### Contents

*Principal symbols, functions and operators*  
*List of abbreviations*  
*Foreword*  
*Preface*

#### 1 Making fringes

1.1 The need for angular resolution  
1.2 The resolution of a single telescope  
1.3 A long-baseline interferometer  
1.4 The interferometric measurement equation  
1.5 Spatial coherence  
1.6 Nomenclature  
1.7 Polychromatic interferometry  
1.8 Chromatic dispersion and group delay

#### 2 Basic imaging

2.1 Fourier inversion  
2.2 Visibility functions of simple objects  
2.3 Sampling the Fourier plane  
2.4 The image-plane effects of Fourier-plane sampling

#### 3 Atmospheric seeing and its amelioration

3.1 The wavefront perturbation model  
3.2 First-order effects on interferometers  
3.3 The effects of finite exposure time  
3.4 The effects of finite aperture size  
3.5 Adaptive optics
### Contents

3.6 Spatio-temporal effects 81  
3.7 Spatial filtering 82  
3.8 Fringe tracking 87  
3.9 Wavelength dependence of atmospheric perturbations 89  

4 **Interferometers in practice** 91  
4.1 Interferometric facilities 91  
4.2 Siting 92  
4.3 Collectors 94  
4.4 Beam relay 97  
4.5 Array layout 103  
4.6 Delay lines 105  
4.7 Beam combiners 108  
4.8 Detectors 121  
4.9 Alignment 122  
4.10 Aperture masking 125  

5 **Measurement noise** 129  
5.1 Atmospheric noise 129  
5.2 Detection noise 134  
5.3 Alternative fringe detection methods 138  
5.4 The interferogram 143  
5.5 Noise on fringe parameters 144  
5.6 Comparison of noise levels 151  

6 **Interferometric observation of faint objects** 152  
6.1 The optimum exposure time 153  
6.2 The optimum aperture size 156  
6.3 AO on faint objects 160  
6.4 Fringe-tracking limits 164  
6.5 Faint-object limits for interferometry 177  

7 **Observation planning** 180  
7.1 Example proposal 180  
7.2 Target selection 181  
7.3 Wavelength and spectral resolution 186  
7.4 Baseline selection 188  
7.5 Calibrator selection 189  
7.6 Surveys 191  
7.7 Short-timescale phenomena 192  
7.8 Complementary observations 193
# Data reduction

8 Scientific inference 194
8.1 The forward problem 195
8.2 The inverse problem 198
8.3 Flat fielding and background subtraction 199
8.4 Extracting the coherent flux 200
8.5 Coherent integration 208
8.6 Incoherent integration 210
8.7 Visibility calibration 211
8.8 OIFITS files 216

# Model fitting and image reconstruction

9 Bayesian inference 218
9.1 The interferometric likelihood 219
9.2 Model-dependent priors 222
9.3 Model fitting in practice 224
9.4 Model-independent priors 225
9.5 Preconditions for imaging 226
9.6 Model-independent image reconstruction 234
9.7 Image quality 239
9.8 Practical case study: imaging and model-fitting on Betelgeuse 243

Appendix A Fourier transforms 248
Appendix B Supplementary online material 255

References 257
Index 265