

Book review

Image Reconstruction from Projections

Implementation and Applications

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[p. i-xii+284, with 120 figures]

This book presents exactly what its title says, i.e. implementation and applications of the image reconstruction from projections. Such a concept of the book splits almost automatically its content into two parts differing in character and presentation.

The first part (Chapter 2) presents very systematically the mathematical fundamentals of the image reconstruction from projections as oriented toward computer implementation. It includes the important standard techniques, like the RADON inversion operators and formula (given in the form convenient for the use in computer), discrete function techniques, discrete back projection operations, discrete filtering, interpolating methods and the like. The reasoning is here excellently clear, the methods are, moreover, illustrated with the well chosen and logically systematized computer experiments: the first of them showing an exemplified reconstruction of the impulse response, the second illustrating the reconstruction at the presence of the additive Gaussian noise, the third dealing with the reconstruction of the band-limited objects, and the fourth (more realistic than the others) discussing the reconstruction in the case when the projection data are contaminated with noise. The final part of this Chapter is devoted to the Rho-filtered layegram reconstruction and it ends with the conclusions mixed with some mention of the problems which remain still open.

The other part includes Chapters from 3 to 6, and is devoted to selected fields of applications.

The fundamentals of the image reconstruction from projections in radio astronomy are reviewed in Chapter 3. Here, the scanning technique is explained both from instrumental and methodological viewpoints. The considerations are completed by discussion of some implementation procedures in terms of the complex visibility and the image defect due to shift error.

Some problems in the global-scale three-dimensional solar corona reconstruction involving both the magnetic field and the electron density distribution in the solar corona are discussed in Chapter 4. Although the global reconstruction of the corona magnetic field is not strictly reconstruction from projections, it is also considered as a technique complementary to the density reconstruction (which is truly reconstruction from projections) needed for more comprehensive treatment of the coronal dynamics. Here the presentation is also clear.

The long Chapter 5 deals with an extremely interesting method of quantitative determination of time changes in the chemistry and flow physiology of the injected or inhaled compounds labelled with radioactive atoms. This method, called emission computed tomography (ECT), is based on seeking the location and intensity of emitted photons in an attenuating medium. The consideration begins with physical fundamentals including single photon radionuclides, positron (β^+) emission, collimation, scattering and attenuation, and it is followed by a review of the more important instrumentation involved, including simple photon scanners, positron mode devices, different positron cameras and the like, and is completed by the explanation of positron imaging principles. In the

further part of this Chapter the effect of attenuation in reconstructions is carefully discussed, while the methods of attenuation compensation are presented a little later being preceded by a review of algorithms for ETC. Some attention is paid to the longitudinal tomography illustrated by some reconstruction examples. The Chapter ends with selected medical application based on state, equilibrium and dynamic imaging, all again illustrated in a very interesting way.

The sixth and the last Chapter is devoted to some applications of the computerized tomography to physiology and medicine. As the measurements are carried out in a four dimensional space including the time coordinate, the problems of sufficiently high temporal resolution of the tomographic technique is analysed. The methodology of cycloidal scanning tomography involving both the single and multiple X-ray source-imaging chain systems is analysed and followed by a review of many applications and related problems in clinical medicine, cardiac and clinical physiology, clinical diagnostic, and the like.

What kind of book is this, then?

This (may be too extended) summary seemed to be necessary for an honest answer to this question. Firstly, it is a surprisingly great variety of applications considered which somehow distinguishes this book. That is why not all the parts of this book can be of an equal interest for an average reader. However, for the readers specializing in one of the fields the same feature offers an opportunity of widening their knowledge and may stimulate some transfer of ideas from one field to another. Secondly, this is really an up-to-date book which provides the readers with the most recent achievements in the respective disciplines of this relatively new sciences. Thirdly, the language is clear and elegant in the most part of the book, though there exists a stylistical differentiation unavoidable in a book written by many contributors. This, however, does not disturb the pleasure of reading. Fourthly, the reasoning is nicely illustrated with well chosen examples, photos and drawings which certainly facilitate and deepen the understanding of the argumentation.

For these reasons this book may be recommended to both the experienced specialists in the respective fields as well as to those less advanced who start their activity in any of the fields discussed. Some parts of this book may become an interesting intellectual adventure (perhaps with exception of Chapter 2) even to those who having no professional contact with tomography are curious enough to invest some effort in widening their knowledge.

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