Contents

Series Editors' Preface			'xi	
Preface				
Acl	Acknowledgments			
PART I		INTRODUCTION TO IMAGE FORMATION AND FOCUSING		
1	Brief	History	3	
	1.1	Rectilinear propagation of light	3	
	1.2	Camera obscura	4	
	1.3	Optical instruments	5	
	1.4	Diffraction	5	
	1.5	Diffraction theory of imaging	6	
2	Appl	oplications		
	2.1	Imaging	10	
	2,2	Energy concentration	11	
	2.3	Focusing techniques	11	
3	Com	bined Method of Ray Tracing and Diffraction	12	
PA	RT II	DIFFRACTION OF SCALAR WAVES		
4	Diffr	action of Three-dimensional Waves	17	

DITT	ACTOR OF THECC-WHICHSIONAL WAYES	11
4.1	Angular-spectrum representations	17
4.2	Rayleigh-Sommerfeld and Kirchhoff diffraction integrals	20
4.3	Formulation of diffraction problems	22

viii Contents

	4.4	Comparison of Rayleigh-Sommerfeld and Kirchhoff	
		theories of diffraction by apertures in plane screens	24
5	Diffra	action of Two-dimensional Waves	41
	5.1	Angular-spectrum representation	41
	5.2	Impulse-response integral	42
	5.3	Parabolic approximation	44
6	Ray	Connection of Huygens' Principle	46
	6.1	Geometrical rays and edge diffraction	46
	6.2	Diffracted rays	47
	6.3	Ray formulations of diffraction problems	49
7	Num	erical Methods for Evaluating Diffraction Integrals	60
	7.1	Linear approximations to phase and amplitude	60
	7.2	Parabolic approximations to phase and amplitude	63
	7.3	Fast Fourier transform techniques	81
РА	RT III	ASYMPTOTIC THEORIES OF DIFFRACTION	
8	Meth	od of Stationary Phase for Single Integrals	91
	8.1	Non-uniform asymptotic approximations	91
	8.2	Transitional and uniform asymptotic approximations	97
9	Meth	od of Stationary Phase for Double Integrals	136
	9.1	Non-uniform asymptotic approximations	137
	9.2	Uniform asymptotic approximations	153
10	Asym	ptotic Theory of Diffraction for Two-dimensional Waves	163
	10.1	Diffraction of a diverging cylindrical wave	164
	10.2	Diffraction of a converging cylindrical wave	172
	10.3	Focusing with first-order cylindrical aberration	184
11	Asym	ptotic Theory of Diffraction for Three-dimensional Waves	201
	11.1	Diffraction of a diverging spherical wave by a circular	
	11.2	aperture Diffraction of a converging spherical wave by a circular	202
		aperture	224
РА	RT IV	FOCUSING OF SCALAR WAVES	
12	Three	-dimensional Waves	243

12.1	Approximate theories	243

	Contents		
	10.0	Focusing at low France numbers	791
	12.2	Portage insident ways	21/
	12.3	Perfect incluent wave	202
	12.4	Rectangular and emptical apertures	243
	12.5	Gaussian deams	250
	12.0	Results of classical theory	330
13	Two-	dimensional Waves	377
	13.1	Approximate theories	377
	13.2	Focusing of perfect and non-perfect waves	389
14	Com	antation of Focused Fields	308
14	1A 1	Transition from ray tracing to diffraction theory	308
	14.1	Merit and applicability of various computational methods	403
	14.2	When methodo	400
	14.3	Other methods	409
DA.	DT 17	DIFEDACTION AND FOCUSING OF	
FA.	KIV	DIFFRACTION AND FOCUSING OF	
		ELECTROMAGNETIC WAVES	
15	Diffra	action Theory	419
	15.1	Radiation problem	419
	15.2	Plane-interface problems	426
	15.3	Rigorous theory of edge diffraction	437
	15.4	Approximate theories of diffraction by apertures	4 49
16	Focus	ing Problems	455
10	16 1	Debye theory for rotationally symmetric ontical system	455
	16.1	Ecousing through a plane dielectric interface	400
	10.2	Focusing through a plane dielectric interface	402
DA	DT VI	ZONE DI ATE I ENSES EOR SOLIND AND	
17	KI 71	WATED WAVES	
		WAIER WAVES	
17	Zone	plate Lenses for Sound Waves in Water	503
	17.1	Single zone-plate lens	503
	17.2	Zone-plate doublet	522
18	Zone-	plate Lens for Focusing of Ocean Swells	528
		- •	
PA	RT VI	I FOCUSING OF WATER WAVES	
19	Linea	r Waves	535
	19.1	Propogation theory	535
	19.2	Focusing problems	542
	· · · · ·		

x	Contents
Δ	Contents

20	Non-linear Waves		557
	20.1	Linear parabolic theory	559
	20.2	Non-linear parabolic theory	563
	20.3	Non-linear evolution of spectral amplitude	565
	20.4	Experimental procedure	569
	20.5	Comparison between experiment and theory	577
References		579 589	
Subject Index			
Author Index			597