

# Preface

In recent years, the technology of optical communication has gained importance due to high bandwidth and data rate requirements. This book focuses on free-space optical (FSO) communication that is capable of providing cable-free communication at very high data rates (up to Gbps). Unlike radio frequency communication that has restricted bandwidth due to its limited spectrum availability and interference, FSO communication has license-free spectrum as of now. This technology finds its application in terrestrial links, deep space/inter-satellite links, unmanned aerial vehicles (UAVs), high-altitude platforms (HAPs), and uplink and downlink between space platform, aircrafts, and other ground-based fixed/mobile terminals. It provides good privacy with flexible interconnection through a distributed or centralized communication system. It is a growing area of research these days due to its low power and mass requirement, bandwidth scalability, unregulated spectrum, rapid speed of deployment/redeployment, and cost-effectiveness. However, despite many advantages, the performance of FSO communication system is influenced by unpredictable atmospheric conditions, and this undoubtedly poses a great challenge to FSO system designers. The primary factors that deteriorate the FSO link performance are absorption, scattering, and turbulence. Out of these, the atmospheric turbulence is a major challenge that may lead to serious degradation in the link performance and make the communication link infeasible. This book gives the basic understanding of FSO communication system and lays emphasis on improving the performance of FSO link in turbulent atmosphere.

The purpose of this book is to cover the basic concepts of FSO communication system and provide the readers with sufficient in-depth knowledge to design a wireless optical link. The intended readers for this book include engineers, designers, or researchers who are interested in understanding the phenomena of laser beam propagation through the atmosphere. This book primarily focuses on outdoor wireless communication, though a little briefing on indoor wireless communication is given in the introductory chapter. Although this book is based on the doctoral work of the first author, it has been completely rewritten and expanded to cover basic concepts of FSO communication system from readers' point of view.

This book has been organized into seven chapters. Chapter 1 provides an overview of FSO technology with historical background and its various applications. Chapter 2 gives a comprehensive coverage of FSO channel models and various atmospheric losses encountered during beam propagation through the atmosphere including free-space loss, pointing loss, absorption, and scattering loss. This is followed by the description of atmospheric turbulence and its effects on the laser communication, i.e., beam wander, beam spreading, beam scintillation, spatial coherence degradation, and image dancing. Various models for the atmospheric turbulent channel are presented. Chapter 3 discusses various components of FSO communication system. It provides description of optical transmitter, amplifiers, and receiver. The design of optical receiver that takes into account different types of detectors, noise sources, and receiver performance in terms of signal-to-noise ratio is presented. Finally, various issues involved in the link design like choice of operating wavelength, aperture diameter, and receiver bandwidth are discussed. Chapter 4 deals with the most challenging aspect of FSO communication system, i.e., acquisition, tracking, and pointing. The initial linkup or acquisition time puts a limit on the overall performance of the system, and hence, it is an essential system design constraint. Various subsystems involved in the accurate pointing of narrow laser beam toward the target are presented in this chapter. Chapter 5 presents bit error rate (BER) performance of FSO link for coherent and noncoherent modulation schemes. Chapter 6 discusses various techniques for improving link performance, i.e., aperture averaging, spatial diversity, coding, adaptive optics, relay-assisted FSO, etc. Finally, the last chapter describes in detail how the optical system designers can calculate link budgets.

Gurgaon, India  
New Delhi, India  
New Delhi, India

Hemani Kaushal  
V.K. Jain  
Subrat Kar

<http://www.springer.com/978-81-322-3689-4>

Free Space Optical Communication

Kaushal, H.; Jain, V.K.; Kar, S.

2017, XXIX, 209 p. 111 illus., 49 illus. in color.,

Hardcover

ISBN: 978-81-322-3689-4