Optics Using MATLAB®

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Scott W. Teare

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Introduction to the Series

Since its inception in 1989, the Tutorial Texts (TT) series has grown to cover many diverse fields of science and engineering. The initial idea for the series was to make material presented in SPIE short courses available to those who could not attend and to provide a reference text for those who could. Thus, many of the texts in this series are generated by augmenting course notes with descriptive text that further illuminates the subject. In this way, the TT becomes an excellent stand-alone reference that finds a much wider audience than only short course attendees.

Tutorial Texts have grown in popularity and in the scope of material covered since 1989. They no longer necessarily stem from short courses; rather, they are often generated independently by experts in the field. They are popular because they provide a ready reference to those wishing to learn about emerging technologies or the latest information within their field. The topics within the series have grown from the initial areas of geometrical optics, optical detectors, and image processing to include the emerging fields of nanotechnology, biomedical optics, fiber optics, and laser technologies. Authors contributing to the TT series are instructed to provide introductory material so that those new to the field may use the book as a starting point to get a basic grasp of the material. It is hoped that some readers may develop sufficient interest to take a short course by the author or pursue further research in more advanced books to delve deeper into the subject.

The books in this series are distinguished from other technical monographs and textbooks in the way in which the material is presented. In keeping with the tutorial nature of the series, there is an emphasis on the use of graphical and illustrative material to better elucidate basic and advanced concepts. There is also heavy use of tabular reference data and numerous examples to further explain the concepts presented. The publishing time for the books is kept to a minimum so that the books will be as timely and up-to-date as possible. Furthermore, these introductory books are competitively priced compared to more traditional books on the same subject.

When a proposal for a text is received, each proposal is evaluated to determine the relevance of the proposed topic. This initial reviewing process has been very helpful to authors in identifying, early in the writing process, the need for additional material or other changes in approach that would serve to strengthen the text. Once a manuscript is completed, it is peer reviewed to ensure that chapters communicate accurately the essential ingredients of the science and technologies under discussion.

It is my goal to maintain the style and quality of books in the series and to further expand the topic areas to include new emerging fields as they become of interest to our reading audience.

James A. Harrington
Rutgers University

Contents

Preface

Optical engineers make use of a wide variety of commercial software tools in the design, development and testing of optical systems. These tools, no matter how excellent in their own right, can fall short of providing needed calculations. This need for flexibility and special calculations is the domain of user-programmable software.

Optics Using MATLAB® was written to tie a number of optical topics into programming activities with MATLAB and can act as a supplement to other textbooks or stand alone. The book is divided into three parts: Part I has five chapters focused on a wide range of basic programming fundamentals using MATLAB and includes topics such as curve fitting, image processing, and file storage. The eight chapters of Part II provide a review of a number of selected topics in optics and demonstrate how these can be explored using MATLAB scripts. Part III discusses how to use MATLAB to improve the usability of custom programs through graphical user interfaces and incorporating other programming languages.

The book was designed such that you can get started on any chapter that catches your attention and seek more specialized information from the earlier chapters as needed. Some examples of the topics in Part II are thin film filters, spectrometers, polarization, complex index of refraction, and wavefront sensing.

Optics Using MATLAB provides a functional overview of developing code using MATLAB that can be used to enhance and increase the understanding of optics topics though the use of visualization tools. This book is not meant to be a fundamental treatment of optics, but rather a complement to the many excellent books on optics, while providing an example-based approach to understanding the underlying optical questions.

I greatly appreciate all of the colleagues and friends who have both directly and indirectly helped me in preparing and writing this book, and I am grateful for their unswerving and unselfish support. I also appreciate the feedback from the many students who over the years have helped me refine my optics and electronics lectures and laboratories.

While I have benefited from the support of many individuals in preparing this work, any errors that remain in the text are mine to fix. I would

appreciate receiving any assistance in the form of comments and corrections. Please direct any correspondence to the author at scott.teare@nmt.edu.

I am most grateful for the support of SPIE for their interest in publishing this work as part of the *Tutorial Text* series and particularly the efforts of Senior Editor Dara Burrows, for putting this work into its final form.

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