Eighth International Conference on the

USE OF COMPUTERS IN RADIATION THERAPY

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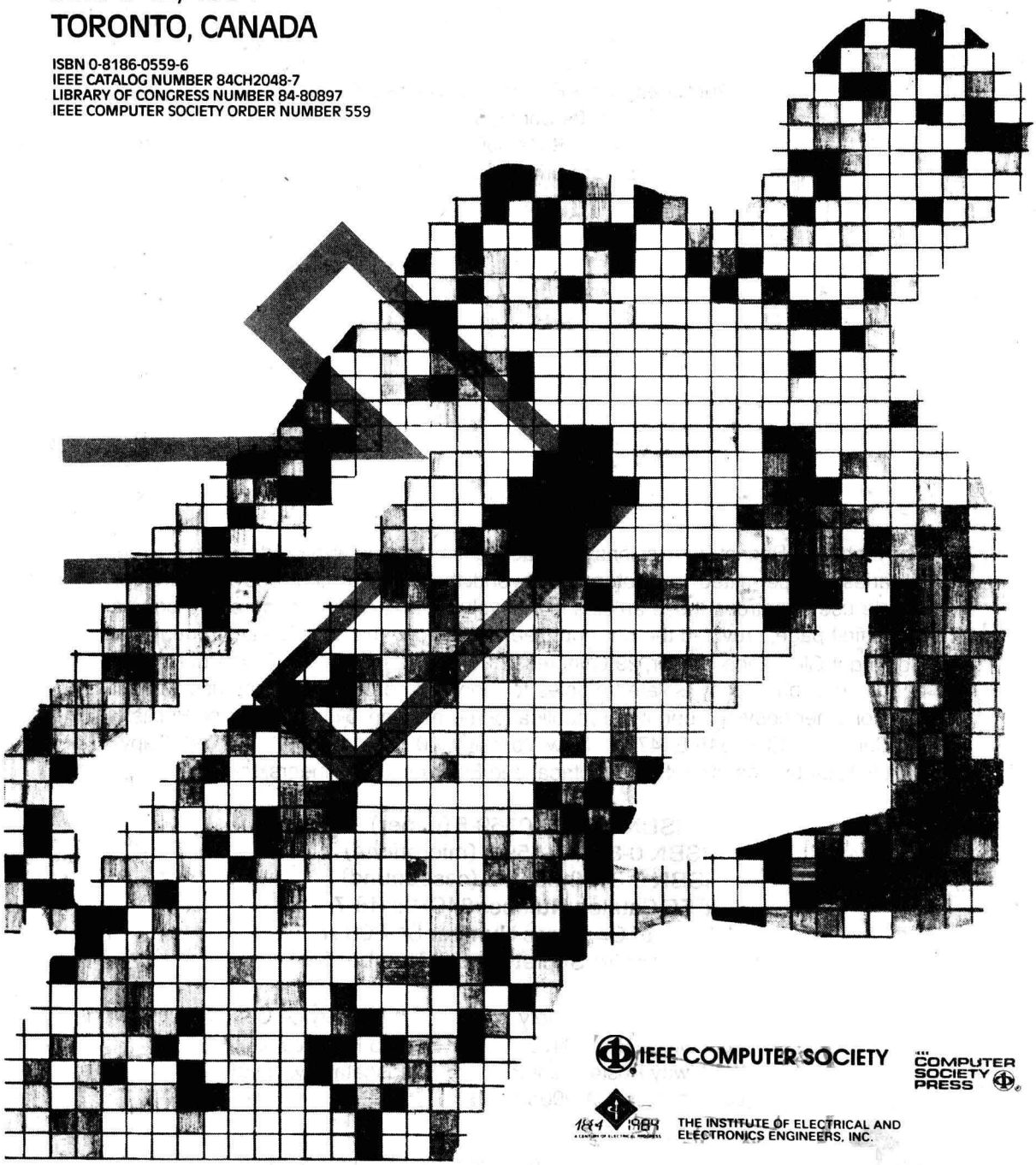

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We would also like to acknowledge the financial support of the Princess Margaret Hospital Trust Fund for sponsoring one of the conference social evenings, and Atomic Energy of Canada Ltd for designing and printing the 8th ICCR stationery.

PREFACE

The 8th International Conference on uses of Computers in Radiotherapy is the 8th in a series of small ad hoc conferences designed to promote uses of computers in radiotherapy in the hopes of improving the practice of that subject. Participation has, by early design and later by tradition, been by invitation. The intent was and is to gather physicists, clinicians and computer technologists that are in the forefront of this subject together. The meetings have always been characterized by a spirit of friendliness and good conversation. The present meeting, in Toronto, Canada is in line with this tradition.

Publications have also resulted from all of the previous meetings and it may be useful to list the meetings and their publications.

1. Cambridge, England, 1966
   "The Use of Computers in Therapeutic Radiology", Special Report No. 1. British Institute of Radiology, London, 1967.

2. Chicago, U.S.A., 1968
   M. Cohen, "Computers in Radiotherapy", (Special Report No. 4). Brit. J. Rad. 43, 658-663, 1970.

3. Glasgow, Scotland, 1970
   "Computers in Radiotherapy", Special Report No. 5. British Institute of Radiology, London, 1971.

4. Uppsala, Sweden, 1972
   "Computers in Radiation Therapy", Radiofysikavdelningen, Akademiska Sjukhuset. S-75014. Uppsala, Sweden, 1972.

5. Hanover, N.H., U.S.A., 1975
   "Computer Applications in Radiation Oncology". E.S. Sternick, Ed. University Press of New England, 1976.

6. Goettingen, Federal Republic of Germany, 1977
   "Computers in Radiotherapy", U. Rosenow, Ed. Strahlenabteilung Universitaets Frauenklinik, D-3400, Goettingen, FRG, 1978.

7. Kawasaki and Tokyo, Japan, 1980
   "Computers in Radiation Therapy", Umegaki, Ed. Japan Radiological Soc. Tokyo, Japan, 1981.

These meetings, spanning almost twenty years, have gone from the time of looking for useful applications for the computer to the present, when it is thought by many that for proper radiotherapy a computer is essential.

It is probably safe to say that during the early years of the conferences, the activity that contributed most to the practice of radiotherapy was the development of accurate treatment planning systems. This has undoubtedly led to an improvement in the accuracy of treatments but it is not easy to show that it has also led to an improvement in results although there are many who firmly believe that this is so.

In the early conferences, considerable discussion took place concerning the merits of small computers versus large computers. Now, computers more powerful than many of the "large" systems of that time are household items. Hardware is still important but now the attention is to particular problems and the "Micros" can do many specialized tasks with efficiency and precision. On the other hand, large computers have become so powerful that it is now becoming practical to use Monte Carlo techniques, if not for routine dosage calculations, at least for analysis of dosimetric problems.

Development of dose calculation algorithms is still held to be important as can be judged from the number of papers presented to this conference. Fully one third of them are on that topic.

Hounsfield published his first paper on CT just after the 4th (Uppsala) ICCR and NMR appeared on the scene for imaging about the time of the 7th meeting. Not surprisingly attention has shifted to imaging and display and to find ways of using the vast and detailed amount of anatomical information that is becoming available for both diagnosis and treatment.

Optimization of radiation treatments, discussed even at the time of the first meeting, is still of interest and is a problem that is almost as far from solution as then. Perhaps until biological response can be well incorporated into treatment planning "optimization" can not be fully realized.

The capture and analysis of patient records and related data is still of interest and a number of papers devoted to that subject appear in this volume.

This publication represents a collection of papers on these subjects and others. They appear as produced by the authors. They are arranged in the order in which they appear in the program except that there are three simultaneous sessions with papers 1 through 48 being given concurrent with 49 through 93 and 94 through 137.

It is hoped, and indeed expected, that this publication, being available at the time of the meeting, will be especially useful during it but will also be referred to for years to come.

J.R. Cunningham
D. Ragan
J. Van Dyk

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Treatment Planning - Past Shortfalls and Future Needs

William E. Powers, M.D.

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ABSTRACT

The expectation of the developers of small treatment planning computers was that 30 such units might satisfy the world demand. Now, 15 years later, approximately 1000 of these devices are in use and have become an accepted minimum standard of patient care. Despite this acceptance, additional developments will be needed in the area of: 1) Physician interaction (definition of tumor extent, desired tumor dose gradient, normal tissue doses, scores of cost benefit, administration of dose within a three dimensional patient and the ability to deliver a desired dose). 2) Patient data collection (CT input, NMR input, other). 3) Dose calculation (Three dimensional irregular fields, accurate patient models, surface dose estimates, irregular internal structures and non-photon beams). 4) Dose display (3-D display, isoeffects, complication probabilities, etc.). 5) As treatments become more complicated with multiple modalities, shaped fields, various fractionation schemes, adjuvant chemotherapy or heat, etc., computer assistance for treatment optimization is required. The physicians have sought computer assistance in order to provide more and better organized information for patient treatment planning. Much remains to be done to facilitate patient care. In addition to treatment planning, these small computer systems represent an under utilized resource within radiotherapy departments for managment information and other modern information system support. Systems must be developed which tie dose calculated (prescribed) to dose delivered and ultimately, to treatment success or failure.

Applications of Computer Technology in Medicine

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ABSTRACT

There are several developments in computer science and engineering that may have a substantial impact on the use of computers in medicine and in radiation therapy, in particular. Perhaps the most profound is the development of microelectronic techniques that make possible the fabrication of custom chips. The opportunities and limitations of VLSI for radiation treatment planning are discussed in the context of a specialized chip that implements a new three-dimensional dose calculation. Microelectronics has made possible the economical production of raster graphics and image processing systems. The combination of these systems and picture archiving and communication systems (PACS) open a number of new possibilities in departments of radiology. Some examples of presentations that allow three-dimensional visualization will be discussed. The proliferation of microprocessor based systems has emphasized the need for portability of software. UNIX seems to be gaining sufficient popularity among the producers of 16-bit microcomputers to have achieved the status of an informal standard. Potential and problems for medicine will be discussed based on the assumption that the trend toward widespread use of the UNIX operating systems continues. Finally, developments in expert systems will be reviewed with particuair attention to their possible applications in radiation therapy.