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11th September 1985

Professor Robert Kalaba Dr. John L. Casti Editor, Applied Mathematics and Computation Departments of Economics and Biomedical Engineering University of Southern California Los Angeles, California 90007

Dear Sirs:

Enclosed please find three copies of our paper: <u>A Computational Solution</u> of the Inverse Problem in Radiation Therapy Treatment Planning by Y. Censor, M.D. Altschuler, and W.D. Powlis, which we submit for publication in your journal Applied Mathematics and Computation.

Sincerely yours,

martin D altschuler

Martin D. Altschuler

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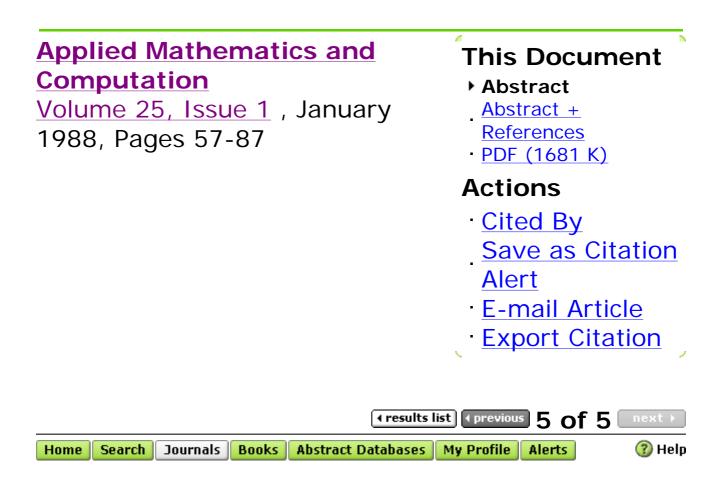
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# Abstract

Radiation therapy concerns the delivery of the proper dose of radiation to a tumor volume without causing irreparable damage to healthy tissue and critical organs. The forward problem refers to calculating the dose distribution that would be delivered to a measured patient cross-section when the radiation field generated by the beam sources is specified. The inverse problem refers to calculating the radiation field that will provide a specified dose distribution in the patient. The forward and inverse problems of radiation-therapy treatment planning are first formulated in their continuous versions, and the point is made that, in this field of application, the inverse problem calls for the inversion of an operator for which no analytic closed-form mathematical representation exists. To attack the inverse problem under such circumstances, a discretized model is set up in which both patient section and radiation field are finely discretized. This leads to a linear feasibility problem, which is solved by a relaxation method. The paper includes full details of this new approach, with discussion of technical aspects such as dose apportionment, software development, and experimental results. Consequences and limitations as well as a precise comparison with other methodologies are also discussed.

<u>\*1</u> A preliminary report on this research was presented at the Eighth International Conference on the Use of Computers in Radiation Therapy, 9-12 July 1984, Toronto, Canada [24].



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