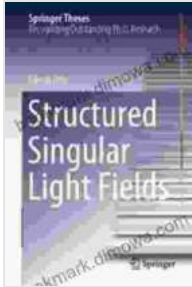


Unveiling the World of Structured Singular Light Fields: A Journey from Fundamentals to Applications



Structured Singular Light Fields (Springer Theses)

by Hai Chau Le

★★★★☆ 4.2 out of 5

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Enhanced typesetting : Enabled

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Structured singular light fields (SSLFs), characterized by their unique spiral wavefront structure, have emerged as a transformative technology with far-reaching implications across diverse scientific disciplines. This doctoral thesis presents a comprehensive investigation into the fundamentals of SSLFs, unlocking their potential for advancements in imaging, optical communications, and quantum optics.

Theoretical Foundations

The thesis delves into the theoretical principles underlying SSLFs, providing a solid understanding of their distinct properties and behavior. Key concepts such as optical vortices, topological charge, and spin-orbit

interaction are thoroughly explained, laying the groundwork for subsequent chapters.

Generation and Manipulation of SSLFs

The thesis explores various techniques for generating and manipulating SSLFs, enabling researchers and engineers to harness their unique properties. Approaches ranging from computer-generated holograms to metasurfaces and nanophotonic devices are meticulously described, providing a practical guide to SSLF engineering.

Imaging Applications

The thesis highlights the transformative potential of SSLFs in the field of imaging. Advanced microscopy techniques, such as structured illumination microscopy and optical vortex coronagraphy, are presented, showcasing the ability of SSLFs to enhance resolution, reduce noise, and improve imaging depth. Other applications, including optical tweezers and particle manipulation, are also explored.

Optical Communications Applications

The thesis investigates the potential of SSLFs for enhancing optical communications systems. Advanced modulation schemes, such as orbital angular momentum (OAM) and spin multiplexing, are discussed, demonstrating the ability of SSLFs to increase channel capacity and improve security.

Quantum Optics Applications

The thesis explores the interplay between SSLFs and quantum optics, opening up new possibilities for quantum information processing and

entanglement manipulation. Applications in quantum computing, quantum imaging, and quantum cryptography are thoroughly examined.

Outlook and Future Directions

The thesis concludes with a comprehensive outlook on the future of SSLFs, identifying promising research directions and potential breakthroughs. Emerging applications in biophotonics, sensing, and nonlinear optics are discussed, highlighting the vast potential of this groundbreaking technology.

This doctoral thesis provides a comprehensive exploration of structured singular light fields, offering a deep understanding of their theoretical foundations and demonstrating their transformative potential in a wide range of applications. The research presented in this thesis paves the way for further advancements in imaging, optical communications, and quantum optics, shaping the future of these fields.

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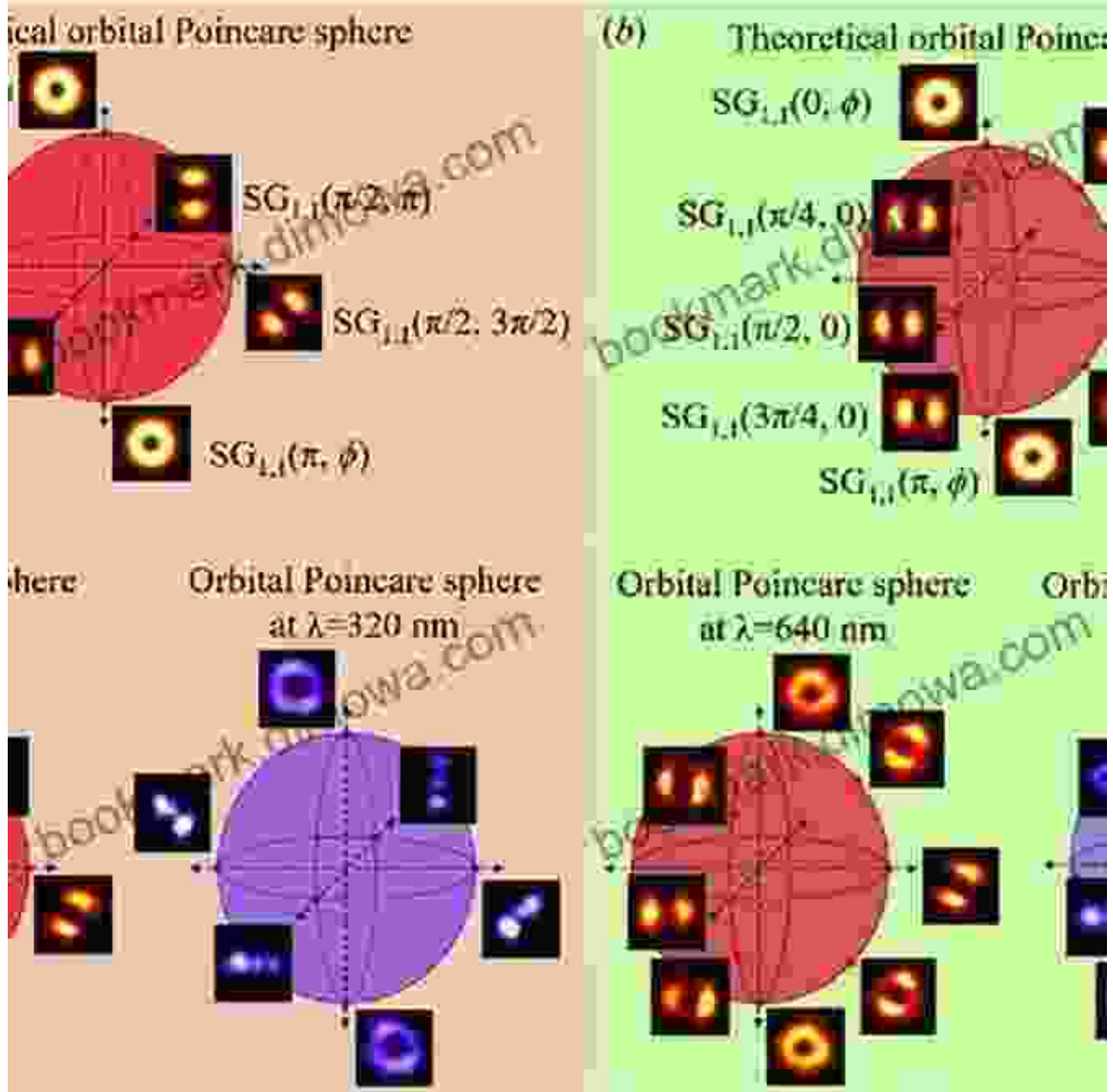
About the Author

Mohammadreza Khorasaninejad is a visionary scientist renowned for his groundbreaking research in nanophotonics and structured light. As an Associate Professor at the Harvard John A. Paulson School of Engineering and Applied Sciences, he has authored over 100 peer-reviewed publications and holds numerous patents. His research has been widely recognized, earning him prestigious awards such as the MacArthur Fellowship and the Blavatnik Award.

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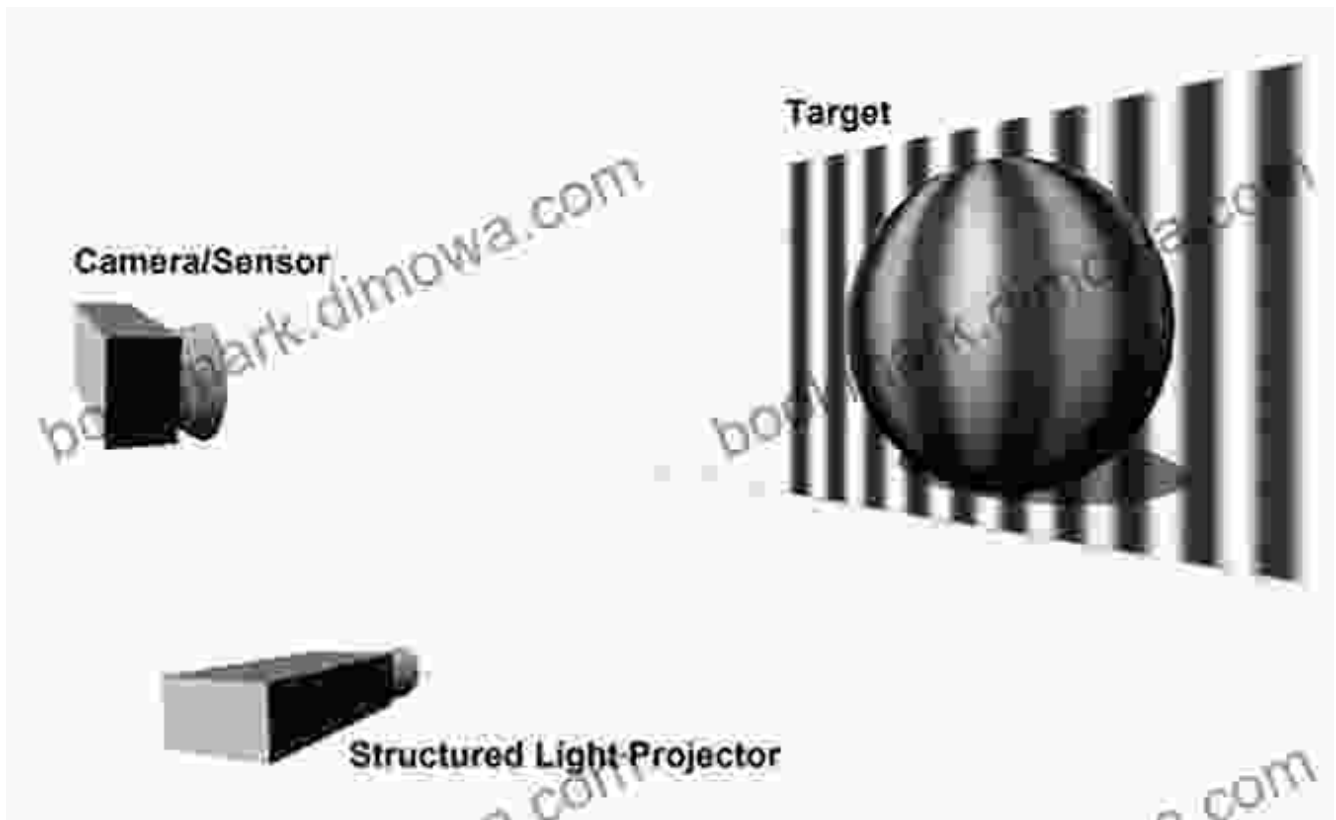
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Figure 1: Engineering Structured Singular Light Fields



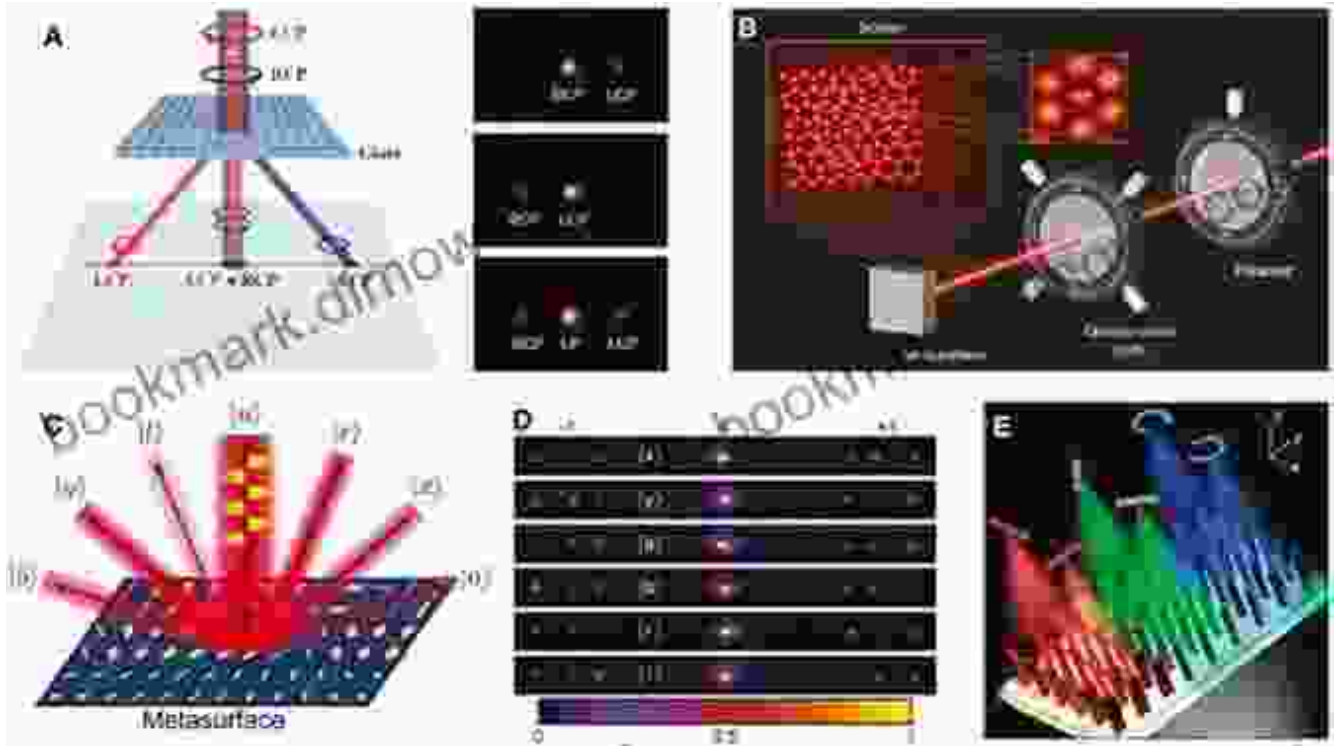
Engineering Structured Singular Light Fields for Imaging and Communications

Figure 2: Advanced Imaging with Structured Singular Light Fields



Advanced Imaging with Structured Singular Light Fields: Microscopy, Coronagraphy, and Particle Manipulation

Figure 3: Enhanced Optical Communications with Structured Singular Light Fields

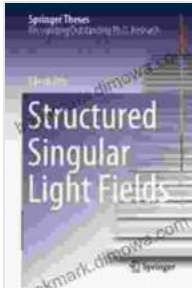


Enhanced Optical Communications with Structured Singular Light Fields: Orbital Angular Momentum and Spin Multiplexing

Figure 4: Quantum Optics Applications of Structured Singular Light Fields



Quantum Optics Applications of Structured Singular Light Fields: Quantum Computing, Imaging, and Cryptography



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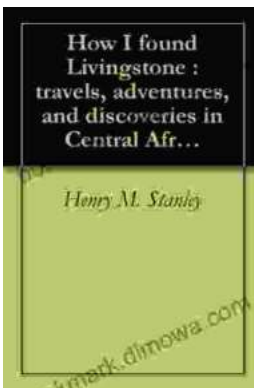
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