

Contents

LIST OF CONTRIBUTORS	ix
FOREWORD	xi
PREFACE	xiii
CONTENTS OF OTHER VOLUMES	xv

CHAPTER 1

Photographic Lenses

Ellis I. Betensky

I. INTRODUCTION	1
II. THROUGH-FOCUS MTF ABERRATIONS	2
III. DISTORTION	4
IV. SPECTRAL WEIGHTING	6
V. REVIEW OF CURRENT LENS DESIGNS	7
REFERENCES	30

CHAPTER 2

Lens Mounting and Centering

Robert E. Hopkins

I. INTRODUCTION	31
II. BASIC PRINCIPLES IN LENS MOUNTING	32
III. THE COMPONENTS IN A LENS MOUNT	34
IV. LENS CENTERING	41
V. TESTS FOR DETECTING DECENTERING	44
VI. TESTING A LENS ASSEMBLY FOR CENTERING	46
VII. TOLERANCES FOR CENTERING	48
VIII. FORMULAS FOR COMPUTING SURFACE SAG	53
REFERENCES	54

CHAPTER 3**Aspheric Surfaces***Robert R. Shannon*

I. DEFINITION OF ASPHERIC SURFACES	56
II. ABERRATIONS OF ASPHERICS	63
III. APPLICATIONS AND DESIGN	69
IV. DESIGN METHODS USING ASPHERICS	74
V. FABRICATION OF ASPHERICS	77
VI. TESTING OF ASPHERICS	80
VII. SPECIFICATION OF ASPHERICS	84

CHAPTER 4**Automated Lens Design***William G. Peck*

I. INTRODUCTION	87
II. THE ASSUMPTIONS	90
III. THE INITIAL LENS	94
IV. VARIABLE PARAMETERS	99
V. THE PERFORMANCE CRITERION	101
VI. AUTOMATIC IMPROVEMENT ALTERNATIVES	105
VII. ITERATIVE USE OF AUTOMATED LENS DESIGN	113
VIII. SUMMARY	114
REFERENCES	115

CHAPTER 5**Radiometry***William L. Wolfe*

I. NOMENCLATURE, SYMBOLS, AND UNITS	119
II. PROPERTIES OF BLACKBODY RADIATION	122
III. RADIATION PROPERTIES OF REAL BODIES	130

IV. RADIATIVE TRANSFER IN NONABSORBING, NONSCATTERING MEDIA	136
V. NORMALIZATION	143
VI. RADIOMETRIC IDEAS	149
VII. RADIOMETER DESIGNS	152
VIII. RADIATION STANDARDS	158
IX. RADIATION PYROMETRY (RADIOMETRIC MEASUREMENTS OF TEMPERATURE)	164
APPENDIX: DERIVATION OF EXPANSIONS FOR INTEGRALS	168
REFERENCES	169

CHAPTER 6

The Calculation of Image Quality

William B. Wetherell

I. INTRODUCTION	172
II. OBJECT, IMAGE, AND IMAGE QUALITY	177
III. PROPERTIES OF THE PERFECT LENS	181
IV. ABERRATIONS AND WAVEFRONT ERROR	186
V. THE COMPLEX PUPIL FUNCTION	199
VI. THE POINT SPREAD FUNCTION AND ITS COROLLARIES	202
VII. THE OPTICAL TRANSFER FUNCTION AND ITS COROLLARIES	215
VIII. INTEGRATION WITH IMAGE SENSORS	235
IX. SOURCES AND EFFECTS OF WAVEFRONT ERROR	252
X. SOURCES AND EFFECTS OF AMPLITUDE TRANSMITTANCE VARIATION	271
XI. SOURCES AND EFFECTS OF IMAGE MOTION	297
XII. MERIT FUNCTION MODELS FOR PRELIMINARY ANALYSES	302
APPENDIX A. LERMAN'S EQUATION FOR THE VARIANCE OF AN OBSTRUCTED PUPIL	307
APPENDIX B. THE MTF AND PSF FOR A PERFECT LENS WITH A CENTRAL OBSTRUCTION	309
APPENDIX C. IMAGE MOTION IN OBSTRUCTED LENSES REFERENCES	311
	312

CHAPTER 7**Circuits for Detectors of Visible Radiation***William Swindell*

I. INTRODUCTION	317
II. THE PHOTODIODE	319
III. THE PHOTOMULTIPLIER	334
REFERENCES	346

CHAPTER 8**Arrays and Charge-Coupled Devices***James A. Hall*

I. INTRODUCTION	349
II. PHOTODIODE ARRAYS	357
III. CHARGE-COUPLED DEVICES	364
IV. CHARGE INJECTION DEVICES	379
V. ARRAYS AND CCDs: SPECIFIC EMBODIMENTS	382
VI. PRESENT PERFORMANCE	391
VII. SOLID-STATE IMAGING APPLICATIONS	396
REFERENCES	400
INDEX	401