



CONTENTS

Chapter 1 Introduction

1.1	Optical metrology	01
1.2	Holography	02
1.3	Conventional holography	03
1.3.1	Recording materials	04
1.4	Electronic recording devices	05
1.5	Computer-generated hologram	05
1.6	Digital Holography	05
1.6.1	Applications of digital holography	08
1.7	Thesis Objectives	08
1.7.1	Thesis Outline	09
	References	11

Chapter 2 Theoretical aspects of Digital Holography

2.1	Introduction	14
2.2	Interference	15
2.3	Coherence	16
2.4	Hologram recording	17
2.5	Hologram reconstruction	18
2.6	Holographic interferometry	21
2.7	Numerical reconstruction of digital holograms	24
2.7.1	Wave propagation	24
2.7.2	The scalar wave equation	25
2.7.3	Fresnel-Kirchoff diffraction integral	27
2.7.4	Numerical reconstruction of digital holograms by Fresnel Transform	29
2.7.5	Reconstruction sing Angular Spectrum Propagation (ASP) integral	34
2.8	Computing intensity and phase of the object wavefront	38
2.9	Codes for numerical reconstruction of holograms	39
	References	41

Chapter 3 Testing of wave front from lenses

3.1	Introduction	45
3.1	Measurement of parallelism of the wave front	46
3.2	Measurement of wave front radius of curvature	54
3.3	Measurement of focal length of test lens	57
3.4	Measurement of lens radius of curvature	61
3.5	Determination of the Refractive Index	63
3.6	Discussions and Conclusion	65
	References	67

Chapter 4 Imaging of refractive index distribution in phase objects

4.1	Introduction	69
4.2	Experimental setup and hologram reconstruction	70
4.3	Computation of phase difference	72
4.4	Measurement of refractive index change	73
4.5	Abel Inversion	74
4.6	Experimental Results	74
4.6.1	Refractive index distribution in a candle flame	75
4.6.2	Temporal evolution of refractive index distribution in a dielectric slab	79
4.6.3	Temperature distribution in air using a point heat source	84
4.7	Discussions and Conclusion	87
	References	88

Chapter 5 Characterization of transparent micro-objects

5.1	Introduction	89
5.2	Digital Holographic Microscope	92
5.3	Reconstruction of digital holograms	95
5.4	Computation of intensity and phase	95
5.5	Computation of optical path length (OPL) change	95
5.6	Experimental investigations	96
5.6.1	Investigations on static object	96
5.6.2	Investigations on onion cells	99
5.6.3	Experiments on Acrylic sheet	104
5.7	Discussions and conclusion	108
	References	110

Chapter 6 Summary and Future Scopes

112