Laser Beam Propagation: Generation and Propagation of Customized Light

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How do laser beams propagate? Innovative discoveries involving laser beams and their propagation properties are at the heart of **Laser Beam Propagation: Generation and Propagation of Customized Light**. This book captures the essence of laser beam propagation. Divided into three parts, it explores the fundamentals of how laser beams propagate, and provides novel methods to describe and characterize general laser beams.

Part one covers the physical optics approach to the propagation of optical waves, the concept of plane waves, the mathematical description of diffraction and Gaussian optics, and adapting the concepts to the single photon level. The book explains the parallels between the paraxial propagation of light beams and the Schrödinger equation in quantum mechanics, and delves into the description of paraxial optics by means of state vectors and operators. It also discusses classical optics and quantum entanglement.

Part two focuses on the application of modal decomposition to the characterization of laser beams, and provides a characterization of time domain pulses. It discusses tools for the temporal characterization of laser beams, the generation of arbitrary laser beams with digital holograms, and the use of spatial light modulators to display reconfigurable digital holograms capable of modifying and shaping laser beams. It also covers various techniques and the control of the polarization properties of light.

Part three defines the most commonly generated shaped light, flat-top beams, outlining their propagation rules as well as the means to create them in the laboratory. It also highlights Helmholtz-Gauss beams, vector beams, and low coherence laser beams.

The text presents the concepts of coherence theory and applies this to the propagation of low coherence optical fields. It also considers the recent developments in orbital angular momentum carrying fields, touches on basics properties, definitions and applications, and brings together the classical and quantum concepts of spatial modes of light.

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