Edited by
Herbert Gross

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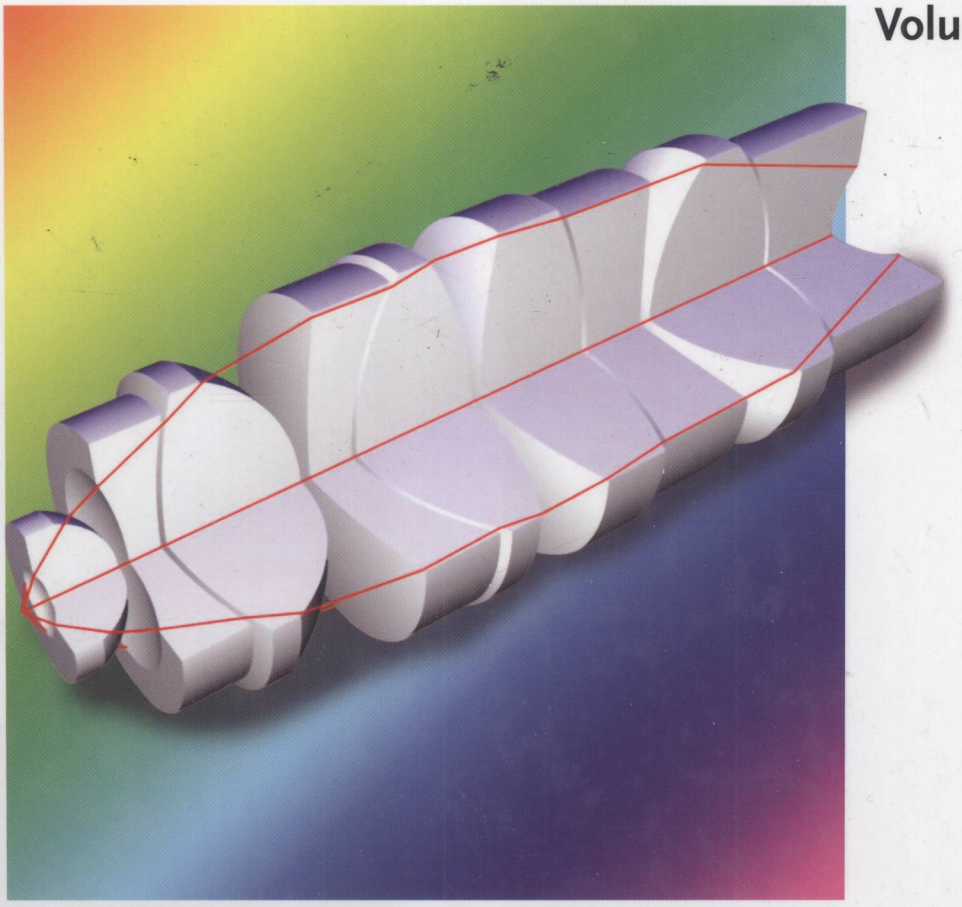
Handbook of Optical Systems

H. Gross
Fundamentals of Technical Optics



Volume 1

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Volume 1: Fundamentals of Technical Optics
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Volume 1: Fundamentals of Technical Optics
Volume 2: Physical Image Formation
Volume 3: Aberration Theory and Correction of Optical Systems
Volume 4: Survey of Optical Instruments
Volume 5: Metrology of Optical Components and Systems
Volume 6: Advanced Physical Optics

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Herbert Gross

Herbert Gross was born in 1955. He studied Physics at the University of Stuttgart and joined Carl Zeiss in 1982. Since then he has been working in the department of optical design. His special areas of interest are the development of simulation methods, optical design software and algorithms, the modelling of laser systems and simulation of problems in physical optics, and the tolerancing and the measurement of optical systems. Since 1995, he has been heading the central optical design department at Zeiss. He served as a lecturer at the University of Applied Sciences at Aalen and at the University of Lausanne, and gave seminars for the Photonics Net of Baden Württemberg as well as several company internal courses. In 1995, he received his PhD at the University of Stuttgart on a work on the modelling of laser beam propagation in the partial coherent region. He has published several papers and has given many talks at conferences.

Preface

The idea of writing the present book was born more than 20 years ago when I was just starting my professional career in the Department of Optical Design in the company Carl Zeiss in Oberkochen. I was in need of a book where one could find both the traditional and modern aspects of optical design, as well as its theoretical basis and also practical considerations.

It was a time of change when the experienced optical designers knew the procedure for the system layout and its optimization, but did not have the ability to optimize the use of the new computer technology with all its capabilities, while both the hardware and software did not possess the capacity eventually needed for various applications. Furthermore, at this time, new system concepts were coming more into play. They required profound scientific understanding of the principles of optics, which until then had played no role in the everyday life of a professional designer. These included lasers as light sources, the properties of which require completely different treatment and modeling. They also included the potential application of novel criteria for evaluation of wave aberrations, point image intensities and transfer functions, as they become more and more realistic, through the use of increasingly faster computers, and the excessive use, for practical reasons, of three-dimensional geometries and generalized surface shapes. All these aspects and recently many others, completely changed the job description of the optical designer and the knowledge which is necessary for effective work in this field.

The tasks of an optical designer are now becoming increasingly interdisciplinary. The knowledge necessary for efficient work is in the area of mathematics, when it comes to system optimization, and in the area of algorithms for numerical simulation. A knowledge of physics is required when it comes to the understanding of the principles of operation of complex optical systems, and also in the area of engineering, in terms of the knowledge necessary for construction, tolerancing, fabrication and assembling of the components. For this reason it is unfortunately extremely difficult for newcomers to find, both during university education and in the available technical literature, all the information necessary, from just one source. An additional complication arises because, in the absence of practical application, university textbooks contain too little implementation aspects, while for experts from the optical industry it is difficult to present the underlying theory in a thorough way and to

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find the time and willingness to process and publish all the information necessary. The objective of the present work is to attempt to fill this gap by presenting both the classical and modern aspects in a consistent manner.

The graphical representations will hopefully help the reader to understand the often complex relationships between the different issues which were of particular concern to me. My purpose was to offer, whenever possible, some visual support. I also tried, as often as I could, to use color layouts allowing for a particularly clear presentation and easy acquisition of knowledge. In this connection my special thanks go to Wiley-VCH Verlag and in particular to Dr. Alexander Grossmann and Dr. Andreas Thoß, who, being of the same opinion, always respected this ambition and assisted the realization of my intention despite the extensive problems which, even today, cannot be taken for granted. I really appreciated their enthusiasm and effort to support me in my work and also in finding solutions to the problems, as well as their continual cooperation in the whole process of writing this book.

It would not have been possible to edit and write down all the contents in an appropriate way by myself. The quantity of material to be included and the desire to complete the whole series in a definite time, as well as the fact that, as a single author, one cannot have experience in all the aspects treated, was the reason for my contacting a number of colleagues, in order to gain their support for this book. I am grateful to Bertram Achtner, Fritz Blechinger, Bernd Dörband, Michael Kempe, Henriette Müller, Wolfgang Singer, Michael Totzeck and Hannfried Zügge for their contributions, for their support, their commitment and enthusiasm. The constructive working relationships with them were a pleasure and have been encouraging all the time.

For their useful hints and assistance, especially in the correcting and reviewing of the first volume of this series, I would like to acknowledge the help of my colleagues Hans-Joachim Frasch, Michael Totzeck, Wolfgang Singer, Michael Kempe and Markus Seesselberg. Most notably my thanks go to Hannfried Zügge. Without his help the first volume of the series would never have appeared in its present form. With his typical accuracy and expertise he contributed a great deal to the elimination of ambiguities and errors.

Especially I would like to thank my wife Beate and my daughter Alexandra for their tolerance and patience when I was writing this book or sitting in front of the computer. Without their help and moral support it would not have been possible to accomplish this work.

Essingen,
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