INTERNATIONAL
LENS DESIGN
CONFERENCE

A digest of technical papers presented at the

The 1985 International Lens Design
Conference is dedicated to William H.
Price, our friend and colleague.

Cosponsored by:

SPIE—The International Society for
Optical Engineering

and

Optical Society of America

In Cooperation with

International Commission for Optics
MONDAY, JUNE 10, 1985

GLOUCESTER ROOM

8:15 AM OPENING REMARKS
Robert Fischer, Hughes Aircraft Company, General Chair

GLOUCESTER ROOM

METHODOLOGY AND FUTURE TRENDS IN COMPUTERIZED LENS DESIGN
R. R. Shannon, University of Arizona, Presider

8:30 AM INVITED PAPER
MA1 Human Dimension of Optical Design Software, Bruce Irving, Optical Research Associates. The user interface for optical design software is explored. Interactive methods, menus, and the use of graphics have evolved. Friendlier future systems may use interactive graphics and artificial intelligence techniques.

9:00 AM INVITED PAPER
MA2 Attempt to Develop an Intelligent Lens Design Program, V. K. Viswanathan, I. O. Bohachevsky, T. P. Cotter, Los Alamos National Laboratory. We are developing a lens design program intended to operate without user intervention, and to improve its quality with repeated usage. Methodology and current status are discussed.

9:30 AM INVITED PAPER
MA3 Analytical Lens Design by a Microcomputer with Artificial Intelligence, Rong-Seng Chang, Chung Shan Institute of Science and Technology, Taiwan, China. We discuss an artificial intelligence optical design program and its techniques, including solving problems in analytic and symbolic form, interactive communication with a microcomputer by natural language, high-speed analog data scanning, and graphic tablet operation.

10:00 AM
MA4 Aberration Theory and the Meaning of Life, David Shafer, David Shafer Optical Design, Inc. The meaning of life will not be revealed, but a related question: why are there higher order aberrations? will be addressed through the triplet and Double-Gauss designs.

10:15 AM
MA5 TRAZ: an Optical Design Computer Program Integrated with a Solid Modeling Computer Aided Design (CAD) System, Ariel Dolan, Electro-Optics Industries, Ltd., Israel. We present an interactive, true 3-D, optical ray tracing program integrated within a solid modeling CAD software, featuring many advantages for optical system analysis and evaluation.

10:30 AM–11:00 AM COFFEE BREAK
Refreshments will be served in the Cumberland Room

GLOUCESTER ROOM

OPTIMIZATION AND DESIGN TECHNIQUES

11:00 AM
MB1 Introduction of Antireflection Coating Parameters in the Lens Design Phase, C. Koshizky, K. Rabinovitch, Electro-Optics Industries, Ltd., Israel. The influence of residual secondary reflections on the performance of optical systems is presented and discussed. Precise antireflection coating requirements are derived, and the effect on the image quality is shown.

11:15 AM
MB2 Improvement of the Automatic Lens Design Program Using Simultaneous Linear Inequalities, Takashi Kurihara, Kimiaki Yamamoto, Olympus Optical Co., Ltd., Japan. A new lens design program improving the Suzuki-Yonezawa method using simultaneous linear inequalities is presented and some properties of the program are demonstrated.

11:30 AM
MB3 Merit Function Construction for which the Global Minimum may be Found, Steven C. Johnston, U. Arizona. A merit function construction is described which may, by a series of optimization runs over successively more complex functions, achieve the global minimum.

11:45 AM
MB4 Nearly Ideal Lens Optimization Procedure, Berlyn Brixner, Los Alamos National Laboratory. Lens optimization leading directly toward diffraction-limited performance minimizes image-spot size and position errors, accompanied by Seidel and higher-order aberration minimizing and balancing.

12:00 M–1:30 PM LUNCH BREAK
ABERRATION THEORY
R. V. Shack, University of Arizona, Presider

1:30 PM  INVITED PAPER
MC1  Selection of Optical Glasses, Paul N. Robb, Lockheed Palo Alto Research Laboratories. A new method of selecting glass combinations for correcting chromatic aberration at up to five wavelengths using combinations of two or three materials is described.

2:00 PM

2:15 PM
MC3  Polarization Aberrations of Lenses, Russell Chipman, U. Arizona. An aberration theory has been developed to characterize the variation of polarization in the exit pupil of lenses for on-axis objects.

2:30 PM
MC4  Principles of Aberration-Corrected Optical Systems, Richard G. Bingham, Royal Greenwich Observatory, U.K.; Michael J. Kidger, Kidger Optics, U.K. We attempt to document useful principles for controlling aberrations. This leads to general approaches for assembling new systems. We give examples from our own work.

2:45 PM
MC5  Target Values of the Third-Order Aberration Coefficients Settled by a New Method, F. Kondoh, Tokyo Optical Company, Ltd., Japan. Spherical transversal aberrations at best focus are essential to determine the third-order aberration coefficients of coma and astigmatism. We discuss this, as well as distortion.

3:00 PM-3:30 PM  COFFEE BREAK
Refreshments will be served in the Cumberland Room

OPTICAL DESIGN USING ASPHERIC AND ASYMMETRIC SURFACES
D. R. Shafer, David Shafer Optical Design, Presider

3:30 PM
MD1  Aberration Characteristics of Nonsymmetric Systems, John W. Figoski, Perkin-Elmer Corporation. The aberrations characteristics of nonsymmetric systems can be understood in the context of centered system aberrations. Design and analysis tools are presented which provide important insight.

3:45 PM
MD2  Effective Use of Aspheres in Lens Design, Michael E. Harrigan, Xerox Corporation. Some techniques for improved optimization results with aspheres are presented along with a comparison of results. New types of aspheres are also suggested.

4:00 PM
MD3  Spline Surfaces as Means for Optical Design, G. M. Flürter, Carl Zeiss, F. R. Germany. A progressive power lens is designed by the aid of spline surfaces and an automatic optimization program. Methods and results are compared with conventional designs.

4:15 PM
MD4  Aberration Field Properties of Simple Nonaxially Symmetric Optical Systems, Tatiana E. Jewell, AT&T Bell Laboratories; Roland V. Shack, U. Arizona. A new approach describing the third-order aberration fields of simple tilted and decentered optical systems (plane-parallel plate, wedge, mirror, including aspherics, and thin lens) is presented.

4:30 PM
MD5  Testing an Unusual Optical Surface, Berge Tatian, Itek Optical Systems Division. A procedure for optically testing a general reflecting surface with a single plane of symmetry is described.
CUMBERLAND ROOM

4:45 PM-6:30 PM POSTER SESSION
Refreshments will be served during the Poster Session

ME1 Optical Design on a Macintosh, Donald C. O’Shea, Georgia Institute of Technology. An optical design program for the Apple Macintosh microcomputer is described. The program features ease of data entry and graphic display of results.

ME2 Optical Design of a Camera Lens System for Echelle Spectroscopy, James K. McCarthy, California Institute of Technology. A camera lens system for echelle spectroscopy using a CCD detector has been designed and yields 20 µm diameter images over the 320-700 nm wavelength range.


ME4 Design of a Wide-Angle All-Reflective Triplet for an Orbiting Push-Broom Linear Array Scanner, Peter O. Minott, NASA Goddard Space Flight Center. The final design of an orbiting push-broom scanner objective for spaceborne land mapping is presented. The features of a special design program used in its development are described. Tradeoffs and alternate design concepts are discussed.

ME5 Design of a High Resolution Catadioptric Camera, D. V. B. Rao, M. Venkata Ravi, P. Chakraborty, ISRO Satellite Centre, India. The design of an f/3.5-catadioptric camera with an EFL of 900 mm and field of view of ±2° for the 0.45-0.9 µm spectral range is presented.

ME6 Family of a Three-Mirror Telescope, Yue-Guang Kuang, Changchun Institute of Optics & Fine Mechanics, China. The formula group of third-order aberrations and the segmented primary telescope mirror. Correction at a segmented quaternary mirror allows looser tolerances on segments in tilt, decenter, and piston error than with a stiff primary. The family of the three-mirror telescope was found.

ME7 Computer Lens Design Program, S. G. Shiue, Jun wen Chen, Chung-Shan Institute of Science and Technology, Taiwan, China. An interactive computer lens design program has been developed. It has capabilities for editing lens data, optimizing zoom lens, evaluating image qualities, etc.

ME8 Impact of the Next Generation of Microprocessors on Lens Design, Gregory K. Hearn, Sciopt Enterprises. Full 32-bit microprocessors could significantly change lens design techniques. This paper examines the impact of the expected 32-bit hardware and software developments on lens design.

ME9 Aberration Losses in Coupling of Graded-Index Fibers Using Spherical Reflector Imaging, Fred C. Unterleitner, Kaptron Inc. Coupling losses due to imaging aberration for spherical reflector imaging between two graded-index fibers have been computed as a function of the basic device parameters.

ME10 Developments in Optical Design Software for Personal Computers, Michael J. Kidger, Geoffrey P. Adams, Kidger Optics, Ltd., U.K. We describe recent developments in optical design software, with reference to advances in personal computer hardware and to current trends in optical design.

ME11 Exit Pupil Correction of Large Segmented Primaries, John E. Stacy, Aden B. Meinel, Jet Propulsion Laboratory. Exit pupil correction is considered for a large segmented primary telescope mirror. Correction at a segmented quaternary mirror allows looser tolerances on segments in tilt, decenter, and piston error than with a stiff primary.

ME12 Automatic Lens Optimization: Recent Improvements, Donald C. Dilworth, Optical Systems Design, Inc. Several refinements to the PSD optimization algorithm have yielded improved convergence and enhanced ability to cope with unusual nonlinearities encountered in the course of optimization.

ME13 GAL-1: a Friendly and Considerate Lens Design Program, C. Koshizky, Electro-Optics Industries, Ltd., Israel. A lens design program for the VAX/VMS is presented, where comprehensive evaluation, optimization, and extremely friendly features are put together. Emphasis is on interactivity, flexible I/O, and graphics.

ME14 Recent Trends of Plastic Aspherical Lens in Japan, and an Aspherical Lens Design by Spherical Geometry, Shunji Uchio, Rays & Energies Application Laboratories Co., Ltd., Japan. Demand for plastic lenses has greatly increased. We discuss an aspherical lens design created by spherical geometry.

ME15 Use of a Multiimage Plane Merit Function for Automatic Lens Design, Chungte W. Chen, Perkin-Elmer Corporation. A multiimage plane merit function is used for improved aberration control and depth of focus for automatic lens design. Examples are shown.
MONDAY, JUNE 10, 1985—Continued

ME16 Irregular Surface Simulation Using Spline Fitting, John Bolton, NASA Goddard Space Flight Center. Optical surface deformations are spline fitted using several algorithms including that from the ACCOS V optical analysis program. The effects of spline fit errors are investigated.

ME17 Polarization Raytracing of Antirefection Coated Lenses, Russell Chipman, U. Arizona. The effect of several example antirefection coated lenses on polarized light is calculated and compared with similar results for uncoated lenses.

ME18 Paper Withdrawn

ME19 The Design of Apochromatic Optical Systems, R. I. Mercado, Lockheed Palo Alto Research Laboratory. Criteria for color correction derived from the dispersion formulas of Hartmann, Cauchy, Schmidt, Conrady, and Buchdahl will be discussed, and their application to the design of apochromatic optical system will be presented.

ME20 Lens Systems Incorporating a Zero Power Corrector—New Four-Element Microscope Objectives with Flat Field or High Powers, H. W. Klee, M. W. McDowell, CSIR-NPRL, South Africa. Several four-element micro-objectives using a quasi zero power corrector are described. Included are a flat field, 10x (0.25 NA) design and a 40x (0.63 NA) design.

TUESDAY, JUNE 11, 1985

GLOUCESTER ROOM

NOVEL OR UNIQUE OPTICAL DESIGNS
P. J. Rogers, Pilkington PE, Ltd., United Kingdom, Presider

8:30 AM
TuA1 Use of a Cartesian Oval-Fiber Optic Lens as a Linear to Angular Position Converter, M. W. McDowell, H. W. Klee, CSIR-NPRL, South Africa. A coherent fiber-optic Cartesian oval lens is described which is used to convert linear positional to angular information, thereby increasing the look angle of a small quadrant detector.

8:45 AM
TuA2 Aplanatic Two-Mirror Compact Collimator, I-Fu Shih, Lee Mickelson, David B. Chang, Hughes Aircraft Company. Design, fabrication, and test results of a compact collimator that was diamond-turned with two mirrors on a single piece of material are presented.

9:00 AM
TuA3 Focus Lens Design for X-Ray Experiments on the Nova Laser, Lynn G. Seppala, Lawrence Livermore National Laboratory. The Nova and Novette final focusing lenses, with added cylinder elements, produce line foci for irradiating x-ray laser targets. Design, implementation, and results are discussed.

9:15 AM
TuA4 Imaging Beam Daylight Heliostat Device for Use in Task Lighting of Building Interiors, Timothy J. Maloney, One Design, Inc. A schematic design for a low cost heliostat has been developed for use in beam daylighting applications where imaging is required. Three refrigerant-filled canisters are distributed equally around the circumference of a lens housing and act as differentially heated boilers whose weight changes as a function of the amount of sunlight falling on the surface of the individual boilers.

9:30 AM

9:45 AM
TuA6 Focal Reducers for Large Telescopes, Malcolm J. MacFarlane, Perkin-Elmer Corporation. A number of focal reducer concepts have been investigated in an effort to replace the prime focus of astronomical telescopes with an auxiliary Cassegrain instrument of equivalent performance.

10:00 AM—10:30 AM COFFEE BREAK
Refreshments will be served in the Exhibit Hall—Marlton Room
LENS DESIGN FOR OPTICAL DATA STORAGE SYSTEMS
A. Taira, Olympus Optical Company, Japan, Presider

10:30 AM INVITED PAPER
TuB1 Lens Design for Optical Disk Systems, Shigeo Kubota, Sony Corporation. Strict aplanatism is required in optical disk systems. Biaspheric design yields superior single aplanatic lenses and can be optimized to tolerate decentering.

11:00 AM
TuB2 Precision Molded Aspheric Lenses for a Camera and for a Compact Disc, Tetsuro Izumitani, Shinichiro Hirota, Isao Ishibai, Hoya Corporation, Japan. Aspheric lenses were molded for conventional optical glasses. An aspheric surface with 0.4-μm figure error and 0.04-μm accuracy error was obtained.

11:15 AM
TuB3 Optical Performance of Aspheric Singlets for Compact Disc Use, Tadashi Kojima, Norikazu Arai, Konishiroku Photo Ind. Company, Ltd., Japan. Optical performance of aspheric singlets for the Compact Disc has been studied. Biaspheric plastic singlets showed optimum performance, maintaining enough back focal length and image field.

11:30 AM
TuB4 Aberration Analysis in Optical Disk Systems, Shigeo Kubota, Sony Corporation, Japan. Aberration theory is successfully used in designing an aspheric objective lens, simulating the read-out signal and calculating tolerances in optical disk systems. Some useful results are presented.

11:45 AM
TuB5 Design of an Aplanatic GRIN Singlet for the Compact Disc System, H. Nishi, M. Toyama, Nippon Sheet Glass Co., Ltd., Japan. A radial gradient-index aplanatic singlet pickup objective lens for the Compact Disc system has been designed. The first lens surface is spherical, the second is flat. Diffraction-limited performance is obtained.

LENS DESIGN FOR OPTICAL COMMUNICATION APPLICATIONS I
W. J. Tomlinson, Bell Communication Research, Inc., Presider

1:30 PM INVITED PAPER
TuC1 Optomechanical Considerations for Laser-Fiber Coupling and Packaging, J. Lipson, R. T. Ku, AT&T Bell Laboratories. The requirements for simplicity, high optical coupling efficiency, and reliability are particularly difficult to reconcile in semiconductor laser packages. Some typical compromises are discussed.

2:00 PM INVITED PAPER
TuC2 Lens Design in a Two-Dimensional World with a Maximum Δ of −1%, D. Mergerian, Westinghouse Electric Corporation. The history of integrated optical waveguide lenses is reviewed from early efforts to induce index changes in waveguides to today's geodesic and grating lenses.

2:30 PM INVITED PAPER
TuC3 Photoelectrochemically Formed Microoptic Elements, Randolph H. Burton, Frederick W. Ostermayer, Jr., AT&T Bell Laboratories. A photoinduced electrochemical etching process is utilized to fabricate microoptic elements on III–V semiconductor materials. By controlling the light intensity profile at the wafer surface, arbitrary profiles can be obtained. The theory and limitations of the process and results for fabricating lenses and gratings or lightwave components are discussed.

3:00 PM–3:30 PM COFFEE BREAK
Refreshments will be served in the Exhibit Hall—Marlton Room

12:00 M–1:30 PM LUNCH BREAK
LENS DESIGN FOR OPTICAL COMMUNICATION
APPLICATIONS II
M. A. Holzman, Holzman Technology Corporation, Presider

3:30 PM
TuD1 Highly Integrated Distributed-Index Planar Microlens and Its Characteristics, M. Oikawa, K. Tanaka, T. Yamasaki, Nippon Sheet Glass Co., Ltd., Japan. A 2-D arrayed planar microlens with 180-μm diameter was monolithically integrated by the ion-exchange technique. The focal length of the lens was 0.45 mm and the N.A. was as large as 0.23.

3:45 PM
TuD2 Design of Geodesic Lenses in Anisotropic Media, J. Bradley, T. Van Eck, E. Malarkey, H. Hahn, D. Flechsig, Westinghouse Electric Corporation. Geodesic lenses were designed in anisotropic media using 2-D ray optics. Tolerances in lens shape and refractive index are reported.

4:00 PM
TuD3 Application of Gradient-Index Lens Design Techniques to Lenses for Integrated Optics, C. Benjamin Wooley, Duncan T. Moore, U. Rochester. The utilization of a material index and a variation of waveguide thickness to create two-dimensional waveguide lenses is described.

4:15 PM
ThD4 Three-Dimensional Ray Tracing: Spherical Reflector Coupler, Carlton M. Truesdale, Corning Glass Works. The insertion loss derived from varying lens geometry and fiber position for a spherical reflector coupler is determined by using 3-D geometrical ray tracing solutions.

4:30 PM
TuD5 Optical Design for Laser-Diode-Based Communication Systems Utilizing Heterodyne Detection, Michael F. Richardson, MIT Lincoln Laboratory. Optics for laser-diode-based communication systems must be designed with the laser source in mind. Heterodyne detection is possible if the optical design allows efficient mode matching between signal and local oscillator field.

4:45 PM–5:30 PM REFRESHMENT BREAK
Refreshments (wine, beer, coffee, and sodas) will be served in the Exhibit Hall—Marlton Room

5:30 PM–7:30 PM DINNER BREAK

TUESDAY, JUNE 11, 1985—Continued
NEW DEVELOPMENTS IN CONVENTIONAL OPTICS I
J. R. Rogers, University of Rochester, Presider

8:30 AM INVITED PAPER
WA1 Biocular Magnifiers: a Review, Philip J. Rogers, Pilkington PE, Ltd., U.K. Published biocular magnifier designs are reviewed. Optimization methods and permissible residual aberration levels are proposed. Recent ideas and future areas of investigation are mentioned.

9:00 AM INVITED PAPER
WA2 Compact Zoom Lens Design Using Aspherical Surfaces, Sadatoshi Takahashi, Akira Tajima, Setsuo Minami, Canon, Inc., Japan. An equation relating the movement of the compensating block to that of others in a zoom lens system is given. From this equation, paraxial constants and lens shapes are obtained to design the zoom lens system.

9:30 AM
WA3 Analysis of Novel Range Extender for Zoom Lenses by Means of Gaussian Brackets, Kazuo Tanaka, Canon, Inc., Japan. As an application of Gaussian brackets, this paper proposes and analyzes a new configuration of a range extender for zoom lenses together with a designed embodiment.

9:45 AM
WA4 Design of Large Ratio Wide Angle to Telephoto Zoom Lenses for 35-mm Photography, M. H. Kreitzer, J. Moskovich, Opcon Associates, Inc. Wide angle to telephoto zoom lenses having zoom ratios of up to 7.5:1 have been designed and successfully developed for 35-mm photography.

10:00 AM
WA5 New Wide Angle TV Projection Lens Having Aspherical Surfaces, Ellis Betensky, Opcon Associates, Inc. A new TV projection lens having aspherical surfaces has been designed and manufactured to cover a semiangular field in excess of 35° with a relative aperture of f/1.0.

10:15 AM–10:45 AM COFFEE BREAK
Refreshments will be served in the Exhibit Hall—Marlton Room

NEW DEVELOPMENTS IN CONVENTIONAL OPTICS II
E. Betensky, Opcon Associates, Inc., Presider

10:45 AM
WB1 Wide Angle Lenses for Projection TV, J. A. Clarke, Philips Research Laboratories, U.K. Projection TV cabinets are bulky. Increasing the projection angle from ±25° to ±40° significantly reduces the cabinet size but introduces severe requirements on the lens design.

11:00 AM
WB2 Recent Trends in the Design of Microscope Objectives, Hiroshi Takenaka, Nippon Kogaku, Japan. We describe improvements in the design of microscope objectives such as planapochromats and planachromats, including lateral chromatic aberration correction, working distance, and glass dispersion.

11:15 AM
WB3 Projection Lenses for a C-Size Light-Valve Display, George W. Hopkins, Hewlett-Packard Company. We studied two types of projector for a LCD breadboard and designed and used an on-axis f/4 lens.

11:30 AM
WB4 Principles of Lens System Incorporating a Zero Power Corrector, H. W. Klee, M. W. McDowell, CSIR-NPRL, South Africa. A novel lens configuration using a zero power corrector element is described. Examples are given of lenses of moderate field with apertures of f/0.6 to f/1.6.

11:45 AM
WB5 Lens Systems Incorporating a Zero Power Corrector—Objectives and Magnifiers for Night Vision Applications, M. W. McDowell, H. W. Klee, CSIR-NPRL, South Africa. Examples are given of wide field objectives (f/1.2) and magnifiers using a zero power corrector element. A novel dual purpose (objective/magnifier) design is also described.

12:00 M
WB6 Current Trends of Precise Plastic Optics in Japan, Motoaki Kawazu, Ricoh Company, Ltd., Japan. Recently, we have seen many applications that demonstrate the advantages of plastic over glass. Current trends in plastic optics, excluding camera lenses, are described.

12:15 PM–1:30 PM LUNCH BREAK
The 1985 David Richardson Medal will be presented to Norman J. Brown. The 1985 Joseph Fraunhofer Award will be presented to Peter K. Runge.

Beyond Optical Design: Interaction Between the Lens Designer and the Real World, Kevin P. Thompson, Perkin-Elmer Corporation. Techniques are explored for enhancing the communication link between the optical designer and the engineering groups involved in the design and implementation of high performance optical hardware.

Testing Methods for Modern Refractive Lenses, Robert E. Hopkins, Optizon. Monochromatic laser sources eliminate the need for chromatic correction. Lenses with remarkable performance can now be built but it requires new approaches to fabrication and testing. Some of these methods are described.

The lens manufacturer's and lens designer's activities should be closely coupled throughout the entire design, fabrication, and testing cycle. The designer must choose materials on the basis of favorable optical, physical, and chemical characteristics for ease of manufacture. Cost and availability are important factors. The manufacturer should “hold the designer’s hand” to help avoid critical shape factors and difficult configurations. Finally, lens performance requirements should be stated in terms of the manufacturer’s test methods and when called upon the designer must be prepared to answer special questions.

SCANNERS FOR VISUAL/IR SYSTEMS

Lens Design Considerations for a New Type of Optical Scanner, William H. Taylor, Kollmorgen Corporation. A compact wide-field reflective image-plane scanner for serial scan thermal imaging is described. Aberrations limiting the useful extent of the instantaneous field of view and a thermal baffling concept are discussed.

A tutorial is given on the development of spinning polygon laser scanners. A new approach is introduced, eliminating both wobble and bow without cylinder optics.

The concept of an afocal IR scanner is presented, showing how two distinct fields of view are obtained simultaneously, with emphasis on the imaging optics.

An optimization technique to reduce narcissus in FLIRs was developed to guide the designer toward low narcissus designs. Application to a FLIR design is shown.

This paper develops and illustrates the geometrical relationships characterizing the behavior of polygonal scan wheels in scanning optical systems.

Dinner will be served outside on the Hyatt premises—weather permitting.
THURSDAY, JUNE 13, 1985

GLOUCESTER ROOM

DESIGN AND TESTING CONSIDERATIONS FOR SPECIAL PURPOSE SYSTEMS
R. E. Hopkins, Optizon, Presider

8:30 AM  INVITED PAPER
ThA1  State of the Technology in Stray Light Analysis,
Robert P. Breault, Breault Research Organization, Inc.
Stray light can be the limiting performance factor of an optical system. Information, theory, and tools are now available to perform accurate stray light analyses.

9:00 AM  ThA2  Optics for an Improved Infrared Meteorological Satellite,
D. Oinen, R. Kent, G. T. Keene, K. E. Leibold, S. L. Shaffer, Eastman Kodak Company. An optical design satisfying the requirements for an operational meteorological satellite system is presented, and the requirements which most influenced the design are described.

9:15 AM  ThA3  A 3-D Camera-Projection System, Milton Laikin, Laikin Optical Corporation. A 3-D camera-projector system has been developed utilizing a relay system with a novel prism arrangement. A wide variety of standard front objective lenses may be used.

9:30 AM  ThA4  Design of Orthoprojector Optics, Hannfried Zügge, Carl Zeiss, F. R. Germany. A high-performance unit providing large range zoom, uniform illumination, image rotation, optical scanning, and high boresight stability is presented.

9:45 AM-10:15 AM  COFFEE BREAK
Refreshments will be served in the Exhibit Hall—Marlton Room

HOLOGRAPHIC DESIGN AND DESIGN TECHNOLOGY APPLIED TO RELATED FIELDS
Thomas I. Harris, Optical Research Associates, Presider

10:15 AM  INVITED PAPER
ThB1  Design of Electron Optics for Electron Beam Lithography,
Eric Munro, Imperial College of Science and Technology, U.K. This paper describes the principles of electron beam lithography, and the computer-aided design and optimization of electron optical systems for this application.

10:45 AM  INVITED PAPER
ThB2  Optical Design of Holographic Optical Element HOE Construction Optics,
Michael J. Hayford, Optical Research Associates. Various design concepts for exposure of transmission and reflection HOEs are described. A method for modelling these systems on optical design programs is discussed.

11:15 AM  INVITED PAPER
ThB3  Nonimage Forming Optical System Design, M. Ruda, Talandic Research Corporation.

11:45 AM  ThB4  Achromatic Doublet Made of Refractive and Holographic Elements, Oden Arnon, Abraham Reichert, Electro-Optics Industries, Ltd., Israel. HOE and refractive elements create a Hologlass doublet for correction of longitudinal chromatic aberration in low power HOEs, using HOE negative dispersion.

12:00 M  CLOSING REMARKS
W. H. Taylor, Kollmorgen Corporation, and D. T. Moore, University of Rochester, Technical Program Co-chairs