
OPTICAL SCANNING HOLOGRAPHY WITH MATLAB®

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Dedication

This book is dedicated to

*Eliza (M.S., Iowa 1980),
Christina (B.S., Cornell 2004), and
Justine (B.S., Virginia Tech 2007).*

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Preface

This book serves two purposes. The first is to succinctly cover the necessary mathematical background and wave optics that pertain to Fourier optics and holography. The second is to introduce optical scanning holography (OSH) - a form of electronic (or digital) holography - to the readers, and to provide them with experience in modeling the theory and applications utilizing MATLAB®.

Optical Scanning Holography with MATLAB® consists of tutorials (with numerous MATLAB examples throughout the text), research material, as well as new ideas and insights that are useful for engineering or physics students, scientists, and engineers working in the fields of Fourier optics, optical scanning imaging and holography. The book is self-contained and covers the basic principles of OSH. Thus, this book will be relevant for years to come. The writing style of this book is geared towards undergraduate seniors or first-year graduate-level students in the fields of engineering and physics. The material covered in this book is suitable for a one-semester course in Fourier optics, optical scanning imaging and holography.

Optical scanning holography is a highly sophisticated technology that consists of numerous facets and applications. It is a real-time (or on-the-fly) holographic recording technique that is based on active optical heterodyne scanning. It is a relatively new area in electronic holography and will potentially lead science and technology to many novel applications such as cryptography, 3-D display, scanning holographic microscopy, 3-D pattern recognition and 3-D optical remote sensing. The main purpose of this book is to introduce optical scanning holography to the readers in a manner that will allow them to feel comfortable enough to explore the technology on

their own - possibly even encourage them to begin implementing their own set-ups in order to create novel OSH applications. Optical scanning holography is generally a simple yet powerful technique for 3-D imaging, and it is my aspiration that this book will stimulate further research of optical scanning holography and its various novel applications.

I have incorporated some of the material from this book into my short course entitled “Optical Scanning Holography” at SPIE Photonics West, in lectures given at the Institute of Optical Sciences (IOS), which is now known as the Department of Optics and Photonics, National Central University (NCU), Taiwan, and also at the Department of Electronics and Computer Science, Nihon University, Japan. The book was finally completed during my time as a visiting professor at Nihon University. I want to take this opportunity to thank my host, Professor Hiroshi Yoshikawa, for his hospitality and arranging a spacious office for me that allowed me to concentrate on the last phase of this book. I would also like to thank Professor Hon-Fai Yau of NCU for providing me with some early opportunities (when the book was still in its infancy) to “rehearse” my optical scanning holography lectures at IOS.

I would like to thank my wife, Eliza, and my children, Christina and Justine, for their encouragement, patience, and love. This book is dedicated to them. In addition, I would also like to thank Christina Poon for reading the manuscript and providing comments and suggestions for improvement.