Contents

PREFACE xi

CHAPTER 1. FEATURE FUSION METHOD FOR RAPID CORROSION DETECTION ON POLE TIPS 1
Suchart YAMMEN and Paisarn MUNEESAWANG

1.1. Introduction. 2
1.2. Algorithm for corrosion detection. 6
1.2.1. Extraction of top-shield region 6
1.2.2. Area-based feature. 9
1.2.3. Contour-based feature 13
1.3. Experimental result 19
1.3.1. Distribution of corrosion 20
1.3.2. Performance metric 20
1.3.3. Robustness 24
1.4. Conclusion. 27
1.5. Bibliography 28

CHAPTER 2. NONLINEAR FILTERING METHOD FOR CORROSION DETECTION ON POLE TIPS 33
Paisarn MUNEESAWANG and Suchart YAMMEN

2.1. Introduction. 33
2.2. Perpendicular magnetic recording 35

2.3. Perpendicular magnetic recorder and corrosion 37
2.3.1. Lubricant layer 38
2.3.2. Thermal effect results in corrosion 41
2.3.3. Recording head/slider manufacturing and corrosion 42
2.4. Length estimator for pole tip 44
2.5. Nonlinear filtering as a corrosion detector. 48
2.5.1. Median filter techniques 48
2.5.2. Median ε-Filter 50
2.5.3. Corrosion detection procedure 51
2.6. Application 54
2.7. Conclusion. 62
2.8. Bibliography 63

CHAPTER 3. MICRO DEFECT DETECTION ON AIR-BEARING SURFACE 71
Pichate KUNAKORNVONG and Pitikhate SOORAKSA

3.1. Introduction. 71
3.2. Air-bearing surface 74
3.3. Imaging system 75
3.4. Contamination detection 79
3.4.1. Texture unit texture spectrum 80
3.4.2. Graylevel co-occurrence matrix 82
3.4.3. Principle component analysis. 85
3.4.4. Identification defect 88
3.5. Conclusion. 92
3.6. Acknowledgment 93
3.7. Bibliography 93

CHAPTER 4. AUTOMATED OPTICAL INSPECTION FOR SOLDER JET BALL JOINT DEFECTS IN THE HEAD GIMBAL ASSEMBLY PROCESS 99
Jirarat IEAMSAARD and Thanapoom FUANGPIAN

4.1. Introduction. 99
4.2. Head gimbal assembly. 101
4.3. Vertical edge method for inspection of pad burning defect 102
4.3.1. Inspection procedure 103
4.3.2. Experimental result 107

4.4. Detection of solder ball bridging on HGA 108
4.4.1. Solder ball bridging defect. 108
4.4.2. Chain code descriptor-based method 109
4.4.3. Morphological template-based method. 112
4.4.4. Experimental result 114
4.5. Detection of missing solders on HGA 121
4.5.1. Image acquisition and enhancement 121
4.5.2. Clustering of image pixels 122
4.5.3. Decision making 123
4.5.4. Inspection result 124
4.6. Conclusion. 126
4.7. Bibliography 127

CHAPTER 5. ANALYSIS METHODS FOR FAULT DEFORMATION OF SOLDER BUMP ON THE ACTUATOR ARM 131
Somporn RUANGSINCHAIWANICH

5.1. Introduction. 132
5.2. Surface tension analysis 133
5.2.1. Model analysis 135
5.2.2. Simulation 138
5.3. Analysis of stress performance at different configurations of solder bump positions 140
5.3.1. Analysis model 144
5.3.2. Design and analysis using FEM 145
5.4. Experimental result 149
5.5. Conclusion. 151
5.6. Bibliography 152

CHAPTER 6. ARTIFICIAL INTELLIGENCE TECHNIQUES FOR QUALITY CONTROL OF HARD DISK DRIVE COMPONENTS 155
Wimalin LAOSIRITAWORN

6.1. Introduction. 155
6.2. Artificial intelligence tasks in quality control 157
6.2.1. Classification and prediction 157

6.2.2. Cluster analysis 159
6.2.3. Time series analysis 160
6.3. AI applications in HDD component quality control 161
6.3.1. Multipanel lamination process modeling using ANN 161
6.3.2. Control chart pattern recognition with AI in actuator production 168
6.3.3. Machine clustering using AI technique 174
6.4. Conclusion 179
6.5. Bibliography 180

CHAPTER 7. BOREHOLE DIAMETER INSPECTION FOR HARD DISK DRIVE PIVOT ARMS USING HOUGH TRANSFORM IN PANORAMA IMAGES 183
Sansanee AUEPHANWIRIYAKUL, Patison PALEE, Orathai SUTTIJAK and Nipon THEERA-UMPON

7.1. Introduction 183
7.2. Panorama image construction 185
7.3. Dimension estimation 189
7.4. Experiment result 190
7.5. Conclusion 195
7.6. Acknowledgment 195
7.7. Bibliography 195

CHAPTER 8. ELECTROSTATIC DISCHARGE INSPECTION TECHNOLOGIES 199
Nattha JINDAPETCH, Kittikhun THONGPULL, Sayan PLONG-NGOOLUAM and Pornchai RAKPONGSIRI

8.1. Introduction 199
8.2. ESD sensitivity test technologies 200
8.2.1. Human body model testing 201
8.2.2. Charged device model testing 202
8.2.3. Machine model testing 203
8.3. Monitoring of ESD prevention equipment 204
8.3.1. Grounding and equipotential bonding systems 205
8.3.2. Ionization 206
8.3.3. Packaging 209

8.4. ESD event localization technologies 211
8.4.1. EMI locators 212
8.4.2. High-speed oscilloscope-based ESD event localization systems 214
8.4.3. RFID localization systems 215
8.4.4. WSN-based localization systems 218
8.4.5. Hybrid localization systems 220
8.5. Conclusion 221
8.6. Bibliography 221

CHAPTER 9. INSPECTION OF STYROFOAM BEADS ON ADAPTER OF HARD DISK DRIVES 225
Suchart YAMMEN

9.1. Introduction 225
9.2. Morphological template-based method 227
9.2.1. Image subtraction 230
9.2.2. Otsu method 231
9.2.3. Morphological operation 232
9.2.4. Logical operation 233
9.3. Decision model 233
9.4. Application 234
9.5. Conclusion 234
9.6. Bibliography 235

CHAPTER 10. INSPECTION OF DEFECT ON MAGNETIC DISK SURFACE AND QUALITY OF THE GLUE DISPENSER ROUTE 237
Anan KRUESUBTHAWORN

10.1. Introduction 238
10.2. Computer vision technologies for scratch detection on media surfaces 239
10.3. Inspection of glue dispenser route 255
10.4. Conclusion 260
10.5. Bibliography 260

CHAPTER 11. INSPECTION OF GRANULAR MICROSTRUCTURE OF FEPT FILM IN HEAT-ASSISTED MAGNETIC RECORDING MEDIA 265
Paisarn MUNEESAWANG

11.1. Introduction 265
11.2. Heat-assisted media recording technology 268
11.2.1. HAMR 268
11.2.2. $L1_0$-ordered FePt as HAMR media candidate 268
11.2.3. Magnetic nanoparticle 270
11.3. Inspection procedure 272
11.3.1. Image segmentation 272
11.3.2. Separation of overlapping particles 273
11.4. Measurement of the size distribution 275
11.5. Measurement of dispersion 278
11.5.1. Lennard–Jones potential index. 278
11.5.2. Experimental result 281
11.6. Conclusion 285
11.7. Bibliography 286

LIST OF AUTHORS 291

INDEX 295