Preface

Optical fiber is one of the twentieth century's technology marvels. It made the modern day high-speed communications networks possible and this significant contribution was recognized by Charles K. Kao being awarded the Nobel Prize in Physics in 2009. However, unknown to most of the general public, optical fiber technology has made significant contributions to sensors and imaging technologies as well. It was recognized during the early part of the optical fiber development that optical fibers having small diameter, extremely long length, and flexibility have desired properties for developing endoscopic imaging devices and sensors. The long fiber length allowed the fiber optic sensors to have long interaction lengths which made them highly sensitive. The small diameter allowed the fiber optic sensors and imagers to be made compact and portable. The flexibility allowed the sensor and imagers to be placed in most tight spaces. Now, fiber optic imaging and sensing devices are being used for a wide range of applications such as in medical, environmental, manufacturing, and defense.

This book is designed to highlight the basic principles of fiber optic imaging and sensing devices. The book is by no means complete and comprehensive. But it is designed to provide the readers with a solid foundation in fiber optic imaging and sensing devices. It begins with an introductory chapter that starts from Maxwell's equations, mostly to show the readers where the governing equations in fiber devices come from and some idea as to how they are derived. The chapter ends with the derivation of the basic optical fiber characteristic equations and solutions (i.e., fiber modes). Chapter 2 reviews most common fiber optic interferometric devices which are bases for many fiber optic imaging and sensing systems. Chapter 3 discusses the basics of fiber optic imagers with emphasis on fiber optic confocal microscope. The fiber optic interferometric sensors are discussed in detail in Chaps. 4 and 5. Chapter 4 deals with fiber Bragg grating based sensor and various applications. Chapter 5 goes over in detail fiber Sagnac loop-based sensors. Chapter 6 covers optical coherence tomography in detail. Unlike other chapters, it goes into details the signal processing and systems level approach of the real-time OCT implementation that I hope the readers may find useful for building their own OCT systems. All the chapters start with theoretical derivation of devices characteristics. This is to help student reader with understanding the

underlying principle of fiber optic devices. Also useful forms of device characteristic equations are provided so that this book can be used as a reference for scientists and engineers in the optics and related fields.

This book could not have been written without the help of contributing authors, Do-Hyun Kim from FDA, Utkarsh Sharma and Xing Wei from Carl Zeiss Meditec, Li Qian from University of Toronto, Kang Zhang from GE Global Research, and Young-Geun Han from Hanyang University; my sincere thanks to them. Also help from one of my current students, Jaepyeong Cha, is greatly appreciated. I must say Brett Kurzman, Editor of Engineering/Applied Sciences, Springer must be one of the most patient people I know. Many thanks to his patience and accommodation.

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