

Contents

	<i>Preface</i>	<i>page</i> ix
	<i>Acknowledgments</i>	xi
1	Introduction to Digital Holography	1
	1.1 Basic Concept of Holography	1
	1.2 Optical Recording in Practice	5
	1.3 Photography	6
	1.4 Recording Setup in Optical Holography	7
	1.5 Computer-Generated Holography	12
	1.5.1 Point-Based Method	14
	1.5.2 Layer-Based Method	16
	1.6 Reconstruction of Digital Hologram	17
	1.7 Capturing Digital Hologram of a Physical Object	19
	1.7.1 Capture of Digital Off-Axis Hologram	19
	1.7.2 Phase-Shifting Holography	21
	1.7.3 Optical Scanning Holography	25
	1.7.4 Non-diffractive Optical Scanning Holography	27
	1.8 MATLAB Simulation	29
	1.8.1 Simulation of Generating a Hologram with the Point-Based Method	29
	1.8.2 Simulation of Capturing an Off-Axis Hologram	31
	1.8.3 Simulation of Capturing a Digital Fresnel Hologram with Four-Step Phase-Shifting Holography	34
	1.9 Summary	34
	Exercises	37
	References	38
2	Fast Methods for Computer-Generated Holography	40
	2.1 Introduction	40
	2.2 Realization of CGH with Fourier Transform	41
	2.3 Direct Look-Up Table Method	42
	2.4 Novel Look-Up Table Method	44
	2.5 The Line Scanning Method	46
	2.6 The Split-Look-Up-Table (S-LUT) Framework	47

2.7	Compressed Look-Up-Table Method	49
2.8	Wavefront Recording Plane Method	50
2.9	Interpolated WRP Method	55
2.10	The Warped WRP Method	56
2.11	MATLAB Simulation	61
2.11.1	Simulation of Computer-Generated Hologram with the WRP Method	62
2.11.2	Simulation of Computer-Generated Hologram with the Downsampled WRP Method	62
2.11.3	Simulation of Computer-Generated Hologram with the WWRP Method	69
2.12	Summary	69
	Exercises	73
	References	74
3	Generation of Phase-Only Fresnel Hologram	76
3.1	General View on Holographic Display System	76
3.1.1	Dual SLM Holographic Display System	76
3.1.2	Split SLM Holographic Display System	77
3.1.3	Amplitude-Only SLM Holographic Display System	78
3.2	Iterative Method for Generating Phase-Only Holograms	79
3.2.1	Generating Phase-Only Hologram for a Single-Depth Image	79
3.2.2	Enhanced IFTA: Mixed-Region Amplitude Freedom Method	81
3.2.3	Noise Reduction with IFTA Multiple Frame Averaging	83
3.2.4	Generating Phase-Only Hologram of a Multi-Depth Object with IFTA	85
3.3	Non-iterative Method for Generating Phase-Only Hologram	87
3.3.1	Random Noise Addition	88
3.3.2	Edge-Enhanced Noise-Addition Method	89
3.3.3	One-Step-Phase-Retrieval	90
3.3.4	Patterned Phase-Only Hologram	92
3.3.5	Sampled Phase-Only Hologram	93
3.3.6	Edge-Enhanced Sampled Phase-Only Hologram	96
3.3.7	Complementary Sampled Phase-Only Hologram	97
3.3.8	Binary Phase-Only Hologram	98
3.4	MATLAB Simulation	99
3.4.1	Simulation of Generating a Phase-Only Hologram with IFTA	100
3.4.2	Simulation of Generating a Phase-Only Hologram with the MRAF	100
3.4.3	Simulation of Generating a Phase-Only Hologram of a Two-Layer Object (Double-Depth Image) with the Noise-Addition Method	106
3.4.4	Simulation of Generating a Phase-Only Hologram of a Two-Layer Object with the PPOH Method	109
3.5	Summary	109
	Exercises	110
	References	111

4	Conversion of Complex-Valued Holograms to Phase-Only Holograms	113
	4.1 Introduction	113
	4.2 Complex Amplitude Modulation	114
	4.3 Double-Phase Macro-Pixel Hologram	116
	4.4 Uni-directional Error Diffusion	121
	4.5 Bi-directional Error Diffusion	123
	4.6 Localized Error Diffusion	125
	4.7 Converting a Complex-Valued Hologram to a Binary Phase-Only Hologram with Direct Binary Search	127
	4.8 MATLAB Simulation	129
	4.8.1 Simulation of Converting a Complex-Valued Hologram into a Phase-Only Hologram with the CAM Method	129
	4.8.2 Simulation of Converting a Complex-Valued Hologram into a Phase-Only Hologram with the Double-Phase Macroblock Method	132
	4.8.3 Simulation of Converting a Complex-Valued Hologram into a Phase-Only Hologram with the UERD Method	135
	4.8.4 Simulation of Converting a Complex-Valued Hologram into a Phase-Only Hologram with the BERD Method	138
	4.8.5 Simulation of Converting a Complex-Valued Hologram into a Binary Phase-Only Hologram with the DBS Method	141
	4.9 Summary	141
	Exercises	145
	References	145
5	Applications of Phase-Only Hologram in Display, Holographic Encryption, and Steganography	147
	5.1 Introduction	147
	5.2 Holographic Projection and Display	147
	5.2.1 Spatial Light Modulator	148
	5.2.2 Holographic Projection	150
	5.2.3 Holographic Display	150
	5.3 Holographic Encryption	151
	5.3.1 Optical Cryptography	153
	5.3.2 Double Random Phase Optical Encryption	154
	5.3.3 Single Random Phase Holographic Encryption	155
	5.3.4 Enhanced Single Random Phase Holographic Encryption	160
	5.3.5 Multiple-Image Holographic Encryption with Arnold Transform	163
	5.4 Holographic Steganography	168
	5.4.1 Data Embedded Error Diffusion Hologram	169
	5.4.2 Image Embedded Error Diffusion Hologram	172
	5.5 MATLAB Simulation	176
	5.5.1 Simulation of the SRPE Method	176

5.5.2	Simulation on the ESRPE Method	179
5.5.3	Simulation of Multiple-Image Holographic Encryption with Arnold Transform	183
5.5.4	Simulation of Generating a DEED Hologram that Embeds an Image	186
5.6	Summary	190
	Exercises	190
	References	191
	<i>Index</i>	194