

## Contents

<b>1</b>		
<b>INTRODUCTION</b>		<b>1</b>
1.1	DISCUSSION OF THE MUTUAL COHERENCE FUNCTION $\Gamma_{12}(\tau)$ ,	2
1.2	SURVEY OF PREVIOUS RESEARCHES,	4
1.3	YOUNG'S INTERFERENCE EXPERIMENT,	7
<b>2</b>		
<b>DEFINITIONS AND MATHEMATICAL PRELIMINARIES</b>		<b>12</b>
2.1	THE ANALYTIC SIGNAL,	13
2.2	HILBERT TRANSFORMS AND CONVOLUTION THEOREMS FOR ANALYTIC SIGNALS,	17

- 2.3 THE CROSS-CORRELATION OF ANALYTIC SIGNALS, 21
- 2.4 REPRESENTATIONS OF THE SOURCE RADIATION, 24
- 2.5 DEFINITIONS, 27
- 2.6 MEASUREMENT, 30

### 3

#### FREE SPACE PROPAGATION OF THE MUTUAL COHERENCE

##### FUNCTION $\Gamma_{12}(\tau)$ 36

- 3.1 DERIVATION OF DIFFERENTIAL EQUATIONS GOVERNING  $\Gamma_{12}(\tau)$ , 36
- 3.2 INTEGRAL SOLUTION FOR  $\Gamma_{12}(\tau)$ , 38
- 3.3 RADIATION FROM A PLANE FINITE SURFACE, 40
- 3.4 FREE SPACE PROPAGATORS [DETAILS OF MEASUREMENT OF  $\Gamma_{12}(\tau)$ ], 43

### 4

#### LIMITING FORMS OF $\Gamma_{12}(\tau)$ 45

- 4.1 MOTIVATION FOR THE DEFINITIONS OF COHERENCE AND INCOHERENCE, 46
- 4.2 PROOF OF THREE THEOREMS, 47
- 4.3 QUASI-MONOCHROMATIC RADIATION, 53
- 4.4 INCOHERENT SOURCES, 57

### 5

#### RADIATION UNDER VARIOUS CONDITIONS OF COHERENCE 65

- 5.1 RADIATION FROM A COHERENT SOURCE, 66
- 5.2 RADIATION FROM INCOHERENT SOURCES REPRESENTABLE BY EQ. (4-31), 67
- 5.3 MEASUREMENT OF NONRESOLVABLE OBJECTS, 73
- 5.4 LABORATORY EXPERIMENT, 78

**6****PROPAGATION THROUGH MEDIA WITH VARIABLE INDEX  
OF REFRACTION 83**

- 6.1 NON-RANDOM SPATIAL VARIATION OF THE INDEX OF RE-  
FRACTION, 84
- 6.2 SPATIAL AND TEMPORAL VARIATION OF THE INDEX OF RE-  
FRACTION, 85
- 6.3 STATISTICAL VARIATION OF THE INDEX OF REFRACTION, 87
- 6.4 SOLUTION OF EQUATIONS, 90
- 6.5 PROPAGATION OF RADIATION THROUGH GROUND GLASS; AN  
EXPERIMENT, 95

**7****IMAGING WITH PARTIALLY COHERENT LIGHT 98**

- 7.1 GENERAL FORMULATION OF THE IMAGING PROBLEM, 101
- 7.2 THE LIMITING FORMS OF THE TRANSFER FUNCTION, 108
- 7.3 IMAGING WITH QUASI-MONOCROMATIC LIGHT, 111
- 7.4 SUMMARY, 113

**8****EFFECT OF COHERENCE ON RESOLUTION IN OPTICAL IMAGES 114**

- 8.1 THE MEASUREMENT OF THE RESOLUTION LIMIT, 115
- 8.2 MATHEMATICAL FORMULATION OF THE IMAGING PROBLEM,  
116
- 8.3 A DETAILED TREATMENT OF SOME TYPICAL RESOLUTION  
LIMIT PROBLEMS, 119

**9****APPLICATIONS OF THE THEORY OF PARTIAL COHERENCE 126**

- 9.1 THE COVINGTON-DRANE ANTENNA, 127
- 9.2 ATMOSPHERIC LIMITATIONS OF IMAGE-FORMING SYSTEMS,  
133

## 10

### PARTIAL POLARIZATION

138

- 10.1 DEFINITIONS, 139
- 10.2 ELEMENTS, 140
- 10.3 CASCADED SYSTEMS, 142
- 10.4 DEFINITION OF DEGREE OF COHERENCE AND DEGREE OF POLARIZATION, 142
- 10.5 MEASUREMENT OF  $\mathcal{J}$ , 144
- 10.6 STOKES PARAMETERS, 145

## 11

### VECTOR FORMULATION

146

- 11.1 DEFINITIONS, 147
  - 11.2 ENSEMBLE AVERAGES, 148
  - 11.3 TIME AVERAGES, 150
  - 11.4 SOURCE TERMS IN EQUATIONS, 150
  - 11.5 SOURCE-FREE REGIONS, 151
  - 11.6 CONSERVATION LAWS, 151
  - 11.7 COHERENCE PROPERTIES OF BLACKBODY RADIATION, 154
- APPENDIX A, 158

## 12

### INTENSITY INTERFEROMETRY

159

- 12.1 MEASUREMENT OF  $R_{ij}(\mathbf{x}_1, \mathbf{x}_2, 0) = \langle I_i(\mathbf{x}_1, t) I_j(\mathbf{x}_2, t) \rangle$ , 161
- 12.2 MEASUREMENT OF RADIO AND VISIBLE STAR DIAMETERS, 171
- 12.3 EFFECT OF PHASE CHANGES ON THE MEASUREMENT OF  $R_{ij}(\mathbf{x}_1, \mathbf{x}_2, 0)$ , 173

**13****LOCALLY STATIONARY FIELDS, SPATIAL AVERAGING,  
AND HIGHER-ORDER CORRELATION FUNCTIONS 175**

- 13.1 LOCALLY STATIONARY FIELDS, 175
- 13.2 SPATIAL AVERAGING, 178
- 13.3 HIGHER-ORDER CORRELATION FUNCTIONS, 179

**REFERENCES 186****INDEX 191**