

Xin Lin

Visible Light Communications





This series of short books cover a wide array of topics, current issues, and advances in key areas of wireless, optical, and wired communications. The series also focuses on fundamentals and tutorial surveys to enhance an understanding of communication theory and applications for engineers.

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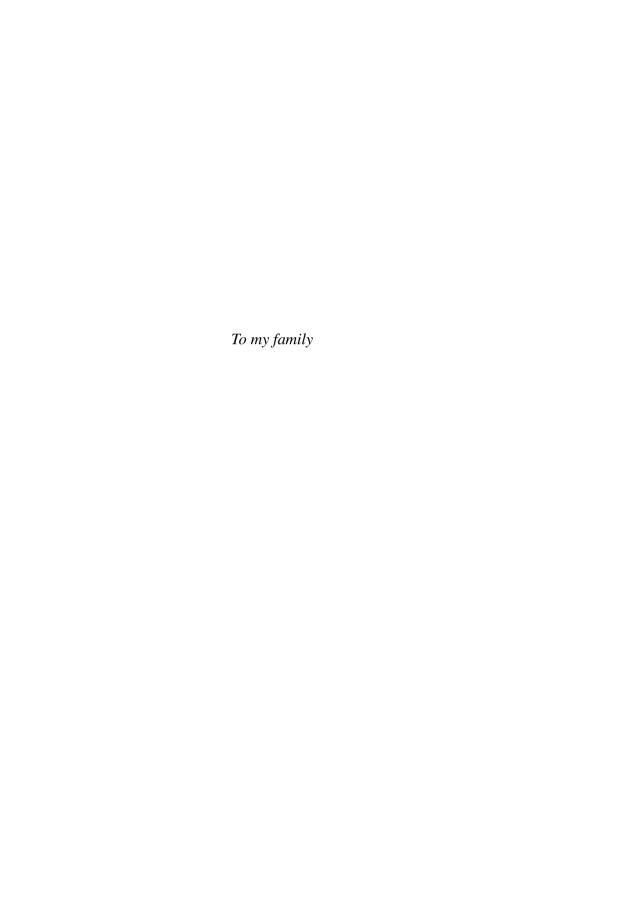
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Preface

Visible light is an electromagnetic wave with wavelengths in a region of the spectrum from about 380 to 780 nm. The developments of visible lightwave technology, such as lightwave propagation, detection, and switching have found ever-increasing applications in optical communications, signal processing, computing, and sensing.

Visible light communication (VLC) as one of lightwave technology is a novel wireless communication technology developed along with LED lighting. One of its most important features is the ability to use the ubiquitous lighting to transmit information around the users, and this makes VLC one of the best techniques to realize ubiquitous information services, such as indoor short-range communications, Li-Fi (Light Fidelity) systems, IoT (Internet of Things) systems, underwater optical wireless communication systems and so on. Thus, it can also be referred to as illumination light communication (ILC), it is a modern and interesting technique related with the daily life of people.

The purpose of this book is to help readers understand the fundamentals that are related with this emerging technology, and its best application areas. Subject matter of this book has been chosen with two general aims in mind. The first is to give readers enough of the basic principles behind practical optical components and systems so that they can do effective research and laboratory works. The second aim is for readers to know the essence of VLC so they can find and build new applications.

This book, apart from emphasizing the basics and applications of VLC, also incorporates many of the recent developments, such as visible-light wireless LAN, underwater optical wireless sensor network, optical metamaterials, Optical multiple-access techniques, new VLC standards, and techniques of combining VLC with art. The book includes author's worked examples of the research and developments and a wealth of references. Depending on the requirement, topics in the book can as a research or

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development material for researchers and engineers in optical engineering or optical communication fields. And it also can provide an important reference material for either an introductory or a more advanced course to science students.

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Acronyms

ACO-OFDM Asymmetrically Clipped Optical OFDM

ADC Analog to Digital Conversion
AEL Allowable Exposure Limit
AM Amplitude Modulation
APD Avalanche Photodiode

ARIB Association of Radio Industries and Businesses

ASK Amplitude Shift Keying

AUV Autonomous Underwater Vehicle

B Blue

BCSK Binary CSK BER Bit Error Rate

BIM Baseband Intensity Modulation

C Cyan

CC Convolutional Codes
CCD Charge-Coupled Device
CD Coherent Detection

CDM Code Division Multiplexing

CIE Commission Internationale de l'Éclairage (International Commission

on Illumination)

CMOS Complementary Metal Oxide Semiconductor

CMY Cyan, Magenta, and Yellow
CRC Cyclic Redundancy Checks
CRI Color Rendering Index
CRT Cathode Ray Tube
CSK Color-Shift Keying

CSML Color-Separation Metalens
CSS Carrier Signal Source
D/A Digital-to-Analog

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DBM Duobinary Modulation
DBR Distributed Bragg Reflector

DC Direct Current

DCO-OFDM Direct Current Biased Optical OFDM

DD Direct Detection
DEMUX Demultiplexer
DLL Data Link Layer
DMT Discrete Multitone

DSOC Deep Space Optical Communication

DSP Digital Signal Processing
E/O Electro-Optic Conversion
EEL Edge-Emitting Laser
ELF Extremely Low Frequency
EMC Electromagnetic Compatibility
EPE External Photoelectric Effect
FDM Frequency Division Multiplexing

FEC Forward Error Correction
FM Frequency Modulation
FOC Fiber Optic Communication

FOV Field of View

FSK Frequency Shift Keying FSO Free-Space Optics

FWHM Full Width at Half Maximum

G Green

GPS Global Positioning System
HD Heterodyne Detection
IC Integrated Circuit
ID Identification

IEC International Electrotechnical Commission
IEEE Institute of Electrical and Electronic Engineers

IFFT Inverse Fast Fourier Transform
ILC Illumination Light Communication

IM Intensity Modulation

IM/DD Intensity Modulation with Direct Detection

IoT Internet of Things

IPE Internal Photoelectric Effect

IR/Ir Infrared

IrDA Infrared Data Association

IS Image Sensor

ISC Image Sensor Communication ISS Information Signal Source