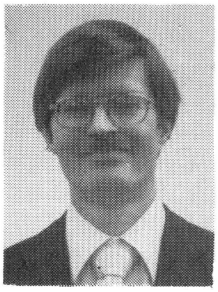


Editorial

H. J. Caulfield, Editor

Some Thoughts on Authorship of Papers

Earlier this year *Optical Engineering* published a paper with twenty-seven coauthors. This notable event stimulated your editor to consider some of the problems and protocol of the listing of coauthors. What follows is a rather unordered set of observations on what I believe to be a very important topic.

First, it is important to realize that there is no universal norm for the order in which authors' names appear on a paper. One distinguished author whose name begins with a letter in the middle of the alphabet chooses to list all of his authors' names in alphabetical order. Many multiple-author papers group their authors by organization and the organizations by the importance of the role they play. Nevertheless, the most common form of ordering is that of the order of significance of the author's contribution to the final product. This is so common that it is often assumed even when it is not the case. I would like to urge this pattern on authors who have any indecision about which format to use simply to avoid any confusion that might arise from other people assuming that the usual pattern has been used.

There is even less uniformity on the matter of how papers are to be cited, both in the text and in the references that follow. Your editor has a very strong opinion about the matter of citation in the references. There, it is important to cite each and every author. This includes the paper recently published with twenty-seven coauthors. Each of these authors made an important contribution, and each would be annoyed to find himself listed as "et al." In the text, these guidelines must change for convenience. I would certainly prefer to see two-author papers referred to by the last names of both authors. It seems to me that a three-author paper is a borderline case and that four names are clearly too many to cite in such a manner. In these cases *et al.* is perfectly acceptable. What is never acceptable in any circumstance is the citing of the second or third author without mention of the first. This unfortunate practice creeps into a great many publications when the last author is the best known of the group. Being best known does not make him the primary contributor, so it is improper for anyone else to draw that conclusion.

Finally, I wish to offer a comment on the lamentable but almost unavoidable "Matthew effect." This effect draws its name from the book of Matthew where Matthew has Jesus commenting on one of his parables and remarking, "For to every one who has will more be given, and he will have abundance, but from him who has not, even what he has will be taken away." The problem is very simply stated: a paper with one well-known author and a number of lesser known authors will come in time to be attributed almost entirely to the well-known author. This effect is invariant with the position of the name of the well-known author in the list of authors. While this effect is probably unavoidable, it should be fought actively. At a minimum, authors of *Optical Engineering* papers ought to take the time and effort to make certain that they refer to a paper by its first author or its first two authors even if this causes the well-known member of the set of authors to be omitted. The rationale for my strong feelings about this is simple. The authors doing the most important work deserve to receive appropriate citation for their contributions, even if they have among their coauthors someone better known than themselves.

Alert readers will note that I have avoided one touchy and controversial question. That is, I have offered no advice as to who ought or ought not to be listed as an author on a paper. My own preference is to try to err on the liberal side. This, however, is more a matter of taste and philosophy than of accepted scientific protocol and ethics. My personal feeling is that if an individual can point to some concept or other original contribution to the work being reported as his own, then he ought to have his name on the paper. This makes it possible to have papers in which technicians show up as coauthors. There are times when, in my estimation, this is not only appropriate but the only honest thing to do.

OPTICAL ENGINEERING EDITORIAL SCHEDULE

July/August 1983
Laser Damage in Materials
Theodore T. Saito
FGRL/NH
USAF Academy, CO 80840
303/472-3133

September/October 1983
Fluorescence
Stanley M. Klainer
ST&E Technical Services, Inc.
20 Belinda Court
San Ramon, CA 94583
415/829-7847

November/December 1983
Spatial Light Modulators: Critical Issues
Armand Tanguay
Departments of Electrical Engineering and Materials Science, and Image Processing Institute
523 Seaver Science Center
University of Southern California
University Park MC-0483
Los Angeles, CA 90089-0483
213/743-6152

January 1984
Optical Computing
Demetri Psaltis
California Institute of Technology
1201 California Ave.
Pasadena, CA 91125
213/356-4856

February 1984
Image Scanning & Recording Methods
Philip S. Considine
EIKONIX Corporation
23 Crosby Drive
Bedford, MA 01730
617/275-5070

March 1984
Critical Technology: Infrared Optics
Irving J. Spiro
M1/129
The Aerospace Corporation
P.O. Box 92957
Los Angeles, CA 90009
213/615-4441

April 1984
Liquid Crystal Applications
Sun Lu
3M Company
420 Bernardo Avenue
Mountain View, CA 94043
415/969-5200 Ext. 317

May 1984
Optical Engineering Technologies
Jerrold Zimmerman
MS 241
Honeywell Electro-Optics Operations
2 Forbes Road
Lexington, MA 02173
617/863-3548

Forum

Educational Optics

John B. DeVelis

Department of Physics
Merrimack College
North Andover
Massachusetts 01845

This column is intended to serve as a forum for students and faculty at both the graduate and undergraduate levels who have developed new classroom and laboratory approaches in the field of optics. Readers are invited to participate and should submit articles for review to me at the above address.

TRISTIMULUS-BASED OPTICAL PROCESSING

Richard F. Carson*
Texas Tech University
Department of Electrical Engineering
Box 43339
Lubbock, Texas 79409

Abstract. The complex superposition integral may be evaluated in a sampled form by a hybrid (optical-electronic) processor which makes use of the vector-space properties of tristimulus (three primary color) systems such as color television.

INTRODUCTION

Due to the potential for increased speed and a large bandwidth, numerous approaches to optical information processing systems have been developed. In the Optical Systems Laboratory at Texas Tech University, several graduate research projects have addressed the problems of designing optical systems capable of evaluating the most general space-variant integral equation, represented by the complex superposition integral

$$\tilde{g}(x,y) = \iint \tilde{h}(x,y;\xi,\eta)\tilde{f}(\xi,\eta)d\xi d\eta \ , \quad (1)$$

where $\tilde{f}(\xi,\eta)$ represents the complex-valued two-dimensional (2-D) input. This integral is especially interesting in that the complex-valued impulse response $\tilde{h}$ depends on the output plane (x,y) and the input plane (ξ,η), rather than just on the difference $(x-\xi, y-\eta)$, as is the case with the convolution integral which describes space-invariant systems.[1]

In this project, the possibility of using incoherent illumination to represent Eq. (1) was explored. When the integral is spatially band-limited and expressed in sampled form as

$$g(i,j) = \sum_{m=1}^{M}\sum_{k=1}^{K} \tilde{h}(i,j;m,k)\tilde{f}(m,k) \ , \quad (2)$$

it is approximated by a set of complex number multiplications and additions.[2] Since incoherent light is linear with intensity and thus carries no phase information, a method was needed that would allow complex numbers and their operations to be encoded into various colors. The tristimulus (i.e., three primary color) method which is used in color television was chosen as an encoding scheme to take advantage of its linear vector-space properties.

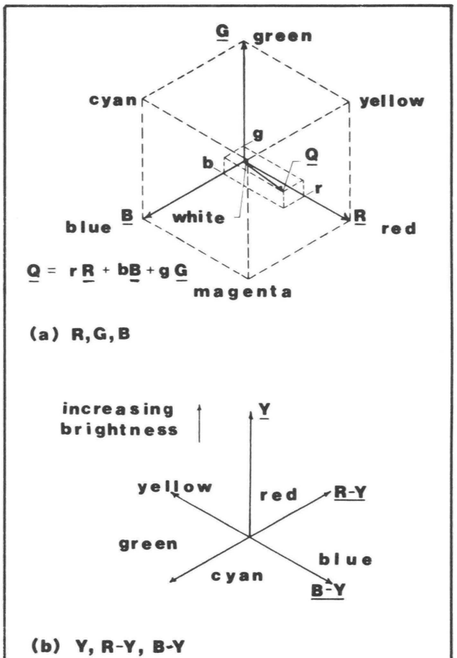


Fig. 1. Tristimulus vector representations.

TRISTIMULUS THEORY

In systems such as color television, three primary colors (red, green, and blue) are mixed in various combinations to reproduce or "match" a wide range of colors. When these primaries are expressed as linear vectors, the result is the (3-D) vector representation or "color solid" of Fig. 1(a). According to linear vector theory, these vectors may be rearranged by a 3×3 matrix transformation to yield an equivalent vector representation:

$$\begin{bmatrix} Y \\ R\text{-}Y \\ B\text{-}Y \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0.701 & -0.587 & -0.114 \\ -0.300 & -0.588 & -0.887 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} . \quad (3)$$

This new vector system allows the separation of a unipolar black and white (B&W) signal (Y) from two bipolar color signals (R-Y, B-Y) (for television broadcasting), as shown in Fig. 1(b). This representation is especially useful for optical processing because the unipolar Y signal can be combined with one of the bipolar signals to represent polar-form complex numbers and their products, as in Fig. 2(a), while the two bipolar color signals (R-Y, B-Y) can be used to represent a complex number plane in rectangular form, as shown in Fig. 2(b).

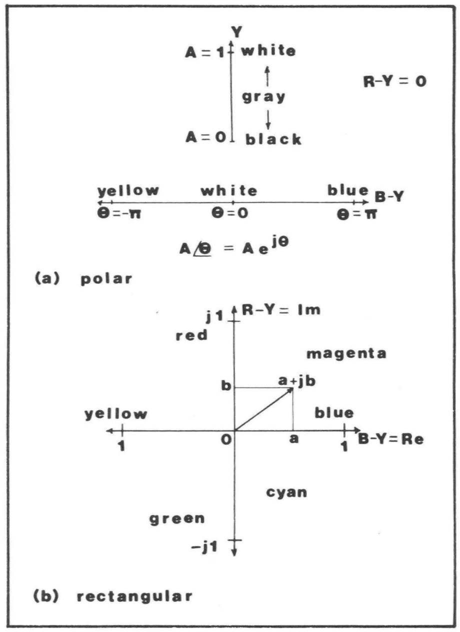


Fig. 2. Complex number representations.

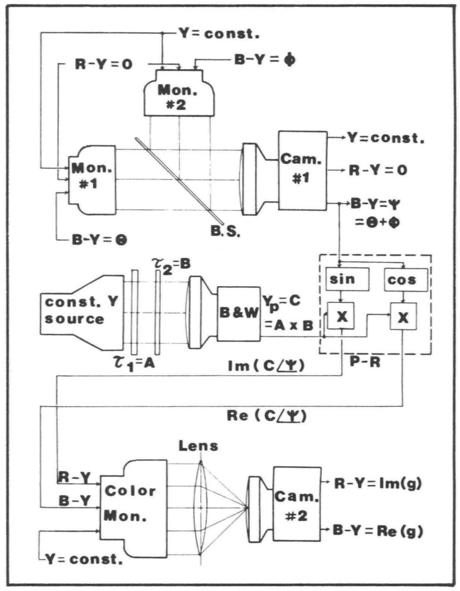


Fig. 3. Experimental processing system.

MULTIPLICATION AND ADDITION

The operations of polar-form multiplication, polar-to-rectangular conversion, and rectangular-form addition may be physically realized and combined to represent Eq. (3), as shown in Fig. 3. The sampled complex functions $\tilde{h}$ and $\tilde{f}$ are split into separate arrays of pixels representing complex number amplitudes and phase angles:

Continued on Page SR-076

*Now at University of Virginia, Department of Electrical Engineering, C-Wing, Thornton Hall, Charlottesville, VA 22901.

FJW INDUSTRIES

A Company Of Distinction

Long the leader in infrared viewing devices, and even longer a manufacturer of precision optics for commercial and military applications.

FJW INDUSTRIES offers you a total optical capability from simple lenses to complex multi-lens assemblies as well as being able to supply your needs for prisims, beam splitters, windows and mirrors. Our in-house coating department allows us to coat high volume single layer coating and enhanced or multi-layer coatings per your specifications.

In recent years we have opened a separate facility for the manufacturing of plastic tank periscopes. These unity powered periscopes are used in the majority of personnel carriers and tanks of governments all over the free world.

Our optical manufacturing capability in Mt. Prospect, Illinois has been expanded to include a complete optical plant in Singapore which allows us not only the opportunity to offer you precision optics but precision optics at competitive prices both in low and high volume quantities.

This year FJW INDUSTRIES has introduced a very exciting new concept in giftware which will soon be in showrooms across the United States.

The FIND-R-SCOPE Infrared Viewers can be found in use internationally by photo-finishers and manufacturers as well as users of Lasers and LED's. This complete line of viewers is available from stock in the U.S.A. or from any of FJW's worldwide distributors.

FJW Industries Is Indeed A Company Of Distinction

3 Plants—USA and Singapore

FJW INDUSTRIES
215 East Prospect Avenue
Mount Prospect, Ill. 60056
Phone 312 / 259-8100
Telex: 910-687-2261
Cable: OPTICSPRO-MPCT

SCHOTT... Precision

SCHOTT OPTICAL GLASS INC.

400 York Avenue Duryea, Pennsylvania 18642
Tel: 717 457-7485 TWX 510 671 4535

A message from F. E. Herkt
President

Schott Optical Glass Inc. was established to assure American defense and industry a dependable, domestic producer and designer of the finest optical glass. We have expanded our production and research facilities eight times since we began in Duryea, Pennsylvania in 1969. Starting with 70 people, we now provide jobs for hundreds of additional American glass workers.

You, as our customers, have demonstrated your faith in the quality of Schott products by ordering them in larger and larger quantities. We are grateful for your help in making us the leading American manufacturer of precision optical glass and a mainstay of Pennsylvania's economy. We haven't paused in our commitment to your growing needs. Highly-skilled scientific minds and the most sophisticated instrumentation in the American glass industry are working for you every day in our new research and development facility to maintain America's leading edge in glass technology.

We are concerned with the difficulties of our domestic economy and the resulting high unemployment rate among American workers. The impact of foreign imports reaches across the spectrum of American industry and the glass industry is no exception. We nevertheless believe strongly in free trade among all nations, provided that there is reciprocity instead of protectionism, subsidies, and so on.

We at Schott can point to a continuing investment in our part of the American industrial complex. We know that our investment will pay off in an improved economy and more jobs in Pennsylvania.

Schott's mission is to be a reliable domestic supplier of the most sophisticated glass products and related technologies. Your past support of our efforts has kept us moving forward to serve you better. Your continued support will keep the American economy strong in this high technology field.

Sincerely,

F. E. Herkt
President

SCHOTT DIVISIONS: COMPONENTS LASER GLASS OPHTHALMIC GLASS PRECISION OPTICAL GLASS RADIATION SHIELDING

Approximately 90% of all products sold by Schott Optical Glass Inc. are manufactured in the United States.

Optical Glass Made In America

Schott Optical is geared to work with the largest production quantities or the smallest prototype development. Our manufacturing facilities (over 300,000 square feet) are ready to back up our scientific knowledge and technical skills to work for you at every stage of your program.

We have the marketing and sales know-how to work closely with your organization to assure that your products made from Schott Optical materials or components get to your customers at the right time, in the right way.

And, above all, Schott Optical has the widest range of precision optical glass and components available in the Western Hemisphere today. Just check our list and let us hear from you.

OPTICAL DIVISION
- OVER 250 TYPES OF OPTICAL GLASSES
- FIBER OPTICS RODS
- HIGH HOMOGENEITY BK-7 BLANKS
- ZERODUR® — LOW EXPANSION MATERIAL
- PHOSPHATE AND SILICATE LASER GLASSES
- CERENKOV COUNTERS

COMPONENTS DIVISION
- PHOTOFILTERS
- CRT FACEPLATES
- SCIENTIFIC FILTER GLASS
- INTERFERENCE FILTERS
- CRT CONTRAST ENHANCEMENT FILTERS
- FIBER OPTICS SPECIALTIES
- B-270/CLEAR SHEET GLASS
- X-RAY LEAD GLASS
- RADIATION SHIELDING GLASS & WINDOWS

OPHTHALMIC DIVISION
- CROWN GLASS — CLEAR & TINTS
- 1.60 LIGHTWEIGHT CLEAR CROWN GLASS
- HIGH-LITE®— HIGH INDEX LOW DENSITY GLASS
- SUN MAGIC ™ PHOTOCHROMICS — FOR SUNWEAR
- PHOTOCHROMICS — FOR PRESCRIPTION
- INDUSTRIAL SAFETY GLASS
- UV FILTERING CROWN
- SPECIALTY GLASS

TECHNICAL SERVICES
- CUSTOM MELTING
- CONTRACT R&D
- ANALYTICAL/PHYSICAL/OPTICAL MEASUREMENTS

— and the list goes on . . .

High technology glass for the most sophisticated applications.

SCHOTT
SCHOTT
OPTICAL GLASS INC.

400 York Ave., Duryea, Pennsylvania 18642
(717) 457-7485 TWX 510-671-4535

Continued from Page SR-072

$$\tilde{h}(i,j;m,k) \Rightarrow A(i,j;m,k)\,\underline{/\theta(i,j;m,k)}$$
$$\tilde{f}(m,k) \Rightarrow B(m,k)\,\underline{/\phi(m,k)} \quad (4)$$

The phase angle arrays, represented by colors on a two-hue number line as in Fig 2(a), are displayed on sources such as color TV monitors (Mon. #1 and Mon. #2 in Fig. 3), and are added together by color addition on a beam splitter at a constant intensity level. The appropriately scaled sum appears on the B-Y output of a color TV camera (Cam. #1 in Fig. 3). The amplitudes are represented on back-to-back spectrally flat filters (τ_1 and τ_2 in Fig. 3). When they are illuminated by a constant intensity source, their product appears on Y_p, the signal from the B&W camera. Together, the two signals yield a polar-form complex product array corresponding, for a single pixel, to

$$\tilde{h}(i,j,m,k)\tilde{f}(m,k) = C\underline{/\psi} = AB\underline{/\theta+\phi}, \quad (5)$$

where the (m,k) indices form the spatial arrays while the (i,j) indices represent various points in time.

Equation (2) is completed by taking an electronic polar-to-rectangular transform of the product signals (P-R in Fig. 3), displaying the transformed output as a rectangular-form product array (represented in color at constant intensity). The complex-number summation is completed by using a lens to achieve color (vector) addition, where the real and imaginary components of these vectors are represented and added as in Fig. 2(b). The output is detected by another color camera (Cam. #2 in Fig. 3), where the B-Y signal carries the real component of the completed form of Eq. (2), while the R-Y signal carries the imaginary component.

EXPERIMENTAL SYSTEM

A system containing the components of Fig. 3 was constructed and tested. The primary concerns in these tests were for linearity and dynamic range. Thus, a source matched to the **R**, **G**, and **B** vectors was constructed so that the validity of linear matrix transformations such as Eq. (3) could be tested. The linearity tests were especially critical because, while cameras and monitors are essentially nonlinear devices, a linear representation is necessary in this case. The dynamic range of any linear region found would determine scaling and accuracy for the number processing functions of the system. The basic complex number operations described in the previous section were also tested for small numbers of pixels.

RESULTS AND CONCLUSIONS

The above tests proved successful in that linear representations such as Eq. (3) could be verified and the operations of complex multiplication, polar-to-rectangular conversion, and complex summation were successfully demonstrated. The lack of a wide linear region and the low SNR inherent in vidicon cameras and CRT monitors severely limited the accuracy of the system, however. Thus, other types of tristimulus-based displays and detectors such as CCD arrays will be needed to construct practical processing systems.

The benefits of this work are twofold. As a graduate thesis project, it provides a good educational experience in areas ranging from linear systems theory to electronic circuit construction and television systems. As a research project, it forms the basis for a new and potentially powerful method of optical processing with incoherent light.

ACKNOWLEDGMENTS

The guidance of faculty advisors John F. Walkup and Thomas F. Krile is greatly appreciated, as is the financial support of the Air Force Office of Scientific Research, Grant 79-0026.

REFERENCES

1. J. F. Walkup, Opt. Eng. 19(3), 339(1980).
2. R. J. Marks II, J. F. Walkup, and M. O. Hagler, J. Opt. Soc. Am. 66(9), 918(1976).

Laboratory Report

OPTICS AND HOLOGRAPHY IN THE SOVIET UNION

Lloyd Huff
University of Dayton Research Institute
Applied Physics Division
Dayton, Ohio 45469

Dr. Igor P. Nalimov (left) and I. Yu. Fedchuk of the Cinema and Photo Research Institute (NIKFI) in Moscow.

During a 12-day period in December of 1982, I had the good fortune to visit research laboratories in Moscow, Leningrad, and Novosibirsk as a guest of the USSR Academy of Sciences. This article represents a somewhat superficial attempt to chronicle some of my observations and to report on Soviet research activities at laboratories in those cities. The title of this article is obviously far too expansive; it would be impossible for any one observer in 12 days to sample more than a narrow slice of the extensive optics and holography research being performed in the Soviet Union. Nonetheless, my tour gave me a firsthand impression of the great depth and diversity of their research program and an appreciation for their dedication to the sciences.

MOSCOW

Cinema and Photo Research Institute (NIKFI)

The principal activity at the Cinema and Photo Research Institute is the development of cinema technology, including conventional film techniques, stereophotography, holography, and stereoholography. The institute has about 800 scientists and 400 support personnel (office workers, technicians, machinists, etc.). There are two groups in the institute working on holography, the Stereophotography and Stereoholography group headed by I. Yu. Fedchuk and the Stereocinematography group under Professor V. G. Komar.

NIKFI has been active in the development of 3-D movies, using conventional stereophotography techniques, and the holographic cinema for several years. The Soviets have long been fascinated with 3-D and are pleased by the current resurgence in the popularity of 3-D movies in the United States. A.G. Boltjansky, head of the stereophotography section under Professor Komar, showed me film clips from four stereo movies recently made in the Soviet Union. The movies, which were recorded on 70 millimeter film and projected through a single stereo projector, were of excellent technical quality.

NIKFI's efforts to develop the holographic cinema are continuing at a substantial level with work directed toward development of large holographic screens, Fourier hologram recording techniques, and large pulsed lasers for scene illumination. NIKFI is developing the holographic movie for entertainment and educational purposes. Their current principal interest is in educational films, and they expect to be displaying instructional holographic movies in the classroom within a few years. The Soviets are obviously much more optimistic about the future of holographic cinema than are Western filmmakers, and apparently they have the funding to support their convictions.

The Soviets have won considerable acclaim in the last few years for their reflection holography work using the Denisyuk technique. Many of these holograms have been produced at NIKFI by Dr. Igor P. Nalimov and coworkers in the group headed by Fedchuk. Special fine-grain films and film processing chemistries developed at NIKFI are largely responsible for the high quality imagery displayed by these holograms. The developer of the fine grain PE-2 film, Professor N. I. Kirillov, died last year, but fortunately his work is being carried on by an associate, N. V. Vasillieva.

Dr. Nalimov is currently pursuing the development of holographic stereograms. He is now producing holograms using the stereogram scheme of Nigel Haig and will soon have operational a system for producing holographic stereograms of the type invented by Lloyd Cross.

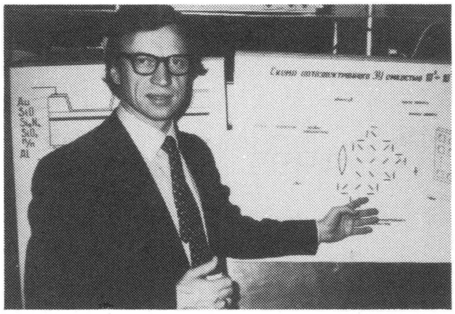
P. N. Lebedev Physics Institute

Directed by Nobel laureate N. G. Basov and staffed by many of the country's top scientists, The Lebedev Institute is one of the Soviet Union's largest and most prestigious research institutes. Lebedev's total staff numbers about 3,500, with some 600 employees engaged in laser/optics work under the direct supervision of Academician Basov. Basov's quantum electronics department is engaged in a broad range of optics research activities, including quantum electronics, opto-electronics, optical communications, plasma physics, laser fusion, and laser surgery. The Opto-Electronics Section, headed by Professor Yu. M. Popov, is engaged in the development of semiconductor laser devices, optical information processing, integrated optics, and optical processing devices.

The Lebedev Institute was the first organization to demonstrate laser action in the quaternary compounds. These devices appear excellent for optical communication through fibers since they can be tailored to operate in the spectral region where losses and dispersion are minimum. A laser output power of 10 milliwatts has been obtained at room temperature in a single mode at 1.3 micrometers. Dr. P. G. Eliseev, who has been working on the development of injection lasers for the last ten years, believes that the development of the quaternary semiconductor laser has solved the source problem for fiber optics communications. He pointed out that the main advantage of the quaternary diode laser system is the ability to adjust the chemical composition of the laser to vary its operating characteristics while maintaining the lattice match between the substrate and the junction.

Scientists at Lebedev are also working on electron beam-pumped semiconductor lasers and have developed a laser screen tube three to four centimeters in diameter capable of projection illuminating a one-meter-square screen with a resolution of 10^3 by 10^3 pixels. These electron beam-pumped semiconductor laser tubes are also being used in optical processing and optical memory systems. The tubes, which must be liquid-nitrogen cooled, are being produced in small quantities at the rate of about 50 per year.

Dr. V. N. Seloz'nev is involved in the development of an optical memory system which makes use of the electron beam-pumped semiconductor laser screen tube in conjunction with a beam splitter system and a volumetric array of semiconductor memory chips. The system under development has a memory storage time of up to one year at room temperature, a read-write speed of one to two microseconds for 10,000 bits, 10^8 to 10^9 bit memory capacity, 10^{-11} joules per bit energy requirement, and 10,000 bits per chip. Each chip is about seven millimeters square and the system contains 10^4 chips. Seloz'nev is very optimistic about the practical application of this system, which is now in the process of reduction to commercial practice for computer memory.



Dr. V. N. Seloz'nev of the P. N. Lebedev Physics Institute in Moscow.

Dr. Alexander Parfenov (left), and Dr. Igor N. Kompanets of the P. N. Lebedev Physics Institute in Moscow.

Liquid crystal light modulators for optical processing applications are being developed by a group headed by Dr. Igor N. Kompanets. Kompanets and coworker Dr. Alexander V. Parfenov have made some rather remarkable advances in light modulator technology in the last few years. They have demonstrated devices with a clear aperture of five centimeters square, diffraction efficiency exceeding 80 percent, and spatial resolution of 300 line pairs per millimeter at the 50 percent MTF point. The response time of these devices is quite fast, with a switch-on time of 0.1 millisecond and a switch-off time of 1 to 2 milliseconds. The best results have been obtained using a layer of single crystal BSO as the photoconductive material. The BSO layer is on the order of 800 micrometers thick, and the thickness of the liquid crystal layer is typically 5 micrometers.

While touring the laboratories of the Opto-Electronics Department, I talked to several people in Professor Popov's group about a variety of interesting research projects being conducted. Dr. Boris Sverdlov is one of several people working on injection lasers in the quaternary compounds, specifically gallium indium arsenide phosphide on a lattice-matched indium phosphide substrate. Sverdlov showed me performance curves for one device he had developed which produced two milliwatts output power at room temperature at a wavelength of 1.253 micrometers.

Distortion in optical fibers, produced by nonlinear coupling efficiency at fiber optic links, is being studied by Dr. Vladimir R. Shidlovski. Harmonics of the input signal are generated by this nonlinear effect, and the amplitude of these harmonics is a function of the mechanical shift of the fibers at the coupling joint.

Dr. A. B. Sergeev's work concerns the generation of ultrashort pulses with injection lasers by use of external resonators. A semiconductor laser is simultaneously driven by a dc current and a microwave frequency matched to the mode spacing of the external cavity. Pulses as short as eight picoseconds have been obtained by this external cavity mode-locking technique.

Dr. Alexander Sobolev is studying the generation of electromagnetic radiation by electron tunneling in thin film metal-barrier-metal structures, an effect first suggested by Javan in 1967. The incentive for this work is the development of coherent sources in the 10^{12} to 10^{14} hertz frequency range. Sobolev has constructed a device that produces coherent emission in the radio frequency range, but so far he has not been successful in obtaining coherent visible radiation. The problem apparently is obtaining thin metal oxide layers with sufficiently smooth surfaces.

Dr. Pavel Berezin is investigating optical processing with Vander Lugt matched filters recorded in thick holograms. Very low noise performance can be achieved because of the narrow Bragg angle in volume holograms.

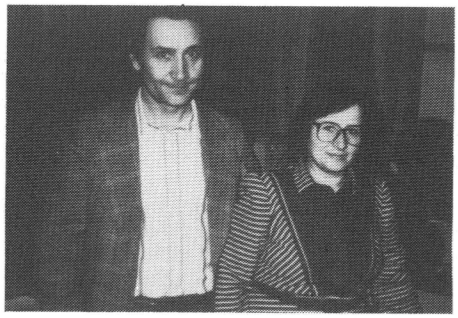
LENINGRAD

A. F. Ioffe Physical Technical Institute

The A. F. Ioffe Physical Technical Institute was founded in 1918 with approximately 80 people. The institute is now one of the largest physics institutes in the USSR Academy of Sciences, with approximately 2,700 people. The director of the institute is Academician V. M. Tuchkevich, a specialist in semiconductors and high power device switching. The institute is involved in many areas of basic physics research, including optical properties of semiconductors, magnetic properties of solids, ferroelectrics, rare-earth compounds, optical investigations of the solid state, low temperature studies, quantum electronics, optoelectronics, holography, and plasma physics. There are three deputy directors under Academician Tuchkevich: Professor V. N. Ageev (plasma physics, astrophysics, surface physics), Professor S. P. Nikonozov (solid state, strength of solids), and Professor Michael P. Petrov (general properties of solid state, electronics, and holography). My host at the Ioffe Institute was Professor Petrov.

Professor Petrov is administratively responsible for about 500 to 600 people. The laboratory he supervises directly contains about 40 people. One of the principal activities in Professor Petrov's laboratory is the investigation of solid-state photosensitive materials. This work includes basic research on the properties of the photorefractive materials BSO, BGO, barium titanate, and lithium niobate. Professor Petrov's group has used the anisotropic properties of such materials to record and read out holograms at different wavelengths to avoid hologram erasure. They have also performed interesting experiments with the formation of multiple volume holograms at different applied electric fields. Since the materials are electro-optic, the refractive index and the Bragg angle are a function of the applied electric field. It is therefore possible to write many holograms in a crystal by varying the applied electric field and then to selectively read out each hologram by adjusting the external field.

Left to right: Professor Michael P. Petrov, Mrs. Petrov, and Dr. S. I. Stepanov. Professor Petrov and Dr. Stepanov are with the A. F. Ioffe Physical Technical Institute in Leningrad.



Dr. and Mrs. B. G. Turukhano of the Nuclear Physics Institute in Gatchina.

Petrov and coworkers A. V. Khomenko, V. I. Marakhonov, M. G. Shylagin, and M. V. Kresinkova have developed a new type of light modulator device using BSO called the PRIZ modulator, which displays performance apparently quite superior to that of the Itek PROM device. The PRIZ modulator makes use of the transverse rather than the longitudinal electro-optic effect. Higher sensitivity, improved resolution, and greater modulation efficiency result. In addition, the PRIZ device displays the desirable features of zero spatial frequency suppression and dynamic image selection.

Other members of Petrov's group, Dr. S. I. Stepanov and Dr. A. A. Kamshilin, are studying holographic recording in photorefractive materials and anisotropic diffraction. Dr. Stepanov has been able to improve the diffraction efficiency of volume holograms recorded in BSO with the use of a traveling reference beam. The net effect of the traveling reference beam is to maintain coincidence between the light interference field and the moving charge grating. Dr. Stepanov has also made a thorough study of the diffraction properties of dynamic holograms formed in BSO.

Czochralski growth of photorefractive crystals is being actively studied to obtain materials with improved properties. Crystal growth parameters such as temperature, rotation rate, and pull rate are being studied for both doped and undoped materials.

Another interesting project is the study of a nonlinear optical effect in optical fibers. Using a Q-switched Nd:YAG laser as the source, a phase-conjugated wave is generated by stimulated Brillouin backscattering in an optical fiber. Since the light is continually refocused as it propagates through the fiber, a long nonlinear interaction region is established and conversion to the phase-conjugated wave is very efficient.

Interesting work in holography and optical processing is being performed at the Ioffe Institute under Professor S. B. Gurevich. Professor Gurevich is Vice-President of the Scientific Council on Holography for the USSR Academy of Sciences. He heads a group of about 30 to 40 people involved in holography and electro-optic techniques. Research areas in Professor Gurevich's section include optical information processing, holographic scanning, holographic recording materials, and television transmission of holographic data taken at remote sites. A highly stable holographic interferometry system has been developed to study crystal growth in space aboard the Salyut satellites. The holographic interferograms are relayed back to earth by television. A crystal growth experiment was conducted on Salyut-6 using a five kilogram package, and a repeat of the same experiment is planned for Salyut-7.

Professor G. A. Gavrilov is working on the development of an optical feedback television system using CCD devices. He is using this television in an automated CCD moire interferometry system which incorporates computerized data reduction and has the capability to distinguish between concave and convex surfaces.

Dr. B. G. Podlaskin is developing multielement photodetector arrays for optical computing hardware. The arrays are being used to perform such operations as Walsh and Hadamard transforms.

Dr. V. K. Sokolov and Dr. V. F. Relin are using image processing to improve the resolution of x-ray microscopy data. Using a combination phase-amplitude filter, they have thus far been able to improve resolution of the raw data by a factor of five. They are now setting up a new system using a photo Titus device developed at the Ioffe Institute.

Nuclear Physics Institute

Holographic research and development work is also being performed at the Nuclear Physics Institute in the small town of Gatchina, located about 30 kilometers outside of Leningrad. The work there is under the direction of Dr. B. G. Turukhano, who heads a group of about 15 people involved in the development of holographic memory, holographic gratings, and color holograms. A prototype holographic memory system has been developed for storing patent data. Each page of a patent is first photographed onto 35 millimeter film, and a Fourier hologram of each film frame is then recorded on a glass disk about 30 centimeters in diameter. The disk can record 10,076 holograms approximately two millimeters in diameter. The exposure system is completely automated and the entire plate can be exposed in about ten hours. Holographic gratings are being used in a high power microscope system to determine the position of precision translation stages. The gratings are crossed to produce a moire fringe pattern which moves across a detector as the translation stage is moved. Fringes are counted to

Continued on Page SR-080

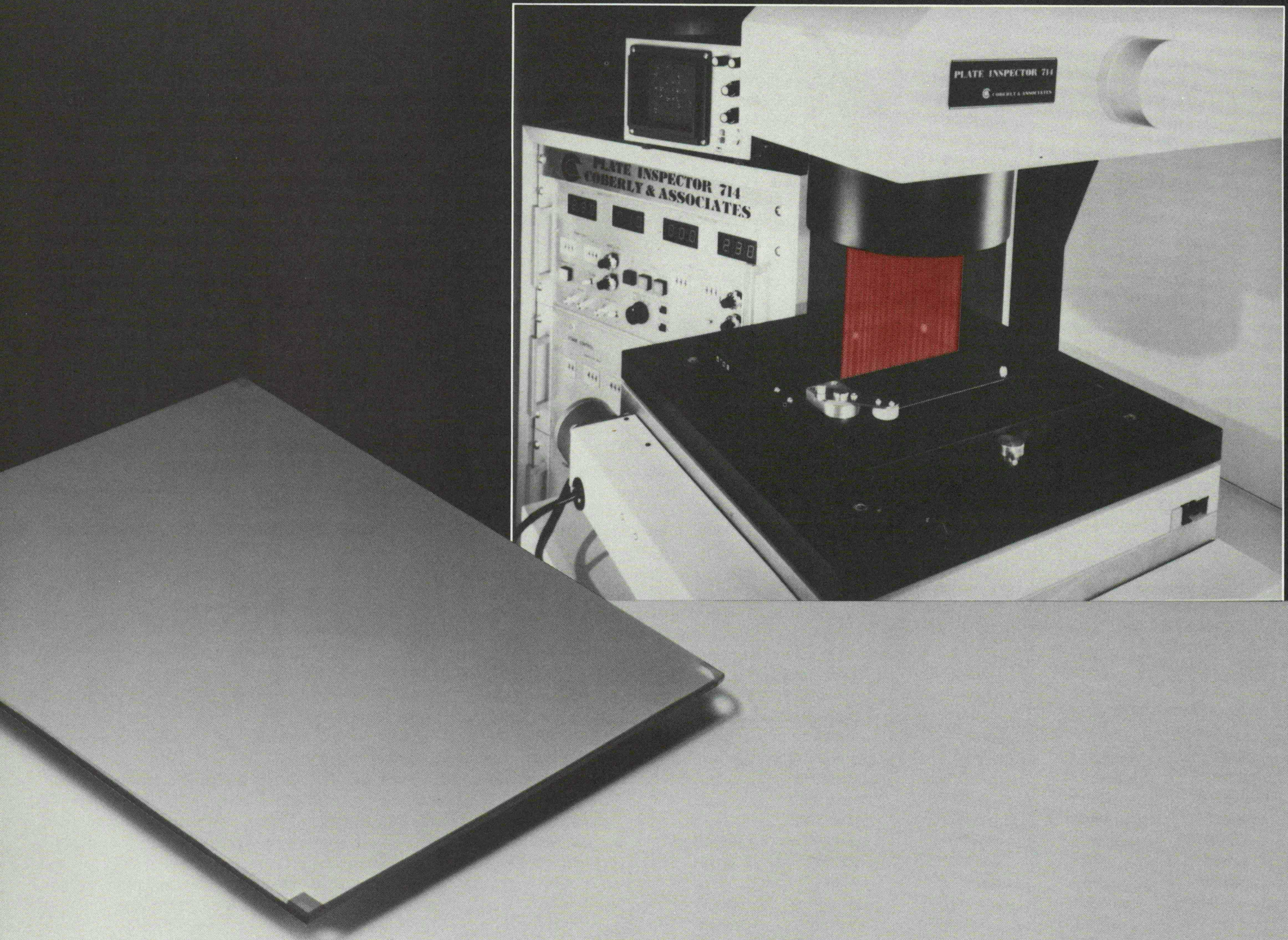


Plate Defect Detection— The Sooner, The Better

Now you can identify photo resist defects and pinholes in chrome plates before they have a chance to multiply. With the PI-714 Plate Inspector, you can identify bad plates before exposures are made, before shipment to customers, or before a plate or mask set is accepted from suppliers.

By uncovering flaws at the mask blank stage, you can dramatically improve overall productivity and reduce the need for costly rework or repair. The PI-714's laser scanning system is also non-destructive; cassette-to-cassette auto-load and sorting mechanisms minimize plate handling. Results are non-operator dependent.

The PI-714 inspects up to forty 5″ x 5″ plates per hour, simultaneously detecting, counting, and displaying the location of micron-sized defects and pinholes. Plate sizes up to 6″ x 6″ are accommodated. Make your mask blank defect detection process objective and automatic. Call (408) 727-1530 for more information . . . the sooner, the better.

COBERLY & ASSOCIATES

3350 Scott Boulevard, Bldg. 47, Santa Clara, California 95051 Telephone: (408) 727-1530

Left to right: Kirill A. Knorre, Professor V. P. Koronkevitch, and Dr. V. K. Malinovsky. Professor Koronkevitch and Dr. Malinovsky are with the Institute of Automation and Electrometry in Novosibirsk. Mr. Knorre is a member of the Foreign Relations Department of the USSR Academy of Sciences in Leningrad.

Continued from Page SR-078

determine the position of the stage. The grating has an accuracy of 0.5 micrometers over a one-meter length, and the setting resolution of the system is 0.25 micrometers. Dr. Turukhano's wife and coworker has produced some very nice color Denisyuk holograms using a multiwavelength pulsed laser and a special film developed at the NIKFI Institute.

NOVOSIBIRSK

Institute of Automation and Electrometry

The Institute of Automation and Electrometry is one of 20 institutes at the Novosibirsk Science Center (Akademgorodok) which is operated by the Siberian Branch of the USSR Academy of Sciences. This branch was founded in 1957 as a part of a program to develop and apply the vast natural resources of Siberia. The Institute of Automation and Electrometry is involved in the study of information and data processing, computers, optical memory, and metrology. One of the principal concerns of the Institute is the transfer of technology to the industrial sector.

A variety of interesting optics and holography research programs are being conducted at the Institute. Professor V. P. Koronkevitch has directed a number of metrology projects. Precise measurements of the gravitational constant have been made using a laser gravimeter which makes use of a stabilized laser interferometer and a falling mirror. Laser kinoforms have been developed for the purpose of correcting aberrations in large telescope optics. Professor Koronkevitch has also worked with Dr. V. S. Sobolev and other researchers for several years in the development of laser anemometry. Dr. V. K. Malinovsky heads a group involved in various studies of optical materials. These studies include Raman scattering in chalcogenide glasses, ellipsometry of photochromic crystals, study of the Weigert effect, and optical memory in thin films. The optical properties of lithium niobate and strontium barium niobate are being studied using both cw and pulsed interferometry and scattering. They have an extensive effort underway in the development of an integrated optics computer using optical memory in thin films of barium sodium niobate.

Dr. P. E. Tverdokhleb and coworkers have conducted an ambitious program to develop a holographic memory system. Dr. Tverdokhleb showed me several prototype systems they have constructed for the archival storage of both image and digital data. A kilobit of information is stored in a Fourier microhologram recorded in an area about 0.5 millimeter square. Multiple microholograms are recorded on a plate about five centimeters square. A computer-controlled playback machine which stores a number of these plates automatically selects the desired plate and displays the holographic image on a television monitor. Tverdokhleb's group has developed all component parts of these holographic storage systems, includng page composers, acousto-optic scanners, and detector arrays. The holographic storage systems currently use the helium-neon laser, but they have plans to replace this laser with a diode laser to reduce the overall size of the package and to increase the lifetime of the system. Tverdokhleb believes there are several advantages to holographic memory storage, including lower cost, longer storage life, and faster access.

SUMMARY

My visit to the Soviet Union was fascinating and altogether enjoyable. I found the people there extremely warm and friendly and most hospitable. It seemed to me everyone made a special effort to entertain me and to make me feel welcome. As a part of my tour, an outstanding social program had been arranged in every city, which allowed ample time for sight-seeing and cultural events. These activities included two operas in Leningrad, a tour of the Hermitage Museum, and a ballet in Moscow.

Our Soviet colleagues have a genuine desire for more communication with Western scientists. They would like us to publish more in their journals, and they are most interested in conducting collaborative projects with Western laboratories. Although the Soviets may lag somewhat in some areas of technology, their basic science is outstanding, and their understanding of theory and principle in many areas is unsurpassed. Perhaps we would do well to cultivate more scientific exchange and improved relations with our Soviet counterparts.

Tricks of the Trade

SIMPLE BEAM INTENSITY CONTROL TECHNIQUE

W. Thomas Cathey
University of Colorado at Denver
Dept. of Electrical &
Computer Engineering
1100 14th Street
Denver, CO 80202

In holography, spatial filtering, and other optical systems, continuous control of beam intensity is desirable. Several expensive devices are available, but if one is willing to sacrifice some laser power, inexpensive polarizers can be used.

Purchase two polarizers designed to screw over a camera lens. Screw one polarizer into the mount of the second. You now have an adjustable attenuator. In use, the downstream polarizer should be fixed to pass the polarized beam. The upstream polarizer is adjusted to give the desired attenuation. The result is a variable attenuator that does not affect the beam polarization. This technique works best if it is placed before any beam expanders and pinhole spatial filters.

Book Reviews

Electromagnetic Scattering and Its Applications

L. P. Bayvel and A. R. Jones, 289 pp., illus., tables, indexes, references. ISBN 0-85334-955-X. Applied Science Publishers Ltd., 22 Rippleside Commercial Estate, Ripple Road, Barking, Essex, IG11 OSA, England (1981) $56.00.

Reviewed by Eric P. Shettle, Atmospheric Optics Branch, AFGL Hanscom AFB, MA 01731.

The stated topic of this book is the scattering of electromagnetic radiation (primarily light), "concentrating on those aspects of importance in laboratory and industrial applications." The emphasis is on recent development in the area. The book is made up of six chapters: Chapters 1 and 2 give a theoretical background of light scattering and radiative transfer; the remaining four chapters discuss the use of light scattering to determine the optical properties of particles, particularly their size distribution, reviewing a number of applications of these techniques.

The 73 page first chapter, entitled "Scattering of Radiation by Particles," is the longest in the book. It reviews the basic theory of the interaction of light with particles, emphasizing the various approximations which are useful for different conditions. Scattering by nonspherical particles is addressed. The second chapter, "Radiative Transfer in Particle Clouds," reviews radiative transfer theory, discussing both radiative transfer in an absorbing media and in the presence of multiple scattering. As with the first chapter, the emphasis seems to be on obtaining usable solutions. Chapter 3 reviews the different theoretical methods used to determine the size distribution of aerosol or hydrosol particles from their scattering of incident radiation. Chapters 4 and 5 discuss different instruments that have been developed, applying these or related methods to the measurements of particle size distributions and other properties such as refractive index. The final chapter discusses a number of different applications of measurements of particle characteristics. In this chapter the emphasis seems to be as much on showing the diversity of fields and applications for which light scattering measurements are utilized as on the details of the measurement technique.

While the discussion primarily emphasizes the measurement of particulate size distributions, the authors only consider the approaches where the light is scattered by a large ensemble of particles. This effectively omits one of the principal classes of techniques for measuring the size distribution of atmospheric aerosols. In these, the scattering volume is small enough that only one particle is illuminated at a time and the size is determined as a function of the intensity of scattered light. These are discussed, for example, by a number of papers in *Aerosol Measurements*, edited by D. A. Lundgren et al., The University Presses of Florida, Gainesville, FL (1979).

The work is extensively referenced with over 300 references, nearly two-thirds of these published during the 1970s. There are approximately eighty references to the Russian literature (the senior author being originally from the USSR).

Overall, I found the book to be quite readable, with few typographical errors, most of these being obvious, such as the use of α instead of θ at the top of p. 183, or the occasional reference to the wrong equation (e.g., p. 66 or 226). There are a few minor points made that are debatable. For example, the authors state that for most practical cases a Legendre polynomial expansion of the angular scattering function can be truncated with the third-order polynomial. For most atmospheric aerosols many more terms are required to adequately represent the angular scattering; for clouds, typically several hundred terms are needed in the Legendre expansion of the phase function. There are a couple of significant algebraic errors in derivations, such as the approximation for m_2 in dielectrics at the top of p. 15.

The specific audience for the book is not indicated, but it is clearly aimed at workers in the area of light scattering and at engineering graduate students. (The authors are in the Department of Chemical Engineering and Technology, University of London.) This book should be of interest to anyone interested in the applications of light scattering to determine the properties of the scatters.

Waves and Photons: An Introduction to Quantum Optics

Edwin Goldin, 211 pp., illus., index, references. ISBN 0-471-08592-8. John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10158 (1982) $25.95.

Reviewed by James M. Florence, University of Texas at Austin, Department of Electrical Engineering, Austin, TX 78712.

As an educator, it is always a pleasure to find a book that presents its subject in a clear, concise, and intuitively satisfying manner for the *student*—a book that does not just dryly present material to be explained by an instructor, but, rather, a book that, by itself, teaches its subject. *Waves and Photons* by Edwin Goldin is just such a book. Designed as an introductory undergraduate test on quantum optics, it serves that purpose extremely well. In addition, this short book provides a compact yet very thorough reference on all of the basics needed to deal with quantized electromagnetic fields at the most advanced levels.

The book is conveniently broken into eight chapters, the first four dealing with waves and the wavelike nature of light, the second four treating light's particlelike aspects. Chapter 1 deals with the simple harmonic oscillator and the analytical description of simple harmonic motion. Here Goldin begins early with a discussion of operators and states as they apply to this classical problem. Chapter 2 introduces the wave concept with the string under tension problem, develops the wave equation, and discusses the traveling wave solutions. Chapter 3 is a mathematical treatment of wave superposition using Fourier series and Fourier integral superposition. Wave packets are introduced and particular attention is paid to the addition of wave energy. The results of the first three chapters are applied in Chap. 4 to describe the wavelike nature of light through the mechanism of Young's experiment. This chapter also has an excellent introductory discussion on correlation and coherence of light waves.

In Chap. 5, we are introduced to Maxwell's equations and electromagnetic waves and then quickly led to the wave-particle conflict with discussions of the blackbody radiation dilemma and the photoelectric effect. The quantized aspects of light are described and the Schrödinger formulation of the quantum problem is presented. The Dirac formulation of the quantum problem and the mathematical tools required to handle and utilize this formulation are presented in Chap. 6. In Chap. 7, the quantized simple harmonic oscillator is treated using Dirac's formulation. The natural states of the oscillator are analyzed with special attention given to the coherent state. Goldin concludes the book in Chap. 8 by applying the results of Chaps. 6 and 7 to the quantized electromagnetic field and analyzing the natural states of this field. The wave-particle paradox is resolved with results that clearly indicate the photon nature of the electromagnetic field and a coherent state that reduces to the classical electromagnetic wave as the number of photons becomes large. Further discussion of correlation and coherence in view of this photon nature of light is also presented.

As can be seen by the chapter synopsis above, the first four chapters are definitely undergraduate material. However, the concise and very intuitive approach in Goldin's presentation can be of benefit for anyone dealing with wavelike phenomena. The second half of the book, although dealing with significantly more advanced material, is still easily read *and* understood by the undergraduate. There is a very good list of problems at the end of each chapter.

This book is an excellent text—well organized, thorough, with a clearly defined purpose and good execution of that purpose. I was particularly impressed with the summaries presented at the end of most sections and chapters. These summaries reviewed the major aspects of the concepts just discussed and clearly stated how those concepts would be used later in the text. The reader is never left in the dark! I highly recommend this book to students and teachers alike.

Graphical and Binary Image Processing and Applications

James C. Stoffel, 583 pp., illus., index, references. ISBN 0-89006-111-4. Artech House, Inc., 610 Washington St., Dedham, MA 02026 (1982) $40.00.

Reviewed by Kendall Preston, Jr., Kensal Consulting, Bldg. 36, 5701 E. Glenn St., Tucson, AZ 85712.

The book *Graphical and Binary Image Processing and Applications* by James C. Stoffel is not a book nor is it on binary image processing. This particular publication is a collection of 43 papers taken from the professional literature on the encoding, transmission, and printing of halftone and graphics material. Insofar as this particular subject area is concerned, it is a helpful reference for those workers active in this field. The literature collected here is divided into nine sections entitled "Electronic Imaging System Fundamentals" (four papers), "Binary Image Models" (three papers), "Binary Image Quality of Metrics" (six papers), "Line Copy Image Thresholding" (three papers), "Pictorial Reproduction" (six papers), "Binary Image Coding" (seven papers), "Binary Image Enhancement" (four papers), "Binary Image Scaling, Thinning and Contour Manipulation" (three papers), and "Applications" (seven papers). Most of the papers are by workers in industry, specifically, Bell Telephone Laboratories, IBM, RCA, and Xerox. Workers in six universities have also contributed, namely, Columbia, MIT, Purdue, University of Illinois, University of Delaware, and University of Southern California. About 10% of the papers are drawn from outside the U.S.A. with one paper from Bell-Northern (Canada), one from NEL (Japan), one from the University of Karlsruhe, one from the Federal Institute of Technology (Zurich, Switzerland), and two from the Polytechnic Institute in Lausanne (Switzerland). The journals from which the papers are drawn are primarily publications of the Institute of Electrical and Electronics Engineers (IEEE Proceedings and several of the IEEE transactions), as well as the Optical Society of America, the Society of Photo-Optical Instrumentation Engineers, the Society of Motion Picture and Television Engineers, and the journals *Computer Graphics and Image Processing* and *Pattern Recognition*. The comprehensiveness of articles from such a wide range of workers and professional publications makes this collection valuable. It is also timely. Forty percent of the collection comes from the interval 1975-1979 and another 40% from 1980 to date.

Particularly valuable is the collection of papers on binary image coding which appears in the section by that name, with others scattered about in other sections. Here, the author (who is employed at Xerox) provides two articles which review various one-dimensional and two-dimensional encoding schemes as well as the data compression ratio feasible as a function of sample spacing. Ting and Prasada, and Netravali and Mounts (all of Bell-Northern) review ordering techniques for facsimile coding and demonstrate results using the CCITT test documents. Sobel (Columbia University) demonstrates applications of 3×3 neighborhood coding; Usubuchi, Omachi, and Ilnuma (NEL) develop an adaptive, predictive coding method and describe their hardware implementation; and Stucki (Zurich) details his polynomial encoding scheme. Knowlton (Bell Labs) describes a hierarchical encoding scheme and also reviews the "blob" coding method of Frank; Kunt and Johnsen (Lausanne) discuss block coding using blocks of various sizes and plot the compression ratios achievable, while Hunter and Robinson (IBM) review the international coding standards with a further description of the evolution of the CCITT test documents. Finally, there is the classic paper of Huang (then at Purdue University) which reviews many coding schemes including WBS (white block skipping) methods (both deterministic and adaptive), runlength coding, and, finally, block coding methods, giving a wealth of examples.

Another valuable section is that on continuous tone and halftone reproduction and printing techniques. This section includes papers primarily drawn from Xerox (Stoffel, Moreland, Roetling, Holladay, etc.), and it includes the design of screens for traditional halftone printing as well as a large variety of digital methods for facsimile-type printers. Stoffel covers methods for dithering, random nucleated halftoning, error diffusion methods, and selective halftone rescreening. Other discussions, in cooperation with Allebach (University of Delaware), cover random texture techniques, partial dotting, and other methods, as well as treating problems of aliasing and moire suppression.

Other sections of the collection are less impressive. The papers on quality metrics are brief and mainly treat legibility. (A far more general treatment of this subject appears in the papers concerning the CCITT test documents mentioned above.) Similarly, sections on image thresholding, image enhancement, image scaling, and thinning all miss the mark. In fact, in the section on thinning no document on this subject appears at all. The author appears unaware of the clever use of thinning and reconstruction for reduced entropy facsimile transmission of text being done at NEL by Usubuchi et al. Also, the section on applications is a potpourri of miscellany, even including a paper on the automated inspection of printed wiring boards. The introduction promises us that the applications section also includes a paper on CAD (computer-aided design), but this paper does not appear. In fact, the entire collection has the feeling of rapid and somewhat haphazard assembly. For example, in the introduction to the section on binary image coding the author tells us that it includes the paper by Netravali and Mounts, which actually shows up in the section on binary image enhancement switched with the paper by Ting and Prasada. Typographical errors abound, even in the table of contents where we find the word "reporduction." Elsewhere, Schreiber's technique of unsharp masking is called "upsharp masking" and Irwin Sobel (of the Sobel Operator) is called "J. Sobel."

In summary, this collection will undoubtedly be a helpful alternative to a library search of the literature on halftone and graphics coding, transmission, and printing. For the newcomer (either expert or neophyte) to this field it provides a useful and comprehensive starting point. For this reason alone it is worth the price to such an individual. For the worker interested in image processing it will serve as a disappointment as the papers in this subject area simply are not included. For such information the reader is referred to compendia published by the IEEE, e.g., "Machine Recognition of Patterns," and the contents of such journals as *Computer Graphics and Image Processing*. Finally, this reviewer must voice disappointment at the complete exclusion of material on color graphics and on the digital reproduction of color material. Certainly material should have been included on the color runlength coding work of Kamae et al. (NTT Japan) and of Frei (Zurich and University of Southern California). Hopefully, such work will be included in future collections forthcoming from Artech House.

Electromagnetic Surface Modes

A. D. Boardman, ed., 776 pp., illus., index, references. ISBN 0471-10077-3. John Wiley & Sons, New York (1982) $83.00.

Reviewed by S. Ushioda, Dept. of Physics, University of California, Irvine, CA 92717.

Electromagnetic surface modes are the normal modes of propagation of electromagnetic waves along surfaces and interfaces, also called "surface polaritons." Although the existence of these modes at boundaries separating two dielectric media or dielectric and metallic media has been known for quite a long time, both experimental and theoretical interests in these modes have increased dramatically in the past decade, due partially to potential applications to integrated optics and related technologies. This book, edited by A. D. Boardman, consists of 18 chapters contributed by leading researchers of surface electromagnetic modes. The purpose of the book is "to bring to the reader's attention a wide cross section of activity on electromagnetic surface modes," according to the editor's preface. A quick scan of the 18 chapter titles certainly indicates inclusion of a wide cross section of subjects related to surface electromagnetic modes.

Several chapters are devoted to the description of surface electromagnetic modes coupled to plasmons (surface plasmon-polaritons) in solids and gas discharge plasmas. Also included are chapters on surface phonon-polaritons, magneto-plasmons, and magnon-polaritons. Surface exciton-polaritons are also discussed in chapters dealing with the general properties of surface electromagnetic modes. In terms of surface geometries, different chapters cover surface electromagnetic modes at plane, cylindrical, and spherical surfaces as well as the surface modes of small metallic particles. Most of the chapters are theory oriented, and experimental aspects of the study of surface polaritons are only treated in five of the 18 chapters. Since the number of probes that are suitable for investigating surface electromagnetic modes is limited, the lack of emphasis on experimental methods is understandable. However, this book would have been better balanced if more experimental aspects of surface polariton studies were included. One outstanding omission is a mention of investigations using electron scattering by surface modes. On the theoretical side, inclusion of discussions on the effects of surface roughness would have added another dimension to this book. In any case, the book succeeds very well in presenting a wide variety of subjects of current interest in the field.

The chapters are organized in a reasonably logical order, moving from general discussions to more specific subject areas. However, there are many repetitions of general statements about the nature of electromagnetic surface modes in the introductory sections of each chapter. It seems that all of these introductory remarks could have been collected in the first chapter to give a perspective of the common theme of the whole book, and thus avoid repetitions of similar introductory material from chapter to chapter.

It is worthwhile to note that a very similar book to the present one was edited recently by V. M. Agranovich and D. L. Mills, *Surface Polaritons,* (North-Holland, Amsterdam, 1982). Some of the contributors are represented in both of these recent books, and in many ways these books complement each other.

In summary, this is a good book to learn about the most current areas of research interests in the field of electromagnetic surface modes. It should be useful not only to the researchers already involved in the field but also to students who wish to enter the field. Since the subject matter is basic to applications in integrated optics, the engineering community should find this book very useful.

Elements of Optical Coherence Theory

Arvind S. Marathay (Joseph W. Goodman, Ed.), 316 pp., illus., index, references. ISBN 0-471-56789-2. John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10158 (1982) $39.95.

Reviewed by George B. Parrent, Jr., Industrial Vision Systems Inc., 10 Lakeside Office Park, Wakefield, MA 01880.

This book, some three hundred pages long, is intended as a textbook and contains an extensive bibliography and an adequate subject and author index which will make it a handy reference book as well. The list of symbols and notations at the front of the book further enhances this aspect of the work.

The material is logically presented in a manner that builds the appropriate mathematical foundations before they are required. Still, the student using this book should be comfortable with linear systems analysis and formal mathematical treatments.

The approach is highly formal, as is usually the case in discourses on the theory of partial coherence. It is unfortunate that Marathay also fell into this trap since, by now, numerous examples of the effects of partial coherence can be found and easily illustrated. Lack of illustrations is perhaps the only serious criticism of the book. The only photographic illustrations are drawn from the late 1950s and early 1960s. More photographs illustrating such things as imaging nonlinearities and speckle considerations would have aided the physical understanding of phenomena discussed.

In summary, the book is a sound, readable, mathematical treatment of coherence theory suitable as a text in a course for which the instructor provides physical illustrations and interpretive additions. As a stand-alone reference on coherence theory, it deserves a place in every serious optical theory collection.

Books Received

Technology Assessment of Optical Methods for Nondestructive Evaluation, Parts I and II, H. S. Silvus, Jr., spiral bound monograph, published by NTIAC, Southwest Research Institute, 6220 Culebra Road, San Antonio, TX 78284, $35/volume. Volume I explores nondestructive evaluation applications of (1) moire fringe methods, (2) Fourier transform methods, (3) speckle interference methods, and (4) optical metrology. Volume II supplements the first volume and covers a range of additional topics related to optics for nondestructive evaluation.

Transfer Theory for Trapped Electromagnetic Energy, revised edition, George Lucas, 74 pp., paperback, John Wiley & Sons, Inc. (1982) $16.95. The transfer theory presented is based on the hypothesis put forward by the author in 1970, postulating lifetime lengthening of a free particle if generated within a grid-isolated and intensity-irradiated gaseous phase.

Short Courses

Laser Institute of America short courses

Laser Safety: Hazard, Inspection & Control, Washington, D.C., June 6–10, 1983. Provides up-to-date information on federal, state, and international laser safety regulations. **Fundamentals and Applications of Lasers, Washington, D.C., June 6–10, 1983.** Practical course explaining fundamental operating principles of lasers and their employment in several applications. **Fundamentals of Conventional & Laser Spectroscopy, Albuquerque, NM, June 13–17, 1983.** Explains principles of conventional spectroscopy and leads to an understanding of more complex laser techniques. Includes atomic and molecular spectroscopies, light sources, laser fundamentals, spectroscopic and electronic instrumentation, laboratory, and laser spectroscopy. Provides hands-on experience in laboratory. All courses are $700. Contact Education Director, Laser Institute of America, 5151 Monroe St., Ste. 103W, Toledo OH 43623. 419/882-8706.

Engineering Technology, Inc. short courses

Electronic Devices and Systems, Las Vegas, NV, June 6–10, 1983. Use of Industrial Lasers in Dynamic Hole Drilling, Cutting, Marking, and Scribing Applications, Sunnyvale, CA, June 8–10, 1983. Cost: $475. Two Continuing Education Units (CEUs). Designed specifically for product managers, production engineers, physicists, design engineers, laser system operators whose duties involve or anticipate involvement in use of industrial laser systems in specific materials processing applications where material is vaporized or otherwise removed from workpiece. Includes problem-solving workshops and evening operational clinic in local laser development and production facility, where corporate product engineers will demon-

Invitation to apply for the 1984 John Eggert Prize for image science

The John Eggert Prize was instituted by John Eggert, late head of the Department of Photography, Swiss Federal Institute of Technology (ETH-Z), and will be offered for the sixth time in 1984. Young scientists are encouraged to submit papers from the field of imaging science. Imaging science is meant to embrace a wide field, comprising optics, photography with and without silver halides, digital and electronic methods of image recording, analysis and processing as well as the physiology and psychology of vision. Personal applications as well as proposals by others will be taken into consideration. Applications with complete literature references in duplicate with copies of most important reprints should reach Prof. Dr. W. F. Berg, a member of the Foundation Council, at Hellstr. 7, CH-8127 Forch, Switzerland, no later than October 15, 1983. The prize for 1984 consists of a sum of SFr. 7500.00 and a certificate. The recipient will be asked to present his work as a lecture at a colloquium of the Institute of Communications Technology of the ETH-Z.