

# Computer Processing of Electron Microscope Images

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With 116 Figures

Springer-Verlag Berlin Heidelberg New York 1980

# Computer Processing Of Electron Microscope Images

## Topics In Current Physics

**S Nieto**



## **Computer Processing Of Electron Microscope Images Topics In Current Physics:**

Computer Processing of Electron Microscope Images P. W. Hawkes, 2012-12-06 Towards the end of the 1960s a number of quite different circumstances combined to launch a period of intense activity in the digital processing of electron micrographs. First many years of work on correcting the resolution limiting aberrations of electron microscope objectives had shown that these optical impediments to very high resolution could indeed be overcome but only at the cost of immense experimental difficulty thanks largely to the theoretical work of K J Hanszen and his colleagues and to the experimental work of F Thon the notions of transfer functions were beginning to supplant or complement the concepts of geometrical optics in electron optical thinking and finally large fast computers capable of manipulating big image matrices in a reasonable time were widely accessible. Thus the idea that recorded electron microscope images could be improved in some way or rendered more informative by subsequent computer processing gradually gained ground. At first most effort was concentrated on three dimensional reconstruction particularly of specimens with natural symmetry that could be exploited and on linear operations on weakly scattering specimens. Chap 1 In 1973 however R W Gerchberg and W O Saxton described an iterative algorithm that in principle yielded the phase and amplitude of the electron wave emerging from a strongly scattering specimen.

Electron Microscopy in Microbiology ,1988-10-01 This volume of this acclaimed series deals with electron microscopic techniques applied for the elucidation of microbial structures and structure function relationships at cellular sub cellular and macromolecular levels. Many of the recent findings on ultrastructural features of microorganisms have been obtained with newly developed methods though classical approaches have not lost their validity. Therefore both conventional and new methods have been incorporated into this volume. The topics dealt with are meaningful not only in bacterial cytology but also in physiology enzymology biochemistry and molecular biology and include aspects of medical and biotechnological application.

**Computer Processing of Electron Microscope Images** P W Hawkes, J Frank, 1980-01-01 Physical and Biological Processing of Images O. J. Braddick, A. C. Sleight, 2012-12-06 This book consists of papers presented at an international symposium sponsored and organised by The Rank Prize Funds and held at The Royal Society London on 27-29 September 1982. Since the inception of the Funds the Trustees and their Scientific Advisory Committee on Optoelectronics have considered that the scope of optoelectronics should extend to cover the question of how the eye transduces and processes optical information. The Funds have aimed to organise symposia on topics which because of their interdisciplinary nature were not well covered by other regular international scientific meetings. It was therefore very appropriate that the 1982 symposium should be on Physical and Biological Processing of Images. The purpose of the symposium was to bring together scientists working on the physiology and psychology of visual perception with those developing machine systems for image processing and understanding. The papers were planned in such a way as to emphasise questions of how image analysing systems can be organised as well as the principles underlying them rather than the detailed biophysics and

structure of sensory systems or the specific design of hardware devices As far as possible related topics in biological and artificial systems were considered side by side

**Advances in Imaging and Electron Physics**, 2018-06-15 Advances in Imaging and Electron Physics Volume 206 merges two long running serials Advances in Electronics and Electron Physics and Advances in Optical and Electron Microscopy The series features extended articles on the physics of electron devices especially semiconductor devices particle optics at high and low energies microlithography image science digital image processing electromagnetic wave propagation electron microscopy and the computing methods used in all these domains Contains contributions from leading authorities on the subject matter Informs and updates on all the latest developments in the field of imaging and electron physics Provides practitioners interested in microscopy optics image processing mathematical morphology electromagnetic fields electrons and ion emission with a valuable resource Features extended articles on the physics of electron devices especially semiconductor devices particle optics at high and low energies microlithography image science and digital image processing

**Electron Probe Microanalysis** Karl Zierold, Herbert K. Hagler, 2013-03-08 The aim of electron probe microanalysis of biological systems is to identify localize and quantify elements mass and water in cells and tissues The method is based on the idea that all electrons and photons emerging from an electron beam irradiated specimen contain information on its structure and composition In particular energy spectroscopy of X rays and electrons after interaction of the electron beam with the specimen is used for this purpose However the application of this method in biology and medicine has to overcome three specific problems 1 The principle constituent of most cell samples is water Since liquid water is not compatible with vacuum conditions in the electron microscope specimens have to be prepared without disturbing the other components in particular diffusible ions elements 2 Electron probe microanalysis provides physical data on either dry specimens or fully hydrated frozen specimens This data usually has to be converted into quantitative data meaningful to the cell biologist or physiologist 3 Cells and tissues are not static but dynamic systems Thus for example microanalysis of physiological processes requires sampling techniques which are adapted to address specific biological or medical questions During recent years remarkable progress has been made to overcome these problems Cryopreparation image analysis and electron energy loss spectroscopy are key areas which have solved some problems and offer promise for future improvements

*Image Sequence Analysis* T. S. Huang, 2013-11-11 The processing of image sequences has a broad spectrum of important applications including target tracking robot navigation bandwidth compression of TV conferencing video signals studying the motion of biological cells using microcinematography cloud tracking and highway traffic monitoring Image sequence processing involves a large amount of data However because of the progress in computer LSI and VLSI technologies we have now reached a stage when many useful processing tasks can be done in a reasonable amount of time As a result research and development activities in image sequence analysis have recently been growing at a rapid pace An IEEE Computer Society Workshop on Computer Analysis of Time Varying Imagery

was held in Philadelphia April 5-6, 1979. A related special issue of the IEEE Transactions on Pattern Analysis and Machine Intelligence was published in November 1980. The IEEE Computer magazine has also published a special issue on the subject in 1981. The purpose of this book is to survey the field of image sequence analysis and to discuss in depth a number of important selected topics. The seven chapters fall into two categories. Chapters 2, 3, and 7 are comprehensive surveys on respectively the whole field of image sequence analysis, efficient coding of image sequences, and the processing of medical image sequences. In Chapters 1, 4, 5, and 6, the authors present mainly results of their own research on respectively motion estimation, noise reduction in image sequences, moving object extraction, and occlusion.

### **Transmission Electron**

**Microscopy** Ludwig Reimer, 2013-11-11. The aim of this book is to outline the physics of image formation, electron specimen interactions, and image interpretation in transmission electron microscopy. The book evolved from lectures delivered at the University of Münster and is a revised version of the first part of my earlier book *Elektronenmikroskopische Untersuchungs- und Präparationsmethoden*, omitting the part which describes specimen preparation methods. In the introductory chapter, the different types of electron microscope are compared, the various electron specimen interactions, and their applications are summarized, and the most important aspects of high-resolution analytical and high-voltage electron microscopy are discussed. The optics of electron lenses is discussed in Chapter 2 in order to bring out electron lens properties that are important for an understanding of the function of an electron microscope. In Chapter 3, the wave optics of electrons and the phase shifts by electrostatic and magnetic fields are introduced. Fresnel electron diffraction is treated using Huygens' principle. The recognition that the Fraunhofer diffraction pattern is the Fourier transform of the wave amplitude behind a specimen is important because the influence of the imaging process on the contrast transfer of spatial frequencies can be described by introducing phase shifts and envelopes in the Fourier plane. In Chapter 4, the elements of an electron optical column are described: the electron gun, the condenser, and the imaging system. A thorough understanding of electron specimen interactions is essential to explain image contrast.

*Digital Pattern Recognition* K. S. Fu, 2013-03-07. Since its publication in 1976, the original volume has been warmly received. We have decided to put out this updated paperback edition so that the book can be more accessible to students. This paperback edition is essentially the same as the original hardcover volume except for the addition of a new chapter, Chapter 7, which reviews the recent advances in pattern recognition and image processing. Because of the limitations of length, we can only report the highlights and point the readers to the literature. A few typographical errors in the original edition were corrected. We are grateful to the National Science Foundation and the Office of Naval Research for supporting the editing of this book, as well as the work described in Chapter 4 and a part of Chapter 7. West Lafayette, Indiana, March 1980. K. S. Fu. Preface to the First Edition. During the past fifteen years, there has been a considerable growth of interest in problems of pattern recognition. Contributions to the blossom of this area have come from many disciplines, including statistics, psychology, linguistics, computer science, biology, taxonomy, switching theory, communication theory, control theory,

and operations research Many different approaches have been proposed and a number of books have been published Most books published so far deal with the decision theoretic or statistical approach or the syntactic or linguistic is still far from its maturity many approach Mathematics of Kalman-Bucy Filtering Peter A. Ruymgaart, Tsu T. Soong, 2013-03-08 The second edition has not deviated significantly from the first The printing of this edition however has allowed us to make a number of corrections which escaped our scrutiny at the time of the first printing and to generally improve and tighten our presentation of the material Many of these changes were suggested to us by colleagues and readers and their kindness in doing so is greatly appreciated Delft The Netherlands and P A Ruymgaart Buffalo New York December 1987 T T Soong Preface to the First Edition Since their introduction in the mid 1950s the filtering techniques developed by Kalman and by Kalman and Bucy have been widely known and widely used in all areas of applied sciences Starting with applications in aerospace engineering their impact has been felt not only in all areas of engineering but as all also in the social sciences biological sciences medical sciences as well other physical sciences Despite all the good that has come out of this development however there have been misuses because the theory has been used mainly as a tool or a procedure by many applied workers without fully understanding its underlying mathematical workings This book addresses a mathematical approach to Kalman Bucy filtering and is an outgrowth of lectures given at our institutions since 1971 in a sequence of courses devoted to Kalman Bucy filters

**Image and Signal Processing in Electron Microscopy** P. W. Hawkes, 1988 **Optics in Biomedical Sciences** G.v. Bally, P. Greguss, 2013-06-05 As there recently has been increased interest in the applications of optical techniques in biomedical research and clinical diagnostics it seemed to be appropriate to organize a comprehensive international conference on optics in medicine and biology Such a broad international meeting had not been held before An international conference on Optics in Biomedical Sciences was organized and took place in Graz Austria September 7th through 11th 1981 sponsored by the International Commission for Optics ICO in co operation with the European Optical Committee the Austrian Association on Biomedical Engineering and the German Society for Applied Optics It seemed timely to establish a forum for communication among specialists on an international level This book presenting the papers given at this conference demonstrates the state of the art of this increasingly expanding field of applications of optics Furthermore the interested reader will find an extended list of references in the various contributions This book helps to overcome the difficulty inherent in all interdisciplinary research fields of gathering widely scattered literature The contributions to this book are focussed on the following topics Biomedical applications of unconventional imaging in microscopy image processing interferometry and holography speckle techniques and spectroscopy optometry and Moire methods In addition the brilliant and humorous closing remarks of Nils Abramson from the Royal Institute of Technology Stockholm have been included **Magnetic Electron Lenses** P.W. Hawkes, 2013-11-11 No single volume has been entirely devoted to the properties of magnetic lenses so far as I am aware although of course all the numerous textbooks on electron optics devote space to them The absence of

such a volume bringing together information about the theory and practical design of these lenses is surprising for their introduction some fifty years ago has created an entirely new family of commercial instruments ranging from the now traditional transmission electron microscope through the reflection and transmission scanning microscopes to columns for micromachining and microlithography not to mention the host of experimental devices not available commercially. It therefore seemed useful to prepare an account of the various aspects of magnetic lens studies. These divide naturally into the five chapters of this book: the theoretical background in which the optical behaviour is described and formulae given for the various aberration coefficients; numerical methods for calculating the field distribution and trajectory tracing; extensive discussion of the paraxial optical properties and aberration coefficients of practical lenses illustrated with curves from which numerical information can be obtained; a complementary account of the practical engineering aspects of lens design including permanent magnet lenses and the various types of superconducting lenses; and finally an up to date survey of several kinds of highly unconventional magnetic lens which may well change the appearance of future electron optical instruments very considerably after they cease to be unconventional.

Inverse Scattering Problems in Optics H.P.

Baltes, 2012-12-06 When in the spring of 1979 H.P. Baltes presented me with the precursor of this volume the book on Inverse Source Problems in Optics I expressed my gratitude in a short note which in translation reads: Dear Dr. Baltes the mere title of your unexpected gift evokes memories of a period which in the terminology of your own contribution would be described as the Stone Age of the Inverse Problem. Those were pleasant times. Walter Kohn and I lived in a cave by ourselves, drew pictures on the walls and nobody seemed to care. Now however Inversion has become an industry which I contemplate with as much bewilderment as a surviving Tasmanian aborigine gazing at a modern oil refinery with its towers, its flames and the confusing maze of its tubes. The present volume makes me feel even more aboriginal, impossible for me to fathom its content. What I can point out however is one of the forgotten origins of the Inverse Scattering Problem of Quantum Mechanics: Werner Heisenberg's S Matrix Theory of 1943. This grandiose scheme had the purpose of eliminating the notion of the Hamiltonian in favour of the scattering operator. If successful it would have done away once and for all with any kind of inverse problem.

Physical Metallurgy R.W. Cahn, P. Haasen, 1996-02-09 This is the fourth edition of a work which first appeared in 1965. The first edition had approximately one thousand pages in a single volume. This latest volume has almost three thousand pages in 3 volumes which is a fair measure of the pace at which the discipline of physical metallurgy has grown in the intervening 30 years. Almost all the topics previously treated are still in evidence in this version which is approximately 50% bigger than the previous edition. All the chapters have been either totally rewritten by new authors or thoroughly revised and expanded either by the third edition authors alone or jointly with new co-authors. Three chapters on new topics have been added: dealing with dry corrosion, oxidation and protection of metal surfaces, the dislocation theory of the mechanical behavior of intermetallic compounds and most novel a chapter on polymer science for metallurgists which

analyses the conceptual mismatch between metallurgists and polymer scientists way of looking at materials Special care has been taken throughout all chapters to incorporate the latest experimental research results and theoretical insights Several thousand citations to the research and review literature are included in this edition There is a very detailed subject index as well as a comprehensive author index The original version of this book has long been regarded as the standard text in physical metallurgy and this thoroughly rewritten and updated version will retain this status

**Electron Crystallography of Organic Molecules** J.R. Fryer,D. Dorset,2012-12-06 Maximum Entropy ME techniques have found widespread applicability in the reconstruction of incomplete or noisy data These techniques have been applied in many areas of data analysis including imaging spectroscopy and scattering Gull and Skilling 1984 The techniques have proven particularly useful in astronomy Narayan and Nityanada 1984 In many of these applications the goal of the reconstruction is the detection of point objects against a noisy background In this work we investigate the applicability of ME techniques to data sets which have strong components which are periodic in space or time The specific interest in our laboratory is High Resolution Electron Micrographs of beam sensitive materials However ME techniques are of general interest for all types of data These data may or may not have a spatial or temporal character Figure 1 shows an HREM image of the rigid rod polymer poly paraphenylene benzobisoxazole PBZO The 0.55 nm spacings in the image correspond to the lateral close packing between the extended polymer molecules Near the center of this crystallite there is evidence for an edge dislocation In HREM images both the frequency and position of the information is important for a proper interpretation Therefore it is necessary to consider how image processing affects the fidelity of this information in both real and Fourier space

**Journal of Electron Microscopy Technique** ,1991 *Mössbauer Spectroscopy II* U. Gonser,2013-04-18 Some newly discovered effects lose their glamor after a short period of euphoria Others however retain their fascination for a long time and even as they mature display unexpected features The Mossbauer effect belongs to the second category Rudolf Mossbauer's discovery of recoilless gamma ray emission in 1957 immediately caused a flurry of attention and confirming work appeared almost at once Since then the flow of publications has steadily increased Most studies follow predictable paths the essential aspects of these conventional experiments have been described in the first volume of the present work Mossbauer Spectroscopy Topics in Applied Physics Vol 5 These straightforward investigations have not however exhausted the field boredom has not set in and unexpected applications continue to appear In the present volume Uli Gonser has collected contributions that display the exotic side of the Mossbauer effect They range from a masterly description of the red shift experiment to a clear exposition of a powerful solution to the old and painful phase problem in crystallography Each of the contributions exhibits a different side of recoilless gamma ray emission Together they show that the field is very much alive and continues to delight us with elegant solutions to old problems unanticipated glimpses at new phenomena clever uses of new technical possibilities and ingenious applications to fields far away from physics I believe that novel features of the Mossbauer effect will continue to



appear and that new applications will still be found

**Electromagnetic Theory of Gratings** R. Petit, 2013-03-12 When I was a student in the early fifties the properties of gratings were generally explained according to the scalar theory of optics. The grating formula which predicts the diffraction angles for a given angle of incidence was established experimentally, verified and intensively used as a source for textbook problems. Indeed those grating properties we can call optical properties were taught in a satisfactory manner and the students were able to clearly understand the diffraction and dispersion of light by gratings. On the other hand little was said about the energy properties, i.e. about the prediction of efficiencies. Of course the existence of the blaze effect was pointed out but very frequently nothing else was taught about the efficiency curves. At most a good student had to know that for an echellette grating the efficiency in a given order can approach unity insofar as the diffracted wave vector can be deduced from the incident one by a specular reflexion on the large facet. Actually this rule of thumb was generally sufficient to make good use of the optical gratings available about thirty years ago. Thanks to the spectacular improvements in grating manufacture after the end of the second world war it became possible to obtain very good gratings with more and more lines per mm. Nowadays in gratings used in the visible region a spacing smaller than half a micron is common.

**Structural Phase Transitions I** K.A. Müller, H. Thomas, 2012-12-06 With contributions by numerous experts

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