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SIGGRAPH 95 Conference Proceedings August 6 - 11, 1995 Edited by Robert Cook Panels Chair Leo Hourvitz

A publication of ACM SIGGRAPH Production Editor Stephen N. Spencer

Sponsored by the Association for Computing Machinery's Special Interest Group on Computer Graphics

PROCEEDINGS





Preface

Welcome to SIGGRAPH 95, the 22nd annual ACM Conference on Computer Graphics and Interactive Techniques. These proceedings contain the papers that were presented during the Technical Program of the conference, which was held in Los Angeles, California on August 9-11, 1995.

The SIGGRAPH proceedings are unlike any other conference proceedings; they are unique in that they contain much of the very best research in the field. The reviewing process is rigorous and very selective, ensuring that the papers are of the highest caliber and that the proceedings continue to be a prestigious place to publish.

This year there were a record 257 papers submitted. The sheer volume of these submissions was overwhelming; if stacked on top of each another, they would have been over 30 feet high. Of these, we accepted 56 papers, 1 paper shy of last year's record. The growing international character of SIGGRAPH was also evident: 42% of the submitted papers were from outside the United States, representing 20 countries on 5 continents. And 20 of the accepted papers had at least one international author.

I am pleased that we were able to be more generous with the page limits than in previous years. Although we couldn't accommodate every request, in most cases we were able to allow the authors an extra couple of pages in which to describe their work. Unfortunately, the large number of papers we accepted means that once again we had some parallel paper sessions at the conference. I elected to have these parallel sessions rather than accept fewer papers or give the authors less time for their presentations.

I wish that everyone could see the review process at work. For years, I have been impressed with the effort given to making this process professional and fair. Though mistakes are certainly made from time to time, there is a tremendous amount of integrity and virtually no politics. The emphasis is exactly where it should be: on finding the best papers.

Here's a snapshot of how the reviewing process worked this year. First, I selected the Papers Committee. It consisted of 25 of the leading researchers in the field, 7 of whom had never been on the Papers Committee before. Then I spent two days with Ed Catmull and Holly Rushmeier (the SIGGRAPH 92 and 96 Papers Chairs) assigning each paper to 2 committee members, one of whom was designated the senior reviewer. The committee members had been asked to rate themselves in more than 50 different areas of expertise to help assure that the papers went to qualified reviewers. Each committee member ended up with an average of 22 papers, half as senior reviewer.

The senior reviewers were responsible for finding at least three additional reviewers from at least two additional institutions for each paper. There were a total of 370 of these additional reviewers. I continued the blind reviewing process introduced last year: the authors were asked to remove their names and all identifying information from the papers, so that the reviewers who were not on the Papers Committee would not know their identities.

The Papers Committee then met in Monterey, California on March 18-19, 1995 to discuss the papers. As each paper was discussed, anyone connected with any of the institutions the authors represented in a paper left the room during the discussion and the identities of the members of the committee who reviewed that paper were hidden from them. This ensured a free discussion and protected the anonymity of the reviewers.

Computer graphics is a broad and inclusive field. Many other fields have had their roots in computer graphics, including computer-human interaction, multimedia, and virtual reality. Because of this, the committee made an extra effort to be generous to work in new areas.

My thanks go first and foremost to the members of the papers committee. I am often impressed by the people I meet at SIGGRAPH because of their intelligence, creativity, integrity, and generous spirit. In no place is this more evident than on the Papers Committee. Serving on this committee involves a staggering amount of work. I am grateful that so many of the best people in the field are willing to devote so much of their limited time to helping ensure the continued quality of these proceedings.

I am grateful to Andrew Glassner, the SIGGRAPH 94 Papers Chair, for giving me a first hand look at the process last year. I would also like to thank Al Barr, Leona Caffey, Ed Catmull, Mary Anne Cook, Steve Cunningham, John Dill, Brenda Dreier, Brian Herzog, Betsy Johnsmiller, Sharon Kaiser, Jim Kajiya, Peter Meechan, Deborah Peifer, Holly Rushmeier, Stephen Spencer, and Cindy Stark for all of their help and support.

Every year I look forward to the SIGGRAPH proceedings to see what new and surprising advances have been made in the previous year. This year there is a great mixture of papers that represent both brand new directions as well as papers that go further that ever before in directions that are well known. I hope you will find them as exciting as I do.

- Robert Cook

1995 ACM SIGGRAPH Awards

Computer Graphics Achievement Award

Kurt Akeley



The SIGGRAPH achievement award is presented to Kurt Akeley in recognition of his contributions to the architecture, design, and realization of high performance 3D graphics hardware systems. These architectures define not only his company, but provide the high-performance 3D graphics facilities that enable scientists, engineers, animators, and other users to visualize, create, and dream in new ways.

Kurt Akeley received a B.E.E. from the University of Delaware in 1980, and an M.S.E.E. from Stanford in 1982. That year he was a member, with previous Achievement Awardee Jim Clark, of the founding team of Silicon Graphics, Incorporated. He has been a key technical contributor since then with primary design responsibility for most of the high-end graphics architectures in SGI's product history. Kurt developed the frame buffers and processor subsystems for the early IRIS series products, and many of the CAD tools used to design these and other products. He was instrumental in developing the graphics systems for the Power Series and Onyx systems, including the GTX, the VGX, and the RealityEngine. He also led the design and documentation of the OpenGL graphics software specification, which is now supported by Silicon Graphics and many other workstation and personal computer yendors.

Clearly he is a hardware wizard, but one who also has a deep understanding of software and especially the critical interaction between hardware and software. Currently, as Vice President and Chief Engineer at SGI, he is responsible for the specification of extensions to the OpenGL graphics software interface. He has received eight patents and has others pending.

In addition to his design contributions, Kurt has published papers about those architectures, and about graphics architectures in general. These publications are seminal contributions for the graphics community around the world. It is practically impossible for a paper describing new ideas in graphics architecture to omit, as background, essential references to Kurt Akeley's contributions. In addition, at the annual SIGGRAPH conferences Kurt's courses on graphics architectures and graphics programming have educated legions of professionals in our industry. He also contributes on the panels and program committees. In 1984 his colleagues at Silicon Graphics recognized his contributions by selecting him as the first overall "Spirit of SGI" award winner. He received the 1993 Distinguished Alumnus award from the Department of Electrical Engineering of the University of Delaware, and was given a University of Delaware Presidential Citation for Outstanding Achievement in 1995.

In short, through his tangible achievements Kurt Akeley has enabled a unique industry, and has enriched the lives of many thousands of users who are now able to break new ground in their own fields because of the power his inventions provide. Therefore, SIGGRAPH is pleased to present the SIGGRAPH Achievement Award to Kurt Akeley.

Publications

Kurt Akeley and Tom Jermoluk, "High-Performance Polygon Rendering," SIGGRAPH '88 Conference Proceedings, pp. 239-246

Kurt Akeley, "The Silicon Graphics 4D/240GTX Superworkstation," IEEE Computer Graphics and Applications, July 1989, pp. 71-83.

Paul Haeberli and Kurt Akeley, "The Accumulation Buffer: Hardware Support for High-Quality Rendering," SIGGRAPH '90 Conference Proceedings, pp. 309-318.

Mark Segal and Kurt Akeley, "The OpenGL Graphics System: A Specification," Silicon Graphics, Inc., 1992.

Kurt Akeley, "RealityEngine Graphics," SIGGRAPH '93 Conference Proceedings, pp. 109-116.

Previous award winners 1994 Kenneth E. Torrance

1984

1983

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1992	Henry Fuchs
1991	James T. Kajiya
1990	Richard Shoup and Alvy Ray Smith
1989	John Warnock
1988	Alan H. Barr
1987	Robert Cook
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1985	Loren Carpenter

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Steven A. Coons Award for Outstanding Creative Contributions to Computer Graphics

Jose Luis Encarnação

The 1995 Steven A. Coons Award is presented to Dr. Jose Luis Encarnação for leadership in applied research using computer graphics for a broad range of industrial and medical applications, in international graphics standards and in computer graphics education.

His work in computer graphics began at the Technical University of Berlin in 1967 when he was also associated with the Heinrich Hertz Institute. In the period 1972-75 he was at the University of Saarbrücken. In 1975 he became Professor at the Technical University of Darmstadt, an appointment he holds today.

His earliest work involved development of basic algorithms such as hidden-line elimination and hardware for matrix manipulations (4 by 4). The Encarnação Scan-Grid Hidden Surface algorithm was particularly appropriate for surface representations used in CAD applications for car body design. It was during this period he became concerned with graphics systems applied to computer aided design—early evidence of his long-term commitment to technology transfer between academia and industry, a hallmark of the German and European technical communities.

His efforts in standards are consistent with that commitment. Starting in 1970, Encarnação lead successful efforts at Standardization in Computer Graphics in Germany. He convened experts from all over Germany and involved many from the group of researchers he had assembled in Darmstadt. He has been especially active in DIN and ISO standards, and was a primary contributor to the GKS graphics standard. He participated in the celebrated meetings at the Chateau Seillac in 1976 that led to the Proposed Core Standard put forth by SIGGRAPH. Recognizing at that time the need for a practical 2D system, he spearheaded the effort to produce the Graphical Kernel System, GKS, an extensive elaboration of an early version of the 3D Core proposals. Subsequently, under Encarnação's direction, Günter Pfaff et al developed a GKS implementation at Darmstadt that became the leading commercial product of its kind and remains in use in German CAD and other graphics application systems.

As a professor specializing in computer graphics for more than twenty years, Dr. Encarnação has been the advisor for more than forty Ph.D. students, many of whom have themselves attained professorial positions. To ensure the stability of Computer Graphics in academic computer science and in industry he initially established the Interactive Graphics Research Group (THD-GRIS) in 1975 at the Technical University of Darmstadt. In 1984 he also founded, and became chairman of the board, of the Computer Graphics Center (ZGDV). In addition to the main laboratory in Darmstadt, it now has associated laboratories in Rostock and in

Portugal. In 1987 he became the director of the Fraunhofer Institute for Computer Graphics in Darmstadt. At the request of the government, he aided in the re-unification task by establishing a Fraunhofer Graphics Laboratory in Rostock. These institutes are staffed by computer graphics professionals, more than a hundred in Darmstadt alone, and provide a home for many more students pursuing study and research in computer graphics and its applications

An early example of successful technology transfer accomplished by these important and valued institutes is the GRADAS system developed in 1975 for AEG. The GRADAS systems was used by the Deutsche Bundespost for more than 15 years for interactive archiving, handling and editing of communications (telephone) drawings. A more recent example is the TRITON system developed for the Deutsche Wetterdienst (weather bureau) for visualizing and presenting weather forecast on TV and now in use by six European TV-channels. The latest contribution is an ISDN-based medical teleconsultation system, KAMEDIN, now being very successfully deployed by the German Telekom.

In 1980 Encarnação was the driving force behind founding EUROGRAPHICS, the eminent forum for graphics researchers and practitioners in the greater European community. Not only did he spearhead its formation, but he devoted considerable energy as its first chairman to sustaining it through its early and formative years.

He is the author of more than one hundred journal articles as well as eight text books. In particular, his book on computer aided design was one of the earliest to apply a systems approach for describing CAD. It was translated into four languages. Revised and extended in a second edition, it remains one of the few books that presents a coherent and unified approach to a theoretical underpinning for computer aided design.

Encarnação serves on several editorial boards, including *Computer Graphics and Applications, The Visual Computer*, and *Computer-Aided Design*, and is Editor-in-Chief of *Computers & Graphics*.

There are many ways Dr. Encarnação has inspired and influenced both the German and broader European computer graphics communities. He has worked effectively to infuse computer graphics into the international community, forging ties with universities, institutes and industry around the world, including Brazil, China, Japan, Mexico, Portugal, Spain, and the USA. He has received prizes and been awarded honorary degrees in recognition of these achievements.

Dr. Encarnação has been a tireless worker and supporter of computer graphics both as a key enabling technology and as a critical academic discipline within the field of computer science. His vision, insight, and energies have successfully sustained his devotion to academic excellence while providing critical liaison with industrial and standardization efforts. In recognition of these accomplishments and contributions to Computer Graphics, SIGGRAPH is pleased to present Dr. Jose Luis Encarnação the Steven Anson Coons Award.

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Encarnação, J., P. Bono, M. Encarnação and W. Herzner, "PC Graphics with GKS," Hanser Verlag (1987) and Prentice Hall (1990)

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