, returned to its original state. As soon as the beam passes the alteration is renewed.

The varying television signal results from the beam survey of the total photosensitive pickup surface area, as altered by the amount of light striking the surface. The change is not instantaneous. Surface characteristics are controlled to provide a reasonable storage in the time between scans, and to accommodate a rapid return to original state. Compromise is inevitable to provide desired sensitivity and minimum storage and refresh times to avoid lag, which appears as a smear on a moving image.

Vertical resolution, as noted before, is dependent upon the raster structure. The discussion of scanning line quality is as applicable to television cameras as to display devices. If camera tube scan were perfect, vertical resolution would be equal to the number of scan lines (line slope ignored) as discussed for monitors.

Although it is difficult to know exactly, it is presumed that there are gaps between scan lines the same as there are in displays. The most obvious problem



SMPTE Imaging Test Pattern

Medical diagnostic images today are produced by electronic systems. Data is displayed by the cathode-ray tube in a video "raster" format. Quality of the image is of utmost importance. The test pattern shown has been developed by the Subcommittee on Recommended Practices for Medical Diagnostic Devices, Society of Motion Picture and Television Engineers, as an aid in monitoring electronic image quality.

The test image has many unique features. Its background is a uniform 50% gray level. Resolution targets are included at both the center and in the corners, in horizontal and vertical planes, at both 100% contrast and 1%, 3%, and 5% gradations to assure the ability to reproduce fine detail at minimum contrast. Further, a full ten-step (11-level) gray scale is wrapped around the center area, including 5% and 95% "shadow" targets at gray scale extremes.

Full contrast black/white bars above and below the gray scale will reveal streaking, transient distortion, and other types of mid- and low-frequency distortion that may be introduced by the video system. The crosshatch (Bars) pattern superimposed over the image serves as a reference for evaluation of size, centering, scan linearity, and aspect ratio.

While developed principally for medical imaging applications, it is expected that this pattern will have wide applications in many fields. The specific format illustrated is configured for the 525/60 scan rate at 1:1 aspect ratio. The SMPTE standard allows for variation in the pattern for various aspect ratios (e.g. 4:3) and to accommodate different scan rates. The pattern is available for many EIA video standards.

(*SMPTE Recommended Practice* is available from SMPTE, 862 Scarsdale Ave., Scarsdale, NY 10583.
EIA Standards are available from Electronic Industries Association, Engineering Dept., Eye St. NW, Washington, DC 20006.
Test Pattern for Video Displays and Hard-Copy Cameras—Radiology 1985:519-527.)

caused by this is that information may be missed between lines. It is debatable how this serves as a reduction in resolution—the same number of scan lines exist in either case. As detail approaches the width of a theoretically perfect scan line, however, it is obvious that the probability of missing detail is greater the less precisely the raster is formed.

Limitation in raster structure may result in a limitation in contrast ratio. If a scan line is too wide, it will overlap the area intended for an adjacent scan line. That area will just have been surveyed by the beam, and will not be fully restored to lighted condition. Therefore signal output is lowered.

The quality of raster structure can be evaluated by laboratory techniques that involve special test charts and camera modification. Usually, it is presumed that if focus is good (as observed on a monitor) and horizontal resolution is expected, the scan line structure is optimized. Yet, this does not assure one how perfectly the job is done.

Once vertical resolution is set, horizontal resolution may be evaluated. The vertical wedge, as presented on the Resolution Chart, is quite adequate. (Fig. 2) The corner wedges, however, taper to less fine detail than the center wedges, as corner performance is usually less. The chart has wedges only in corners and at the center; special charts may be developed for testing in greater detail if so required. Of course, element density must reach the highest resolution expected.

Resolution is evaluated by the television signal coming from the camera. The waveform is viewed on an oscilloscope that has been triggered in a way to show detail in each scanning line of the raster—individually. An oscilloscope with delaying sweep capability is required. Either separate horizontal and vertical synchronizing pulses must be available from the camera or a sync separator must be provided (some oscilloscopes have them built in). The main sweep is synchronized from the vertical pulse; while the delayed sweep may be set on "Start after delay time," but preferably on "Trigger after delay" and synchronized from the horizontal pulse. Thus, using the delay control, one is able to select line by line down the raster to inspect the resolution modulation. Usually the oscilloscope "sweep gate" pulse is mixed into the video line to show, on a display, the area being viewed on the oscilloscope. A line of signal will appear.

Full contrast must be measured from a large block of information, which is a 100% contrast reference. As the modulation is viewed down the wedge to finer detail, modulation will decrease. There is no standard or accepted common practice as to what is acceptable minimum modulation. For lack of other precedence, 10% of full contrast would be considered minimum.

(To be continued in the July issue of ID.)

BEST PAPER AWARD

LC panel displays high contrast, wide viewing angle

Despite their broad installation base, twisted nematic (TN) effect display modules generally lack the high contrast and wide viewing angle cone necessary for many display applications. But, a supertwisted birefringence effect (SBE) display, developed by researchers at Brown Boveri Research Center, Baden/Dättwil, Switzerland, promises to dramatically improve image quality in present TN display modules through retrofitting.

The SBE display has the same polarizer-cell-polarizer configuration as the TN display. With the SBE, however, its layer is twisted by 270 deg, with boundaries having a high pre-tilt. The 270-deg twist imparts a very steep slope to the distortion-voltage curve.

Direction of the local optic axis for the select and non-select operating voltages differs by only about 10% for 100-line multiplexing (see Fig.). The high-pretilt boundary layers are required to eliminate a competing distortional structure having 180 deg less twist; and to prevent formation of a two-dimensional stripe instability, sometimes referred to as a "scattering state."

Operating the SBE layer like a TN display with polarizers aligned in plane with, or perpendicular to, the orientation direction on the adjacent boundaries, or operating the layer in a guest-host mode, results in a low contrast ratio because of the incomplete vertical orientation of the select state.

To obtain a contrast ratio high enough for practical applications, it was necessary to use an off-axis polarizer orientation in a birefringence mode so that both optical normal waves are excited in the twisted layer and noticeable interference occurs between them. The SBE display appears bright yellow when the non-select voltage is applied and black when the select voltage is on. Rotating either of the two polarizers through an angle of 90 deg results in a complementary mode of operation (to the previous "yellow mode") having a bright colorless appearance in the select state and a dark purplish-blue appearance ("blue mode") in the non-select state.

Researchers from Brown Boveri Research Center, Baden/Dättwil, Switzerland, received this year's "Best Paper Award" at the Annual SID Luncheon in San Diego, CA, May 7, 1986—for their SID '85 presentation *24x80 Character LCD Panel Using the Supertwisted Birefringence Effect.*

A prototype display was developed having 270 x 540 lines in a double matrix design and multiplexed duty cycle of 1/135. Pixel size is 0.40 mm x 0.40 mm with 50 μm separation lines that result in an active viewing area of 121.5 mm x 243.0 mm. A 10 x 6 font is used for the alphanumeric characters.

Elastomer connectors fasten the display cell to a printed circuit board containing 30 type SM 1804K driver ICs having 45 outputs each. Three cascaded ICs deliver the strobe pulses and four groups of three cascaded ICs supply the data waveforms to the upper half of the display. Subdividing the data flow into four groups reduces the frequency of the data transfer and hence the power consumption. The lower half of the display is driven in the same manner.

The picture information of the whole display is divided into eight subsections that are stored in a 256K EPROM in such a way that each byte of memory contains one bit for each of the eight data lines.

Key requirements essential for SBE display fabrication are the attainment of a uniform layer thickness and high-pretilt boundaries. Current distributed-spacer technology is capable of yielding the required thickness uniformity, although difficulties sometimes may still arise from poor quality glass plates (waviness in the glass plates may cause colored stripes to appear in the display). Brown Boveri researchers developed a cost effective process that allows uniform high pretilt boundaries to be produced over large areas.

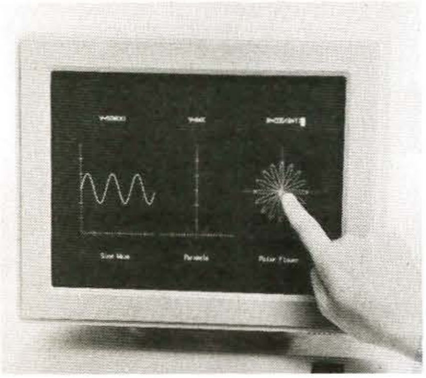
The supertwisted birefringence effect itself was found to allow duty cycles of about 1/600 in a display having 24 x 80 characters. This limit was caused by non-uniformities in the high pretilt orientation layer and by chromatographic separation during cell filling.

Voltage drops caused by the resistance of the transparent electrodes and the internal resistance of the driver ICs, however, further lowered this limit to the value of about 1/300, using currently available materials. The prototype display has been successfully operated at a simulated multiplexed duty cycle of 1/270.

The SBE display seems to be ideally suited for applications where large-area displays of high complexity, high contrast, wide viewing cone and low power consumption are required, such as for portable personal computers. It is not suitable, however, for applications that require gray scale, full color capability, and response times fast enough for moving pictures.

(Developed from 24 x 80 Character LCD Panel Using the Supertwisted Birefringence Effect, by T.J. Scheffer, J. Nehring, M. Kaufmann, H. Amstutz, D. Heimgartner, and P. Eglin, Brown Boveri Research Center, Baden/Dättwil, Switzerland—SID '85, Orlando, FL, April 29-May 3, 1985.)

Circle Reader Service #110



Video display touch-screen

Acoustic wave, touch-screen system for video displays offers crosspoints in three dimensions. The system can define up to 16 pressure points, as well as up to 50 touchpoints per inch (512 x 384 on a 14-in.-diagonal display). It can be customized for installation on displays from 5 to 25 in. diag, or on their graphic pads. The acoustic touch system not only creates an invisible matrix of touch points across the face of a CRT, but also uses two piezoelectric elements to generate surface acoustic waves (SAWs). The number of touchpoints can be varied in the system with the digital circuitry. Price: $150 per unit (in quantities of 2,000).

ZENITH ELECTRONICS CORP., Glenview, IL (312/391-8181)

For information, circle Reader Service #46

Shielded din socket

The SJ-0507-5, shielded din socket, provides optimum protection from connection interference in computer and peripheral equipment applications. Offered in PC and right angle mount, the din socket has five to eight pins, with either 180-deg or 240-deg orientation. It is available with molded cable assemblies protected by foil and mylar shielding.

SHOGYO INTERNATIONAL CORP., Great Neck, NY (516/466-0911)

For information circle Reader Service #59

Laser diode lenses

Collimating lenses and lens/diode assemblies are available for optical disk recording, fiber-optic communications systems, He-Ne laser replacement, non-contact printing, medical apparatus, and other applications. Laser diode collimating lenses have focal lengths from 1.95 to 300 mm. Sample plastic bi-aspheric laser diode lenses are available for testing and evaluation. Price: $15 each.

D.O. INDUSTRIES INC., East Rochester, NY (800/828-6778)

For information circle Reader Service #60

Photon detection system

Accurate measurements of low, variable light levels are made possible with a photon detection system that consists of a detector unit, housing a photomultiplier, integrated with a control unit containing voltage supplies and a powerful counting logic circuit. This arrangement enables the system to be interfaced with specific microcomputers that pass control commands, receive and store data. The device is available for use with IBM PC, PC/XT and portable or IBM-compatible and BBC-B microcomputers.

THORN EMI ELECTRONICS, Middlesex, UK

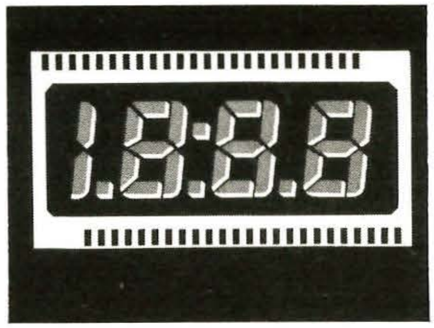
For information circle Reader Service #67

Die cutter

Line of die cutters in 9 different sizes, ranging from 22⅞" × 30⅝" to 48⅞" × 76", are capable of embossing and die cutting membrane switches; as well as commercial foil stamping, die-cutting, embossing, and heat scoring of a variety of paper and paperboard materials.

TOSI, Fullerton, CA (800/824-0945)

For information circle Reader Service #72



3-D LCD panel

Liquid crystal displays provide simulated 3-D presentations. The first unit in a series features 3½ digits, 0.7 in. high, 3 decimals, and a colon. Contacts are on 0.100-in. centers with physical glass size of 1.5 x 2.75 x 0.115 inches. Options include color polarizer, color filters, backlighting and virtually any custom artwork modification to suit custom requirements. Price: $48.95 (evaluation units); $9.90 (in quantities of 10,000 for production use).

UCE INC., Norwalk, CT (203/838-7509)

For information, circle Reader Service #47

Film recorder

Raster scan film recorder interfaces directly to high performance (flicker-free) graphics workstations, including IBM 5080 and 5081, Sun Microsystems 3160C and 2160C, Ramtek 2020, Chromatics CX1400, Silicon Graphics, IRIS Series 2000, Raster Technologies 1/380, and more. The Dunn Mullticolor film recorder has preprogrammed/programmable exposure profiles, Gamma correction, flat-faced CRT with red-enhanced phosphor, and Auto Comp—automatic video and film calibration options. It is available with 4 optional film backs: 35 mm, 4 × 5, Polaroid 300, and 8 × 10. Price: $5,000 (15kHz) and up.
DUNN INSTRUMENTS, San Francisco, CA (415/957-1500)

For information circle Reader Service #71

Data acquisition system

PC-based data acquisition system—Model 3595 Isolation Measurement Pod (IMP)—is designed to make measurements of temperature, strain, voltage, current, resistance, thermocouples, RTOs, status, frequency, period events, counts, and digital outputs. It can be installed in extremely harsh environments (−20C to +70C), has NEMA 4X rating, and can scan and transmit data from up to 1 km away. The IMP series is powered by IBM PC and has up to 20 digital or analog channels. Up to 600 channels can be measured and transmitted in 1 sec.
SOLARTRON INSTRUMENTS, Elmsford, NY (914/592-9168)

For information circle Reader Service #74

Graphics board

VideoGraph/EL, an add-on graphics board for the IBM PC, XT or AT, drives standard electroluminescent displays; runs standard IBM software in 160 x 100, 320 x 200, or 640 x 200 resolution modes; and is available in monochrome color. Price: $695.
NEW MEDIA GRAPHICS CORP., Burlington, MA (617/272-8844)

For information circle Reader Service #52

Computer image recorder

Palette computer image recorder is an interactive software-driven system producing full-color presentation quality prints, slides, and overhead transparencies. It can produce hard-copy with resolution up to 920 × 700 pixels, depending on hardware and software driving it. The system accepts Polaroid 35 mm instant slide film, conventional 35 mm film, Polaroid Polacolor 3¼ × 4¼ in. print film and Colorgraph Type 691 instant overhead film. Palette is compatible with Zenith models Z-148, Z-150, Z-158, and Z-160. It is also compatible with models Z-138, Z-171, and the Z-200 series when equipped with an optional CGA video emulation card. Price: $1,995.
POLAROID, Cambridge, MA (617/577-2000)

For information circle Reader Service #79

Electro-optical inspection

VISION 105 automatic electro-optical inspection and gaging system inspects PCB panels at every manufacturing stage, from artwork to outer layers after tin-lead reflow. The system detects cuts, shorts, nicks, pinholes, improper conductor clearance widths, and improper annular ring widths.
OPTROTECH INC., Billerica, MA (617/667-9969)

For information circle Reader Service #65

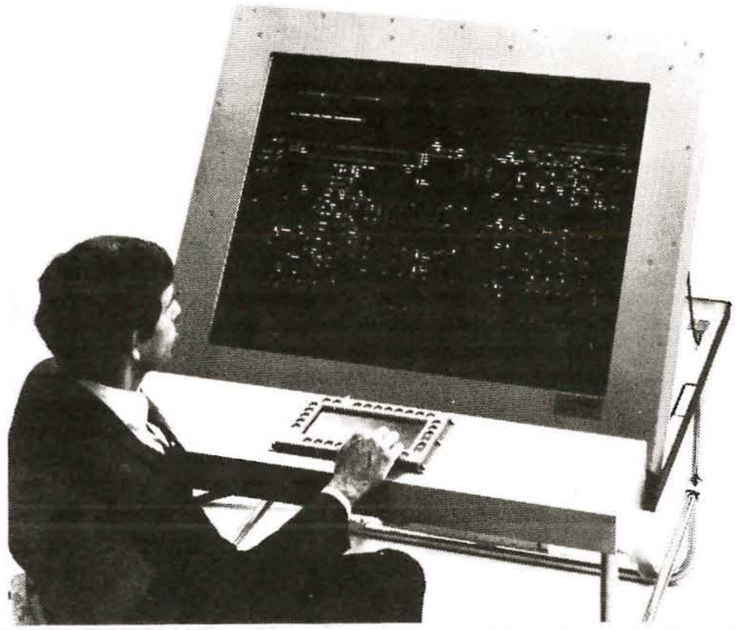
PHOTONICS TECHNOLOGY, INC.

PIONEERS AND LEADERS IN THE Design, Development, and Production of AC Gas Discharge Displays

PHOTONICS TECHNOLOGY PRESENTS

THE WORLD'S FIRST METER-SIZE, HIGH RESOLUTION FLAT DISPLAY TERMINAL

DEVELOPED FOR MILITARY PROGRAMS INCLUDING U.S.ARMY AFATDS



This is the world's first large area, high resolution, non-projected, flat display terminal. Utilizing AC gas discharge plasma display technology, the terminal has an active display matrix of 1600 by 1200 pixels measuring over 39 inches (one meter) diagonally with 5.3 square feet of viewing area and a resolution of 2500 pixels per square inch. All drive electronics are mounted in a 4 inch thick picture frame package around the perimeter of the transparent, thin (0.5 inch) display screen allowing for rear-projected and see-through applications.

Jointly developed by Photonics Technology, Inc., Luckey, Ohio and Magnavox Electronic Systems Co., Ft. Wayne, Indiana.

Photonics and Magnavox are presently completing the development of AC gas discharge flat panel displays ranging in size up to 3 meters with active display matrices up to 4096 by 4096 pixels. Multicolor displays are also being developed.

Photonics is the world's leading developer and manufacturer of sophisticated, high technology AC gas discharge displays. We are able to design and manufacture flat display panels, monitors, and/or terminals in a variety of sizes at relatively low costs. Our flat displays range in size from a few centimeters up to one meter. Some of our standard and custom displays include the following:

Panel Size, Pixels	Resolution, Pixels Per Linear Inch
128 x 256	40, 60
128 x 512	60
256 x 256	60
256 x 512	64
512 x 512	60, 64, 73, 83
512 x 1024	60
1024 x 1024	60, 73, 83
1200 x 1600	50.8, 101

Our standard display resolution ranges from 30 to 100 pixels per linear inch (900 to 10,000 pixels per square inch). Display resolutions up to 200 pixels per linear inch are available.

For Further Information, Contact:

Donald K. Wedding Sr., VP Marketing Photonics Technology, Inc., P.O. Box 432, Luckey, Ohio 43443, 419-666-0033.
Research, Development, and Manufacturing facilities located at 6967 Wales Road, Northwood, Ohio 43619.

President's Message

I welcome this, my first opportunity to communicate with all the members of SID, as well as the large number of other readers of *Information Display.*

By the time this column appears in print the SID '86 Symposium will be history but I am confident that it will again set new records for attendance, exhibits, and coverage of last-minute developments from around the world. Chairman Tom Credelle, Program Chairman Allan Kmetz, and all the members of the SID '86 Program Committee are to be congratulated for their hard work and success in organizing an outstanding conference. My thanks also go to the staff of *Palisades Institute of Research Services* who have taken care of most of the administrative and organizational details.

I feel privileged to follow in Ifay Chang's footsteps as president of SID. Our society is entering its 25th year and appears stronger and healthier than at any other time in its history. Our membership is at an all-time high and the number of sustaining members has quadrupled in the last few years. Our UK/Ireland chapter is doing well in its first year and our newest Canadian chapter was inaugurated in April of this year. SID's two annual display meetings, the Symposium and International Display Research Conference, continue to enhance our international image. The Symposium exhibits and the expanded distribution of *Information Display* provide a greater opportunity for an ongoing dialogue among display scientists, engineers, users, manufacturers, and systems integrators.

As I look ahead toward the coming year, I would ask for your continued support of your society's activities, in particular the *Proceedings* which we are trying to strengthen and publish more regularly. We also need your inputs about technical and chapter news for ID, as well as your active participation in identifying and nominating SID members to be considered for our national awards. I hope you will share your ideas and suggestions, as well as criticisms, with me in the future.

JRaalte

CHAPTER MEETINGS PLANNER

SEPTEMBER 19: UK & Ireland
Program: AGM and Military Displays
Location: Great Malvern
Host: RSRE
Contact: Derek Washington, Sec.
Philips Research Labs
Redhill, England

NOVEMBER: UK & Ireland
Program: Interactive Displays, SID Japan meeting feedback
Location: Martlesham Heath
Host: British Telecom
Contact: Derek Washington, Sec.
Philips Research Labs
Redhill, England

(This quick-glance calendar is intended to help SIDers plan their business trips around local Chapter meetings—but to make it work will require your input of advance notice for upcoming meetings.)

UK & Ireland: June 10, 1986
Program: Technical Meeting
Location: GEC Research, Wembley, England
Topic: Highlights from SID International Symposium San Diego
Speakers: Alan Mosley, GEC, Recent LCD advances;
Simon Bliss, PPC, Flat panel DCEL Displays;
David Emberson, Mullard, Thin flat microchannel plate CRT;
Ian Charles, BBC, Display requirements for HDTV.

Los Angeles: April 23, 1986
Location: Hacienda Hotel, Los Angeles Intl. Airport
Program: Technical Meeting
Topic: High Definition Television
Speaker: Don Kline, Director, Technology, Panavision

Don covered the history, current status of hardware, standards and likely future trends in this technology that is evolving rapidly, fueled by advances in electronics, data compression techniques, and a better understanding of psychophysics of viewing television images. He was joined by Richard Stumpf, Vice President, Engineering and Production, Universal Studios, in a panel discussion. Don gave an excellent talk on this subject to an IEEE group last year.

The Chapter's March meeting was a joint session with the Orange County Chapter of the Human Factors Society. Attendees were treated to some innovative ideas for using color for sonar and air traffic control displays by Gerald Stone (Hughes) and Keith Hanson (Hadcon), respectively, and were presented hot-off-the-press results of Army-funded color studies on aircraft cockpit display legibility for high ambient color displays by Dr. Kirk Moffitt of Anacapa Science (Santa Barbara).

Bay Area: April 22, 1986
Location: The Blue Pheasant, Cupertino, CA
Program: Technical Meeting
Topic: Inside the Electrohome Color Projector
Speaker: Cliff Guice, Electrohome (USA)

Cliff Guice described in detail the workings of his company's ECP1000 portable color projector. Subjects covered were the CRT/Optics alignment, dichroic combining cube, optics assembly, and automatic multi-format synchronizing techniques that allow the unit to operate with a wide variety of computers. Models of the key optical elements and a covers-off demonstration of the unit were presented, followed by audience discussion.

Japan: March 24, 1986
Location: Japan Marine Club, Chiyodaku, Tokyo
Program: Technical Meeting
Topic: Potential for High-Quality Flat Panel Displays
Sponsors: Meeting was jointly held with the
Hoso Bunka Kikin (Cultural Broadcasting Foundation),
NHK (Japan Broadcasting Corp.),
Institute of Television Engineers of Japan,
Institute of Electrical Engineers of Japan,
Society of Applied Physics of Japan, and
Institute of Electronic Communication Engineers of Japan.

Session I—PDP, LCD, VFD

- High-Luminance and High-Efficiency Surface Discharge AC Plasma Panel—H. Uchiike, Hiroshima Univ.
- Color-Mixing Technique in LCDs—T. Uchida, Tohoku Univ.
- Active Matrix Type Flat VFDs—S. Tanaka, Sharp Corp.

Session II—LED, EL

- Blue-Emitting LED for Flat Panel Display—I. Akazaki, Nagoya Univ.
- II-VI Group Compound Semiconductors for Blue Emission—A. Yoshikawa, Chiba Univ.
- Low Voltage and Multi-Color Emission Characteristics of Thin-Film EL—K. Hamakawa, Osaka Univ.
- High-Efficiency Thin-Film EL—H. Onishi, Ehime Univ.

The panel sessions were followed by a panel discussion among the 250 attendees.

UK & Ireland: February 26, 1986
Program: Symposium
Location: Thorn EMI, Middleton, Manchester
Topic: Large-area displays

Prof. Gareth Roberts, Chief Scientist at Thorn EMI, welcomed SID Symposium delegates to the company's new conference and exhibition facilities. Mino Green then opened the day-long technical proceedings with a comprehensive tutorial on electrochromic displays.

Professor Green described the extensive work on these displays at Imperial College, London, where he and his colleagues have developed a good theoretical model that is proving to be very predictive.

They have discovered that the diffusion rate of guest ions is a function of current density, and believe this provides some explanation for many contradictory results in the literature. Prof. Green sees large-area passive displays as the application best suited to this technology. Memory can be retained for months; present display colours are blue or pink on a white ground; and a transmissive mode is also possible.

Paul Holland of Racal gave a wish-list for an ideal large display to be viewed from more than ten feet: large angle of view, very low power, viewable in all light levels, full colour, full motion, low volume, easy addressing, alpha-numerics and graphics, cheap, long life, reliable and vandal proof. These are not all possible yet, but there are interesting developments. Racal has installed a 125k-pixel guest-host LCD announcement board at Paddington (London) British Rail station. It is driven by intelligent controllers which can be linked together, each handling up to 160 characters, and is backlit with 80W tubes (60 characters per tube). Failure rate is below 5 pixels/year.

The public message-board theme was continued by Roger Cato of the British Airports Authority. A trend in new terminal buildings is to move away from the very large flap-boards to local lower-information content displays such as CRTs and LCDs. Large message boards lead to high crowd densities (often in areas where smooth passenger flow is required). On the plus side, passengers find the noise of a flap-board provides a useful cue to changing information. Concluding with another display application, Cato claimed the BAA have ten of the largest displays in the world (runway landing-lights), each is 1300′ long, 300′ wide, costs £15M, and has a power consumption of 200kW.

Tony Hughes (RSRE) described a large-screen LCD projector developed through a collaborative venture between RSRE, Laser Scan, and RADE. This was also demonstrated in the accompanying exhibition. The laser generates local heating, which changes the state of the smectic liquid crystal; local disorder, which scatters light, is preserved on cooling. Memory is 3+ years, contrast better than 100:1, and a resolution of 3000 lines by 3000 lines is obtained. The demonstration showed its use to overlay information on a large-area map display.

(Continued on page 32 . . .)

New SID Officers

Dr. John A. van Raalte, SID President, is Director, Display Systems Materials and Processing Research, with responsibility for color CRT and electroluminescent display research, at RCA Laboratories (Princeton, NJ).

He received his PhD. degree in Electrical Engineering from the Massachusetts Institute of Technology in 1964. From 1964 to 1970, as a member of the Technical Staff at RCA David Sarnoff Research Center, he worked on laser color selection, holography, liquid crystal displays and TV projection systems.

Following his appointment in 1970 as Head, Displays and Device Concepts Research, he initiated and directed efforts to develop new vidicons, microsonic filters, and flat large-screen TV displays. In 1979, he was appointed Head, VideoDisc Recording and Playback Research, and was promoted to Director, VideoDisc Systems Research in 1983. In 1984, he was appointed to his present position.

Dr. van Raalte has served SID as: National Secretary, 1981; Treasurer, 1982-1984; Vice President, 1984-1986. He has also been Program Chairman and General Chairman of previous International Symposia; Member of the Sponsors Advisory Committee of the Biennial Display Research Conference (now the International Display Research Conference); Member of the Steering Committee of Eurodisplay '81 and '84; and Japan Display '83; and SID National Convention Chairman 1978-1985.

He is a member of Tau Beta Pi, Kappa Nu, Sigma Xi; a Senior Member of IEEE and a Fellow of SID.

Lawrence E. Tannas, Jr., SID Vice President, is a researcher and frequent lecturer on electronic information displays with over 20 years experience in advanced engineering and research in the field. He currently is engaged in full time display research at Rockwell International, AMSD (Anaheim, CA).

Previously, Larry spent more than six years on EL displays device development: Aerojet ElectroSystems (Azusa, CA), Hycom (Irvine, CA), and Rockwell (Anaheim, CA). Earlier, at Honeywell, he invented the backup reentry guidance display for the Apollo Re-entry Vehicle. While at Rockwell International, he developed the engineering prototype liquid crystal display for the world's first full-scale LCD production. At Aerojet he developed a thin-film electroluminescent display suitable for production. He holds 5 patents and is recipient of several NASA and technology citations for his work in the display field.

In between display device development, Larry developed a curriculum leading to a Professional Certificate in Display Engineering at UCLA Extension that includes four short courses on Information Displays. As an outgrowth of this program, he compiled and edited the book *Flat-Panel Displays and CRTs*, which was published by Van Nostrand Reinhold (VNR) in 1985.

Professionally, Larry Tannas is a Fellow and National Officer of SID, Senior Member of IEEE, and Member of AIAA, SPIE, AVS, and Human Factors Society. He holds MS and BS degrees in Electrical Engineering from UCLA.

Dr. Peter Pleshko, SID Secretary, is a Senior Consultant for Workstation and General Purpose Displays with IBM's Corporate Development staff in Purchase, NY. He joined IBM's Research Division in 1963 and moved to IBM Kingston in 1975 where he managed different departments in Plasma Display Technology.

In 1981, Dr. Pleshko was appointed manager of Plasma Display Technology Development and Manufacturing; and, in 1984, was named manager of Flat Panel Display Technology and Manufacturing Strategies for IBM. He has been in his present position since 1985.

Peter has been actively involved in SID since 1973, serving, initially, the Mid-Atlantic chapter in various offices and committee chairs, and later at the national level, as the SID Symposium Awards Chairman (1979), Symposium Program Secretary (1980), Seminar Chairman (1983), National Membership Chairman (1981-1983) and Mid-Atlantic Regional Director (1980-1986).

Dr. Pleshko holds 11 patents and has published over 30 technical papers in the display and electronics fields. In addition, he has received 15 IBM awards for his work in semiconductor devices, circuits, memories, and displays.

Named a Fellow of SID, he also received SID's highest honor the Francis Rice Darne Memorial Award in 1975. Peter is a member of Eta Kappa Nu, Sigma Xi, a senior member of the IEEE, and a licensed Professional Engineer in the State of New York. He received his PhD. in Electrical Engineering from NYU, and an MBA in Professional Management from Pace University.

Walter F. Goede, SID Treasurer, is Manager of the Electronics Development Engineering Section at the Northrop Corp., Electronics Div. (Hawthorne, CA), where he has been involved in ultra-high-resolution CRTs, flat-panel display technology forecasting, cockpit displays, and image processing.

Walter received his BS and MSEE degrees from the University of Illinois where he was involved in early AC plasma display development. After graduation, he spent six years working on the development of flat-panel cathode-ray tubes at Northrop. Subsequently, he spent two years at Tektronix where he worked on thin-film electroluminescense, liquid crystal displays, projection displays, and high-resolution color displays; and then returned to Northrop.

Actively involved in SID he was General Chairman of the 1984 SID Symposium. Mr. Goede also has his own private consulting practice on flat-panel displays and technology forecasting. He holds 6 display patents; has produced over 35 publications on various display subjects; teaches classes in various flat-panel display topics; and is listed in Who's Who in the West for his contributions in the display field.

Sustaining Members

Ad-Vance Magnetics Inc.
625 Monroe St.
Rochester, IN 46975
219/223-3158

AEG-Telefunken Corp.
Rt.22-Orr Dr.
Somerville, NJ 08876
201/722-9800

Amuneal Mfg. Corp.
4737 Darrah St.
Philadelphia, PA 19124
215/535-3000

Applied Films Lab Inc.
6797 Winchester Circle
Boulder, CO 80301
303/530-1411

Audiotronics Corp.
7428 Bellaire Ave.
P.O. Box 3997
No. Hollywood, CA 91609
818/765-2645

Babcock Display Products
1051 S. East St.
Anaheim, CA 92805
714/491-5110

Ball Electronic Systems Div.
P.O. Box 589
Broomfield, CO 80020
303/469-5511

BDH Chemicals Ltd.
Broom Rd., Poole
Dorset BH12 4NN, UK
0202-745520

Bendix Corp.
Flight Systems Div.
Teterboro, NJ 07608
201/288-2000

Bidco Inc.
8 Commercial St.
Hicksville, NY 11801
516/433-0740

Canon, Inc.
7-1, Nishi-Shinjuku 2
Shinjuku-ku, Tokyo 160
Japan
714/556-1036 (California)

Cardion Electronics
Div. of General Signal Corp.
Long Island Expressway
Woodbury, NY 11797
516/921-7300

CELCO
(Constantine Engrg. Labs Co.)
70 Constantine Dr.
Mahwah, NJ 07430
201/327-1123

Cherry Electrical Prod. Corp.
3600 Sunset Ave.
Waukegan, IL 60085
312/662-9200

Clifton Precision/
Special Devices
5100 State Rd.
Drexel Hill, PA 19026
215/622-1718

Clinton Electronics Corp.
6701 Clinton Rd.
Loves Park, IL 61111
815/633-1444

Conrac Corp.
3 Landmark Sq.
Stamford, CT 06901
203/348-2100

Control Interface Co. Ltd.
Optoelectronics Div.
21 Rt. 10
East Hanover, NJ 07936
201/887-3222

Corning Glass Works
Electronic Materials Dept.
MP21-3
Corning, NY 14830
607/974-7451

C.W. Cameron Ltd.
Burnfield Rd.
Giffnock
Glasgow, Scotland
UKG46-7TH

Dale Electronics
P.O. Box 609
Columbus, NE 68601
402/564-3131

Data Images
1283 Algoma Road
Ottawa, Ontario
Canada, K1B3W7

Digital Electronics Corp.
26142 Eden Landing Road
Hayward, CA 94545
415/786-0520

Displays Inc.
RD #4, Box 6AAA
Lewistown, PA 17044
717/242-2541

Display Components Inc.
334 Littleton Rd.
Westford, MA 01886
617/692-6000

Eagle Magnetic Co. Inc.
P.O. Box 24283
Indianapolis, IN 46224
317/297-1030

EEV Inc.
7 Westchester Plaza
Elmsford, NY 10523
914/592-6050

EG&G Gamma Scientific
3777 Ruffin Rd.
San Diego, CA 92123
619/279-8034

Electro-Plasma Inc.
4400 Martin-Moline Rd.
Millbury, OH 43447
419/255-5197

EM Industries
Advanced Chem. Div.
5 Skyline Dr.
Hawthorne, NY 10532
914/592-4660

Endicott Research Grp. Inc.
2601 Wayne St.
Endicott, NY 13760
607/754-9187

Futaba Corp.
629 Oshiba
Mobara, Chiba 297, Japan
0475-24-1111

Garrett Mfg. Ltd.
255 Attwell Dr.
Rexdale, Ontario
Canada M9W 5B8
416/675-1411

GEC Avionics
(Affil. General Electric Co.
p.l.c. of England)
4500 N. Shallowford Rd.
Atlanta, GA 30338
404/394-7800

General Atronics Corp.
Sub. of Magnavox Govt. & Ind.
Electronics Co.
1200 E. Mermaid Lane
Philadelphia, PA 19118
215/233-4100

General Electric Co.
Aircraft Instrument Dept.
50 Fordham Rd.
Wilmington, MA 01887

George D. Harris Assoc. Inc.
The Plaza Building
Fairlawn, NJ 07410
201/796-5200

GML Information Services
594 Marrett Rd.
Lexington, MA 02173
617/861-0515

Grid Systems Corp.
2535 Garcia Ave.
Mt. View, CA 94043
415/961-4800

GTE
100 Endicott St.
Danvers, MA 01923
617/777-1900

Hartman Systems
A Figgie International Co.
360 Wolf Hill Rd.
Huntington Station, NY 11746
516/427-7500

Hazeltine Corp.
Cuba Hill Rd.
Greenlawn, NY 11740
516/261-7000

Hewlett-Packard Co.
Optoelectronics Div.
370 W Trimble Rd.
San Jose, CA 95131
408/263-7500 (x6450)

Hoya Optics Inc.
3400 Edison Way
Fremont, CA 94538-6138
415/490-1880

Hughes Aircraft Co.
P.O. Box 1042
El Segundo, CA 90245
818/391-0711

Hycom Inc.
16841 Armstrong Ave.
Irvine, CA 92714
714/261-6224

IBM Corp.
Armonk, NY 10504
914/765-1900

Imapro Corp.
Imaprint Design Inc.
West Royalty Industrial Pk.
Charlottetown, Prince Edward Is.
Canada C1E 1B0
613/226-4080

Incom Inc.
205 Chapin St.
Southbridge, MA 01550
617/765-5730

Industrial Electronic
Engineers Inc.
7740 Lemona Ave.
Van Nuys, CA 91405
818/787-0311

Infodex Inc.
395 W. Main St.
Waterbury, CT 06702
203/757-9291

Interstate Electronics Corp.
Display Product Operations
1001 E. Ball Rd.
Anaheim, CA 92803
714/635-7210

ISE Electronics Corp.
P.O. Box 46
Ise, Mie, Japan
0596/39-1111

K & R Engrg. Sales Corp.
354 Route 206
Flanders, N.J. 07836
201/584-5235

Litton Systems Canada Ltd.
25 Cityview Dr.
Rexdale, Ontario, Canada M9W 5A7

Litton Systems Inc.
1215 South 52nd Street
Tempe, AZ 85281
602/968-4471

LXD Inc.
24500 Highpoint Rd.
Cleveland, OH 44122
216/292-3300

Magnavox Govt. &
Ind. Elec. Co.
1313 Production Rd.
Fort Wayne, IN 46808
219/429-5263

Magnetic Radiation Inc.
92 N. Lively Blvd.
Elk Grove Village, IL 60007
312/437-5200

Microfield Graphics Inc.
8285 SW Nimbus Ave., Ste 161
Beaverton, OR 97005
503/626-9393

Mitsubishi Chemical
Industries America Inc.
5 Palo Alto Sq., Ste 225
Palo Alto, CA 94306
415/885-9433

Mitsubishi Electronics
America, Inc.
991 Knox St.
Torrance, CA 90502
213/515-3993

NEC Electronics Inc.
401 Ellis St., PO BOX 7241
Mountain View, CA 94039
415/960-6041

Nederlandse
Philips Bedrijven B.V.
PO Box 218
5600MD Eindhoven
The Netherlands
31-40-791111

Norden Division
United Technologies Corp.
100 Helen St.
Norwalk, CT 06856
203/852-4905

OKI Electric Industry Co., Ltd.
550-5 Higashiasakawa-cho
Hachioji-shi
Toyko, 193, Japan
0426/63-1111

Optical Coating Lab. Inc.
2789 North Point Pkwy.
Santa Rosa, CA 95407-7397
707/545-6440

Optical Radiation Corp.
1300 Optical Dr.
Azusa, CA 91702
818/969-3344

Orwin Associates Inc.
88 Seabro Ave.
Amityville, NY 11701
516/842-7177

Ovonic Display System Inc.
1896 Barrett St.
Troy, MI 48084
313/280-1900

Panelvision Corp.
265 Kappa Dr.
Pittsburgh, PA 15238
412/963-9635

Penn-Tran Corp.
Rt. 144 North
Wingate, PA 16880
814/355-1521

Philips Electronics Ltd.
601 Milner Ave.
Scarborough, Ontario,
Canada M1B 1M8
416/292-5161 Ext. 2567

Phosphor Prod. Co. Ltd.
#1 Factory Rd.
Upton, Poole
Dorset BH16 5SJ UK
0202-632116

Photo Research Div.
Kollmorgen Corp.
3000 N. Hollywood Way
Burbank, CA 91505
818/843-6100

Photonics Technology
6967 Wales Rd.
Northwood, OH 43619
419/666-0033

Planar Systems Inc.
1400 NW Compton Drive
Beaverton, OR 97006
503/625-2006

Plessey Displays
Station Rd.
Addlestone, Weybridge
Surrey KT15 2PW, UK
0932-47282

Plessey Optoelectronics
and Microwave Ltd.
Wood Burcote Way
Towcester, Northhants,
England NN127JN
0327-51871

PTK
Div. Emerson Electric Co.
1173 Los Olivos Ave.
P.O. Box 6128
Los Osos, CA 93402
805/528-5858

Quantum Data Inc.
455 E. Kehoe, Suite 104
Carol Stream, IL 60188
312/668-3301

Racal Microelectronic
Systems
Worton Grange Ind. Estate
Reading RG2 0SB, UK
0734-864611

Rank Electronic Tubes Ltd.
Sidcup-By-Pass
Sidcup Kent DA14 6LZ, UK
01/302-0271

Raytheon Co.
Ind. Components Operation
465 Center St.
Quincy, MA 02169
617/899-8400

RCA Laboratories
David Sarnoff Research Center
Princeton, NJ 08540
609/734-2000

SAI Technology Co.
4060 Sorrento Valley Blvd.
San Diego, CA 92121
619/452-9150

Sanders Associates Inc.
MER15-1222
C.S. 2035
Nashua, NH 03061
603/885-3522

Schott America—Glass &
Scientific Products Inc.
3 Odell Plaza
Yonkers, NY 10701
914/968-8900

Sigmatron Nova Inc.
1901 Oak Terrace Lane
Thousand Oaks, CA 91320
805/498-4504

Singer-Librascope
Aerospace & Marine Systems Grp.
833 Sonora Ave.
Glendale, CA 91201
818/245-8711

Sony Corp.
7-35 Kitashinagawa 6-chome
Shinagawa-kuTokyo, 141 Japan
03/493-3406

Stanford Resources Inc.
P.O. Box 20324
San Jose, CA 95160
408/448-4440

Supertex Inc.
1225 Bordeaux Drive
Sunnyvale, CA 94088
408/744-0100

Syntronic Instruments Inc.
100 Industrial Rd.
Addison, IL 60101
312/543-6444

Taliq Corp.
265 N. Whislam Rd.
Mountain View, CA 94043
415/967-2990

Tecknit
129 Dermody St.
Cranford, NJ 07016
201/272-5500

Tektronix Inc.
Information Display Products
P.O. Box 500
Beaverton, OR 97007
503/644-0161

Test & Measurement
Systems Inc.
349 Cobalt Way
Sunnyvale, CA 94086
408/720-8877

Texas Instruments Inc.
P.O. Box 225936, MS105
Dallas, TX 75265
214/238-4533

The Report Store
Div. of Ergosyst Assoc. Inc.
910 Massachusetts #503
Lawrence, KS 66044
913/842-7348

Thomas Electronics Inc.
100 Riverview Dr.
Wayne, NJ 07470
201/696-5200

Thomson-CSF Components
Dumont Div.
550 Mount Pleasant Ave.
Dover, NJ 07801
201/328-1400

Thorn-Emi Brimar Ltd.
Greenside Way Middleton,
Manchester M24 1SN UK
061/681-7072

UCE Liquid Crystal Displays
24 Fitch St.
Norwalk, CT 06855
203/838-7509

Venus Scientific Inc.
399 Smith St.
Farmingdale, NY 17735
516/293-4100

Visual Information Institute Inc.
P.O. Box 33
719 Lower Bellbrook Rd.
Xenia, OH 45385
513/376-4361

Westinghouse Electric Corp.
Industrial & Government Tube Div.
Westinghouse Circle,
Horseheads, NY 14845
607/796-3350

Zenith Electronics Corp.
1000 Milwaukee Ave.
Glenview, Il 60025
312/391-7657

Litton Systems Canada—Two Sustaining Memberships

Advertisers Index

(... continued from page 29·)

Owen Wynn (Specialised Electro Optic Services) followed with a tutorial on large-area displays for vehicle and other simulators. The requirements for "out-of-the-window" displays are 1000 fL brightness, 20:1 contrast, up to 360° viewing angle, better than 0.5 arc-minute resolution, full colour, real-world geometry, realistic depth perception, and no flicker or break-up. In the final paper, Ken Freeman (Philips Research Laboratories) described a high-definition TV projector developed as a study tool for enhanced-viewing-experience systems research. Its three f1.0 lenses (weighing 16kg each) project the output from 5", 50kV CRTs to give a 1.3m × 0.8m screen image of more than a million pixels. Convergence (better than half-pixel) is programmably monitored over 16 × 16 points, and set up using 9 points only. The system can be used to explore new scan-standards (including 1249 line, 50Hz, 2:1 interlace), and can be changed from one standard to another without switching off.— ***Derek Washington, Philips Research Laboratories, Redhill England.***

BUSINESS STAFF

Eugenie L. Gray
Publishing Director

Leslie A. Saunders
Marketing Manager

Harriet Sherman
Art Consultant

Business Office: 212/687-3836

REGIONAL SALES OFFICES

New England
The Boston Man
PO Box 207
Hingham, MA 02043
617/848-9306
N. Wood

New York, New Jersey
C. Lynn Coy & Associates
55 Forest Street
Stamford, CT 06902
203/327-4626
Ted Taylor

Mid Atlantic
C. Lynn Coy & Associates
288 Lancaster Avenue, Bldg. 3
Malvern, PA 19355
215/647-1611
Nancy Hunter

Southeast
C. Lynn Coy & Associates
55 Forest Street
Stamford, CT 06902
203/327-4626
Al Junge

Midwest
C. Lynn Coy & Associates
307 S Milwaukee #109
Wheeling, IL 60090
312/520-0199
Al Riefenberg

West Coast
Ted Lucas
P.O. Box 852
Cedar Glen, CA 92321
714/337-8889

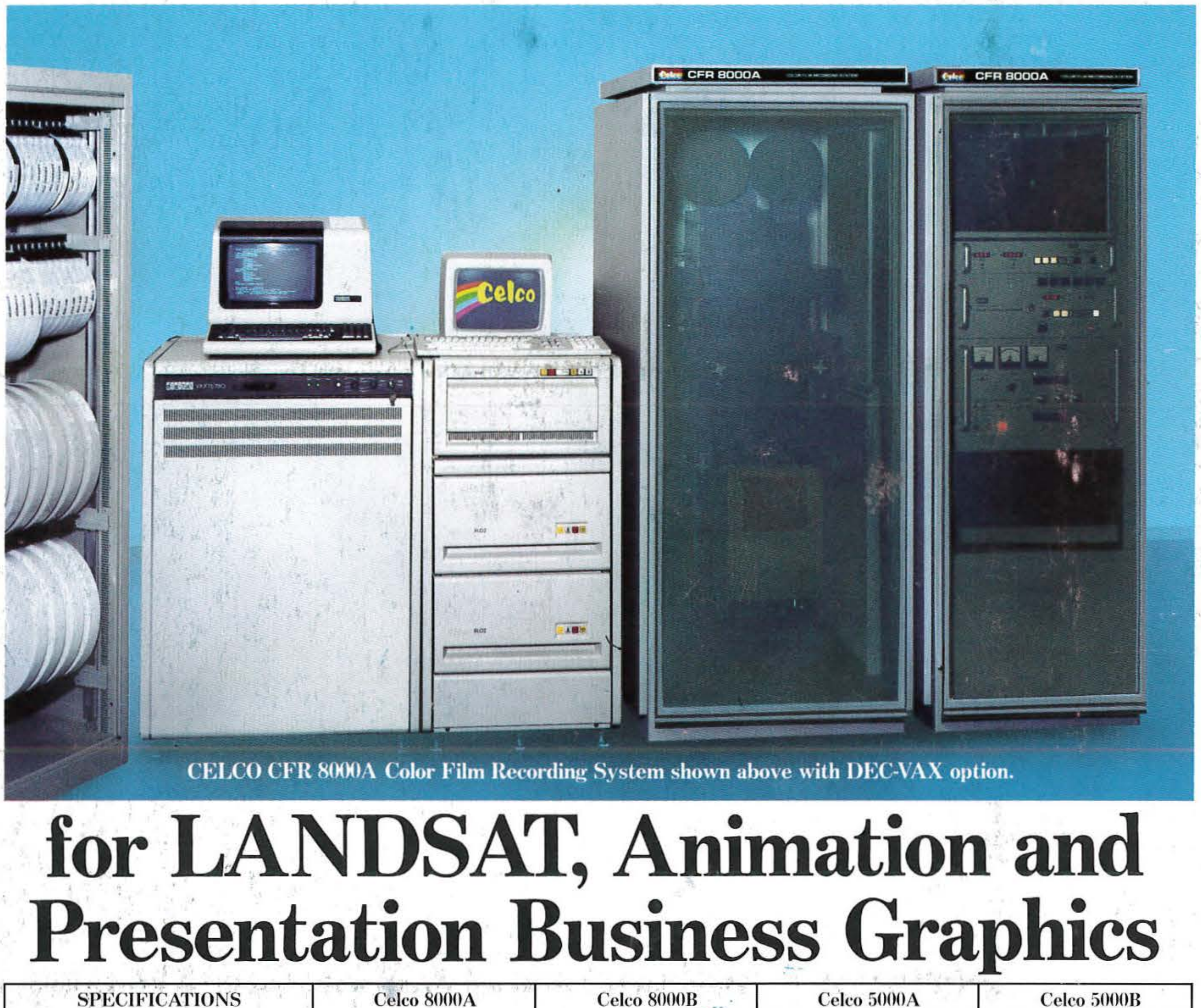
RECRUITMENT ADVERTISING

MetaData Inc.
310 East 44th Street
New York, NY 10017
212/687-3836
Leslie A. Saunders

EDITORIAL

Joseph A. MacDonald
Editorial Director

Ultra-High Speed and Resolution Color Film Recording Systems



CELCO CFR 8000A Color Film Recording System shown above with DEC-VAX option.

for LANDSAT, Animation and Presentation Business Graphics

SPECIFICATIONS	Celco 8000A	Celco 8000B	Celco 5000A	Celco 5000B
■ **Resolution**	7500 resolvable pixels		4200 resolvable pixels	
■ **CRT Size**	7″ diameter CRT (0.0008″ spot size)		5″ diameter CRT (0.0008″ spot size)	
■ **Recording Speed**	Less than 20 seconds for a complex 35mm graphics slide (run length encoded)			
■ **Variable Pixel Rates**	From 400ns/pixel to 6.2μs/pixel, in 400ns increments			
■ **Addressability**	4096 x 8192 (pixel x pixel), 8192 x 8192 (Run length encoded)			
■ **Film Format Flexibility**	Multi Format from 16mm to 8″ x 10″	Fixed, selectable from 16mm to 8″ x 10″	Multi Format from 16mm to 8″ x 10″	Fixed, selectable from 16mm to 8″ x 10″
■ **Graphic Arts Workstations Interface Compatibility**	Includes Autographix, Artronics, Executive Presentation Systems, MAGI, Management Graphics			
■ **Mainframe Compatibility**	DEC-LSI-11, PDP-11 and VAX; Perkin-Elmer 3200 series; IBM channel			
■ **Device Independent Graphics Software Compatibility**	ISSCO, UNIRAS			

Celco

For complete details circle reader service number or call CELCO today.

CONSTANTINE ENGINEERING LABORATORIES COMPANY
70 Constantine Drive Mahwah, NJ 07430 TEL: 201-327-1123
1150 E. Eighth Street Upland, CA 91786 TEL: 714-985-9868

Circle Reader Service #20