

Next SIGGRAPH Meeting is Tuesday, October 11th, 1988,

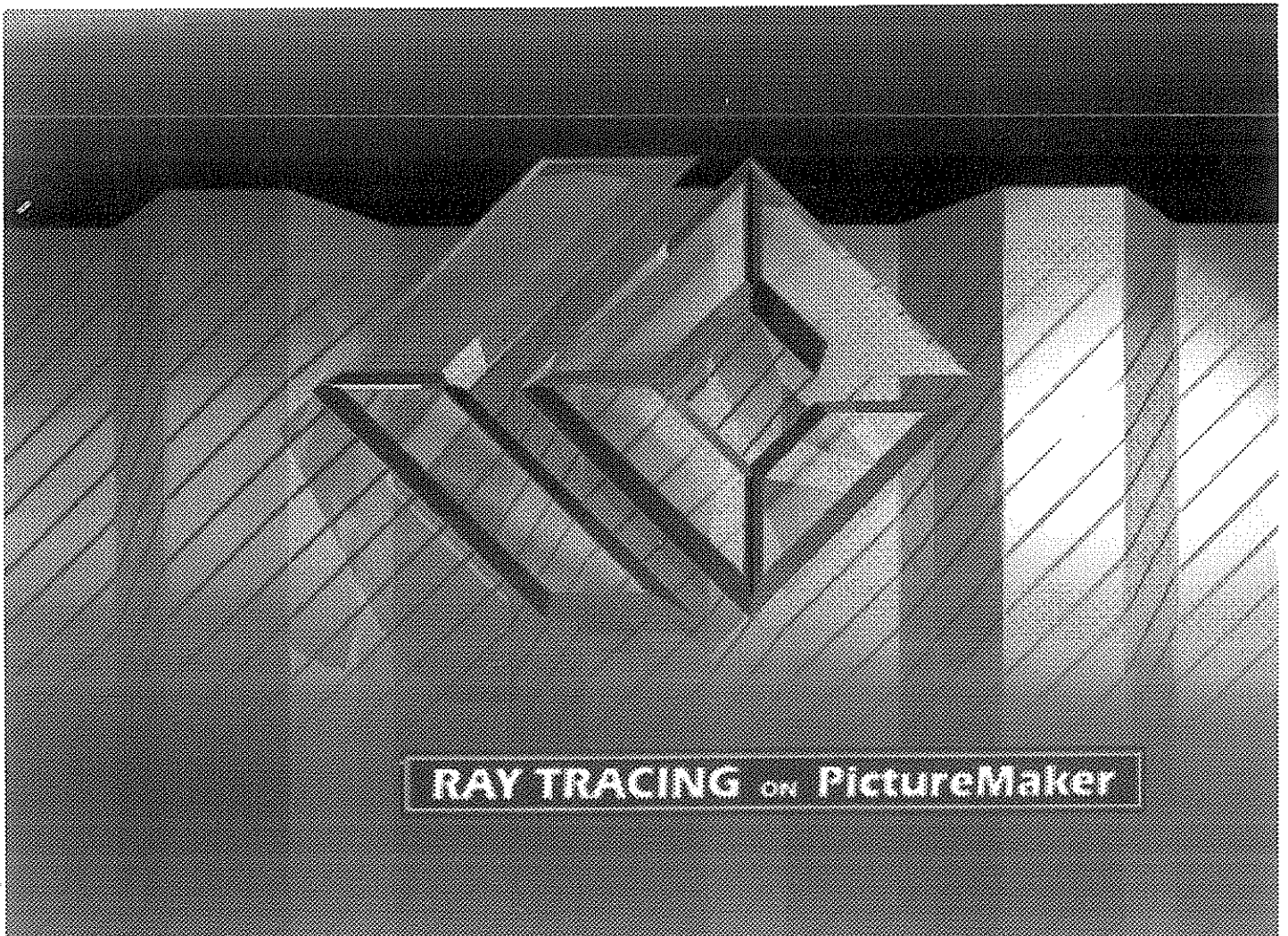
*Hollywood Roosevelt Hotel, 7000 Hollywood Blvd., Hollywood,
1 1/2 blocks East of La Brea Blvd. Social Hour: 6:30 pm,
Program "Ray Tracing For The Masses" at 7:30 pm.
Meeting is \$2.00 for L.A. SIGGRAPH members, \$4.00 for non-members.*

Meeting description on page 2.

D I M E N S I O N

October 1988

Cubicom Corporation



RAY TRACING ON PictureMaker

Ray Tracing For The Masses

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D Volume 2, Number 2. D is published monthly for the L.A. Chapter of ACM/SIGGRAPH by Image Production Service. Copyright 1988. All rights reserved. I.P.S., 2950 Los Feliz Blvd. Suite 102, L.A., CA 90039, 213-661-7725. For information regarding membership, meetings, events or suggestions contact L.A. ACM/SIGGRAPH, P.O. Box 90698 World Way Postal Center, Los Angeles, Ca. 90009 or call the SIG-phone: 213-392-1074.

SIGGRAPH Meeting
October 11, 1988
Newsletter Deadline
October 11, 1988
Executive Council Meeting
October 22, 1988

On the Cover

This month's cover "D" is brought to us by Rachel Blachly. The logo from Cubicomp was produced with Ray Tracing techniques, translated to TIFF & ported into PageMaker for printing.

Next Meeting

The next meeting will feature Cubicomp Corporation, Tuesday, October 11, 1988 at the Hollywood Roosevelt Hotel, 7000 Hollywood blvd., Hollywood, 1-1/2 blocks east of La Brea. For information: (213) 661-7725 or (213) 466-7000. Cubicomp is the world's largest manufacturer of 3-D graphic & video animation products, with more than 700 systems installed worldwide.

The Cubicomp product line includes the Vertigo workstation-based system for large, complex models and intricate animation sequences. A wide range of PictureMaker products are also available on a PC-based platform for the production

of broadcast quality graphics and animation. Low cost ModelMaker products complete the line, with a full selection of 3-D solid modeling capabilities, including interface to CAD-oriented applications, for users who do not require animation.

The speakers at our meeting will be Edwin P. Berlin, Jr., founder and Chief Technical Officer, and Peter A. C. McBride, Vice President of Marketing. Mr. McBride will explain the background of the company and describe the many Cubicomp products. Mr. Berlin will speak on a recent innovation, "Ray Tracing For The Masses." He will explain the problems in implementing this technique, and the efforts at Cubicomp to produce a practical ray tracing solution.

Ray Tracing For The Masses
 Edwin P. Berlin, Jr.

Ray tracing is a method of producing computer-generated images of 3-D objects which have sophisticated surface properties. In its simplest form, ray tracing traces light rays backwards from the eye, through each pixel on the screen and into the mathematical representation of the scene. When a ray hits an object, a shading computation is performed and other rays may be cast. If the surface is reflecting, a

PictureMaker CG systems. Existing algorithms were impractical: one image we produced took 27 days to render on an IBM AT. Our research eventually focused on four areas: One, incorporation of recent techniques for using a hierarchy of bounding volumes. Two, improving the computation of ray/polygon intersections. Three, selective use of ray tracing, or other techniques (as needed) for shading; while using fast methods for hidden surface removal and antialiasing. Four, making these techniques run efficiently on our RACE hardware (a co-processor, which plugs into an IBM PC slot, with processing speed of 10 million instructions/second and a peak of 20 MFLOPS).

Numerous schemes have appeared for organizing objects [1] [2]. The idea is to enclose each object in a bounding volume and first test a ray against that volume. If it misses, it cannot intersect the enclosed object. A hierarchy of bounding volumes can efficiently reject many objects with a single test.

We first developed a method for computing an optimum hierarchy, then a "near optimum" hierarchy which is much faster and performs nearly as well as the optimum. We are currently developing a method with order($N^{4/3} \log N$) execution

We began experiments to produce a ray tracing system fast enough for commercial animation.

ray is cast in the reflection direction. If the object is transparent and refracts, or bends, light; a ray is cast in the refraction direction using Snell's Law. If an object is in shadow, a ray is cast to each light source to see if other objects intervene, casting shadows at the point in question.

About 3 years ago, we first began experiments to produce a ray tracing system fast enough to be practical for commercial animation on our

time where N is the number of primitive objects.

We use a pre-computation trick due to Kay and Kajiya [2] to reduce the cost of intersecting a ray with a bounding volume, and volumes are examined in roughly the order they appear along the ray by keeping them partially sorted using leftist trees [3].

If a ray passes all bounding volume tests, and the polygon is actually hit, then the ray

is intersected with the plane of the polygon in question and computation is performed to determine a normal vector at the intersection point. Similar computations using the same interpolation coefficient may be used to produce texture and bump map data.

The software we developed selectively uses ray tracing without making the rendering take significantly longer. For example, someone might build a model of a room. A mirror could be put on a wall with little impact on the total rendering time. Some aspects of an image are accomplished with ray tracing while others are not. In a given scene, only shadows cast on the floor may be important. Users may be highly selective in choosing when or when not to apply ray tracing.

The software we developed selectively uses ray tracing without making the rendering take significantly longer.

Finally, all this was made to work with our existing PictureMaker system on the RACE platform. All code is written in C for maintainability. We currently have well over 100 customers with this once rare capability. Edwin P. Berlin, Jr.

[1] Arvo, James and David Kirk, "Fast Ray Tracing by Ray Classification," Computer Graphics, Vol. 21, No. 4, 1987, pp. 55-64.

[2] Kay, Timothy L. and James Kajiya, "Ray Tracing Complex Scenes," Computer Graphics, Vol. 20, No. 4, 1986, pp. 269-278.

[3] Knuth, Donald E., The Art of Computer Programming, Vol. 3, Sorting and

OCT. 6: ICCA/LA LOCAL MEETING: Proud Bird Restaurant, 11022 Aviation Blvd., L.A. Social: 6:00 pm, Dinner: 7:00 pm, Speaker: 8:00 pm. \$20 w/ dinner members, \$25 non-members (RSVP req.). Info: Judy Carter, 213-872-1811.

OCT. 6-9: ARTEXPOCAL '88: Featuring a special viewing of the NYC ACM/SIGGRAPH Electronic Theatre '88; L.A. Convention Center, Main Hall. Info: 212-418-4288 or 213-714-1151.

OCT. 9-12: CAD/CAM '88: CAD/CAM, CAE, CIM AND RELATED INDUSTRIAL TECHNOLOGIES: Hynes Convention Center, Boston, MA. Info: NCGA, 2722 Merrilee Drive, Suite 200, Fairfax, VA 22031; 800-6250-NCGA.

OCT. 11: L.A. ACM/SIGGRAPH LOCAL MEETING: CUBICOMP CORP., Hollywood Roosevelt Hotel, 7000 Hollywood Blvd., Hollywood. Info: 213-392-1074 or 213-661-7725.

OCT 11: LA ACM/SIGGRAPH NEWS-LETTER DEADLINE. Send submissions to: Randy Randall, L.A. ACM/SIGGRAPH, 2950 Los Feliz Blvd., Suite 102, L.A., CA 90039; 213-661-7725.

OCT. 17: IICS LOCAL MEETING: Speaker/program and location to be announced. Info: 818-363-0272 or 818-449-0006.

OCT. 18: VISUAL MUSIC ALLIANCE Tour of DEGRAF/WAHRMAN. 8936 Keith St., near Robertson & S.M. Blvd. in L.A. 8:00pm Members: free, non-members: \$5, Info: Ange Pike, 818-885-7316.

OCT. 18: L.A. MAC USERS GROUP: 3rd Tues. of each month. 7:30 pm Department of Water & Power, Aud., 111 N. Hope Street, L. A. Info: 213-278-LAMG.

OCT. 19: L.A. AMIGA USERS GROUP: 3rd Wed. of each month. 7:30 pm, Veteran's Auditorium, 4117 Overland Ave., Culver City. Info: Tom Irwin, 213-387-3698. Site info: 213-202-5688.

NOV. 3: ICCA/LA LOCAL MEETING: Proud Bird Restaurant, 11022 Aviation Blvd., L.A. Social: 6:00 pm, Dinner: 7:00 pm, Speaker: 8:00 pm. \$20 w/ dinner members, \$25 non-members (RSVP req.). Info: Judy Carter, 213-872-1811.

NOV. 8: L.A. ACM/SIGGRAPH LOCAL MEETING. Info: 213-392-1074 or 213-661-7725.

NOV. 8: LA ACM/SIGGRAPH NEWS-LETTER DEADLINE. Send submissions to: Randy Randall, L.A. ACM/SIGGRAPH, 2950 Los Feliz Blvd., Suite 102, L.A., CA 90039; 213-661-7725.

NOV. 7-11 NICOGRAPH '88 Sunshine City Convention Center, Tokyo, Japan. Sponsored by Nippon Computer Graphics Association in coop w/NCGA. Info: NICOGRAPH '88 Secretariat Ogawa Bldg., 1-2-2, Uchikanda, Chiyoda-ku, Tokyo 101, Japan phone: 03-989-3331.

NOV. 15: L.A. MAC USERS GROUP: 3rd Tues. of each month. 7:30 pm Department of Water & Power, Aud., 111 N. Hope Street, L. A. Info: 213-278-LAMG.

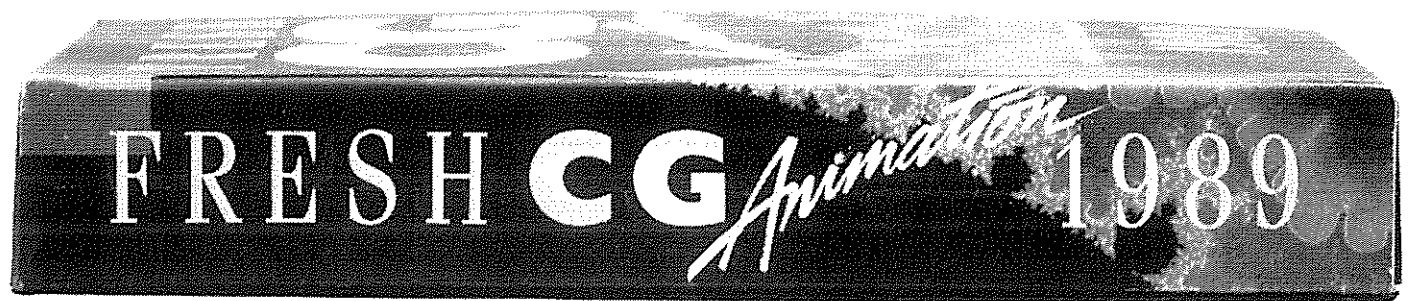
NOV. 16: SO. CAL. CUBICOMP USERS GROUP (SCC): General Meeting - Networking Forum & Screening of new work. Hosted by Vibeke Sorensen at Calif. Inst. Of The Arts, 24700 McBean Parkway, Valencia. Social: 6:30 pm, Program: 7:30 pm. Info: 213-661-7725 or 213-851-7594.

NOV. 16: L.A. AMIGA USERS GROUP: 3rd Wed. of each month. 7:30 pm, Veteran's Auditorium, 4117 Overland Ave., Culver City. Info: Tom Irwin, 213-387-3698. Site info: 213-202-5688.

NOV 21: IICS LOCAL MEETING: Titan SESCO demos their new Universal Maintenance Training System - interactive video trainer for US Marines. Info: 818-363-0272 or 818-449-0006.

FEB. 14-16: VIDEO EXPO - SAN FRANCISCO: Sponsored by Knowledge Industry Publications; San Francisco Civic

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Must possess or be eligible for and obtain a valid California Community College credential authorizing service in the appropriate subject matter area. Salary commensurate with education and experience.

Send letter of interest, resume indicating educational background and full description of teaching experience, list of completed coursework relevant to the position, and names of three references to the following: Personnel Office, North Orange County Community College District, 1000 North Lemon St., Fullerton, CA 92634. **DEADLINE DATE FOR APPLICATION: NOV. 15, 1988.**

DATA BASE EXPERT FOR VMS TO UNIX CONVERSION PROJECT. Large company - L.A. area location. Hands-on manager with communication, accounting and distribution skills. B.S. in Computer Science, must know UNIFY, RPG programmer desired. Send resume to the Editor at 2950 Los Feliz Blvd., Suite 102, Los Angeles, CA 90039.

TRAINING

CHUCK SECOR PRODUCTIONS: Animation Classes: Video Works II, Adobe '88 and art - sound management techniques on the Macintosh II, with scanner and music digitizing. Morning and Afternoon Sessions. P.O. Box 7677, Glendale, CA 91205; 213-664-2914.

IPS: 2D Paint & 3D CG Production Classes: Targa 32 & 3M/SPECTER on IRIS 3130. 2950 Los Feliz Blvd., Suite 102, L.A., CA 90039; 213-661-7725.

PAINT BOX PLUS: 10 week course on the Quantel Paint Box. Info: Stephanie Slade at (213) 856-8530.

TECH BOOKS & VIDEO

HI DE HO, Comics & Fantasy; 525 Santa Monica Blvd., S.M.; 213-394-2820.

KINOKUNIYA BOOK STORES, ART BOOKS; The New Otani, 110 S. Los Angeles St., L.A.; 213-687-4447. 2141 W. 182nd St., Torrance; 213-327-6577.

LA 411, Production Reference Book; LA 411 Publishing Co., P.O. Box 480495, L.A., CA 90048; 213-460-6304.

MODERN VISUAL COMMUNICATIONS, INC., Visual Expression Videos; 9016 Wilshire Blvd., Suite 220, Beverly Hills; 213-785-0778.

OPAMP TECHNICAL BOOKS, Eng., Computers, Television; 1033 N. Sycamore Ave., L.A.; 213-464-4322.

PASADENA SCIENTIFIC & TECHNICAL BOOKS; 1388 E. Washington Blvd., Pasadena; 213-684-5727, 818-794-4499.

SAMUEL FRENCH'S THEATRE BOOKS; 213-876-0570, 818-762-0535.

TECHNICAL BOOK COMPANY; 2056 Westwood Blvd., West Los Angeles; 213-475-5711.

WANTED

USED GRAPHICS BOARDS WANTED: TARGA 32 or 24, EGA or VGA, also composite to RGB encoder. Contact the Editor, Randy Randall, at 2950 Los Feliz Blvd., Suite 102, Los Angeles, CA 90039; (213) 661-7725.

SERVICES

LEASING OF HIGH TECHNOLOGY PRODUCTS: Equitable Life Leasing, 540 N. Golden Circle Dr., Suite 115, Santa Ana, CA 92705.

SOFTWARE DEVELOPMENT AND C.G. PRINTMAKING: Targa color separations, Cubicomp Utilities, Holograms, and Computer Prints. Info: S. McSherry Triad Computer Graphics 1750 El Cerrito Ste. 12, Ho., CA 90028.

VISTA 2D GRAPHICS & BROADCAST BETA-SP EDITING, 3/4" DUBS, Timestream Video, 11821 N. Circle Dr., Whittier; 213-699-8797.

VIDEO EQUIPMENT RENTALS: Inter Video / TriTronics Inc., 733 N. Victory Blvd., Burbank, CA 91502; 818-843-3633.

VIDEO EQUIPMENT RENTALS: CMTV, 1900 W. Burbank Blvd., Burbank, CA 91506; 818-843-6644.

LINOTRONIC STATS FOR PRINTING, Direct from your Computer: Alpha Graphics, 115 East Broadway, Glendale; 818-243-5694.

COMPUTER RENTAL CENTER: Rents IBM, Compaq, Macintosh, IBM compatibles, printers, H.P. Laserjet II and Apple Laserwriter. Serving the So. Calif. region. 818-797-6784.

COMPUTER NOISE DRIVING YOU CRAZY? Acoustic Analysis & Solutions; George Augspurger, P.O. Box 39536, L.A., CA 90039; 213-660-9351.

Classifieds - CG Classes and Training

ART CENTER AT NIGHT: CG Program, college credit available. Mac and 2D paint. Info: 818-584-5035.

CAL ARTS: Sch. of Film & Video: 13 wk cert, BFA & MFA, CG in conj. w/ other major. Wavefront, Cubicomp, Amiga, CMX video editing, DVE, 16 mm film. 24700 McBean Parkway, Valencia, CA 91355; Vibeke Sorensen, 805-255-1050.

CAL STATE UNIV., NORTHRIDGE: School of Eng. & Computer Science. Northridge, CA 91330; 818-885-2166.

C.S.U.L.A.: CG for Artists/Designers. Undergrad. & grad. deg. Info: Tony Longson, 213-487-4433, or 213-224-3523.

OTIS ART INSTITUTE / PARSONS SCHOOL OF DESIGN & WEST COAST UNIVERSITY: CG for Artists &

Designers - 1 yr. cert. program. Info: Tony Longson, 213-487-4433, 11am-5pm.

RANCHO SANTIAGO COLLEGE: 13 wk cert., degree program, CG in conj. w/ other major. Intro to CG; Beg. & Adv. Modeling; Beg. & Adv. Animation. Cubicomp, IBM AT, Matrix PCR. 17th St. @ Bristol, Santa Ana, CA 92706; Sharon Ford, 714-667-3000.

FULLERTON COLLEGE: 18 wk cert. in CG & Animation. Intro to CG; Modeling; Paint; Desktop Publishing. Cubicomp, Zenith AT, plotter & printer. 321 E. Chapman Ave., Fullerton, CA 92634; Todd V. Glen 714-992-7351.

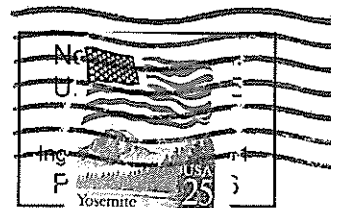
U.C.L.A.: 13 wk cert., BFA & MFA degree program, CG in conj. w/ other major. Fall Ext. Classes: CG I - An Intro; Intro to Compact Disc Interactive; Intro to

VideoWorks II; Adobe Illustrator 88; Intro to... Computers in Print, Elec. Transmission, Multimedia & Film; Intro & Intermediate to Adv. Desktop Publishing; Device Independent CG; Adv. Software Modeling Tech. in Engineering; Simulation & Models. Wavefront, Cubicomp, IBM AT (+ others), video, 16 mm film. Programs & equipment avail. depends on dept. CG classes offered by Dept. of Film & TV, Engineering Dept., Art/Design Dept. and U.C.L.A. Extension. P.O. Box 24901, Los Angeles, CA 90024; John G. Watson, 213-206-8503.

U.S.C.: Computer Science Dept. & School of Cinema & Television: classes in CG and animation to f.t. students. Info: Richard Weinberg at (213) 743-6288.

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