

# Contents

About the Editor .....	xi
Contributors .....	xiii
Preface .....	xv
<hr/>	
<b>Part I Fundamentals of Computer Vision Technology .....</b>	<b>1</b>
<b>1. Image Acquisition Systems .....</b>	<b>3</b>
<i>Mohd. Zaid Abdullah</i>	
1 Introduction .....	3
2 The electromagnetic spectrum .....	4
3 Image acquisition systems .....	6
4 Conclusions .....	31
Nomenclature .....	31
References .....	32
<b>2. Image Segmentation Techniques .....</b>	<b>37</b>
<i>Chaoxin Zheng and Da-Wen Sun</i>	
1 Introduction .....	37
2 Pre-processing techniques .....	38
3 Segmentation techniques .....	41
4 Conclusions .....	52
Nomenclature .....	53
References .....	54
<b>3. Object Measurement Methods .....</b>	<b>57</b>
<i>Chaoxin Zheng and Da-Wen Sun</i>	
1 Introduction .....	57
2 Size .....	58
3 Shape .....	59
4 Color .....	63
5 Texture .....	67

6	Combined measurements .....	72
7	Conclusions.....	72
	Nomenclature.....	73
	Appendix.....	74
	References.....	77
<b>4.</b>	<b>Object Classification Methods .....</b>	<b>81</b>
	<i>Cheng-Jin Du and Da-Wen Sun</i>	
1	Introduction .....	81
2	Artificial neural network.....	82
3	Statistical classification .....	86
4	Fuzzy logic .....	91
5	Decision tree.....	94
6	Support vector machine.....	96
7	Conclusions.....	102
	Nomenclature.....	102
	References.....	104
	<b>Part II Quality Evaluation of Meat, Poultry, and Seafood .....</b>	<b>109</b>
<b>5.</b>	<b>Quality Evaluation of Meat Cuts .....</b>	<b>111</b>
	<i>Liyun Zheng, Da-Wen Sun and Jinglu Tan</i>	
1	Introduction .....	111
2	Quality evaluation of beef.....	112
3	Quality evaluation of pork .....	125
4	Quality evaluation of lamb.....	129
5	Future perspectives .....	131
6	Conclusions.....	132
	References.....	132
<b>6.</b>	<b>Quality Measurement of Cooked Meats .....</b>	<b>139</b>
	<i>Cheng-Jin Du and Da-Wen Sun</i>	
1	Introduction .....	139
2	Shrinkage .....	140
3	Pores and porosity.....	145
4	Color.....	149
5	Image texture .....	150
6	Conclusions.....	153
	Nomenclature.....	153
	References.....	154
<b>7.</b>	<b>Quality Inspection of Poultry Carcasses .....</b>	<b>157</b>
	<i>Bosoon Park</i>	
1	Introduction .....	157
2	Poultry quality inspection .....	158

3	Color imaging for quality inspection .....	159
4	Spectral imaging .....	163
5	Poultry image classifications.....	171
6	Conclusions.....	182
	References.....	183
<b>8.</b>	<b>Quality Evaluation of Seafood .....</b>	<b>189</b>
	<i>Murat O. Balaban, Asli Z. Odabaşı, Sibel Damar and Alexandra C.M. Oliveira</i>	
1	Introduction.....	189
2	Visual quality of seafood.....	189
3	Conclusions.....	206
	References.....	207
<b>Part III Quality Evaluation of Fruit and Vegetables .....</b>		<b>211</b>
<b>9.</b>	<b>Quality Evaluation of Apples .....</b>	<b>213</b>
	<i>Vincent Leemans and Olivier Kleynen</i>	
1	Introduction.....	213
2	Material .....	215
3	Shape grading .....	222
4	Color grading .....	222
5	Evaluation of surface defects .....	224
6	Calyx and stalk-end recognition .....	230
7	Defect recognition and fruit classification .....	231
8	Conclusions.....	238
	Nomenclature.....	239
	References.....	239
<b>10.</b>	<b>Quality Evaluation of Citrus Fruits .....</b>	<b>243</b>
	<i>Enrique Moltó and José Blasco</i>	
1	Introduction.....	243
2	Image analysis in the visible spectrum.....	247
3	Quality inspection in the non-visible spectrum.....	255
4	Internal quality inspection .....	256
5	Inspection of clementine and satsuma segments .....	258
6	Conclusions.....	260
	References.....	260
<b>11.</b>	<b>Quality Evaluation of Strawberries .....</b>	<b>265</b>
	<i>Masateru Nagata and Jasper G. Tallada</i>	
1	Introduction.....	265
2	Grading of size, shape, and ripeness .....	267
3	Detection of bruises and fecal contamination .....	273
4	Estimation of firmness and soluble-solids content .....	279
5	Estimation of anthocyanin distribution .....	283

	6 Further challenges.....	284
	7 Conclusions.....	285
	References.....	285
<b>12.</b>	<b>Classification and Quality Evaluation of Table Olives .....</b>	<b>289</b>
	<i>Ricardo Díaz</i>	
	1 Introduction.....	289
	2 Classification of table olives.....	290
	3 Application of machine vision.....	294
	4 Industrial applications.....	301
	5 Conclusions.....	301
	Acknowledgments.....	302
	References.....	302
<b>13.</b>	<b>Grading of Potatoes .....</b>	<b>305</b>
	<i>Franco Pedreschi, Domingo Mery and Thierry Marique</i>	
	1 Introduction.....	305
	2 Surface defects.....	306
	3 Potato classification.....	307
	4 Applications.....	308
	5 Conclusions.....	315
	Acknowledgments.....	316
	References.....	316
<b>14.</b>	<b>Quality Evaluation of Fruit by Hyperspectral Imaging .....</b>	<b>319</b>
	<i>Renfu Lu</i>	
	1 Introduction.....	319
	2 Techniques for measuring optical properties.....	320
	3 The hyperspectral imaging system.....	324
	4 Applications.....	333
	5 Conclusions.....	344
	Acknowledgments.....	344
	Nomenclature.....	344
	References.....	345
	<b>Part IV Quality Evaluation of Grains .....</b>	<b>349</b>
<b>15.</b>	<b>Quality Evaluation of Wheat .....</b>	<b>351</b>
	<i>Digvir S. Jayas, Prabal K. Ghosh, Jitendra Paliwal and Chithra Karunakaran</i>	
	1 Introduction.....	351
	2 Machine vision.....	353
	3 Soft X-ray imaging.....	362
	4 Near-infrared spectroscopy and hyperspectral imaging.....	364
	5 Thermal imaging.....	369

6	Potential practical applications of machine vision technology .....	370
	Acknowledgments .....	371
	References .....	371
<b>16.</b>	<b>Quality Evaluation of Rice .....</b>	<b>377</b>
	<i>Yukiharu Ogawa</i>	
1	Introduction .....	377
2	Quality of rice .....	377
3	Quality evaluation of raw rice .....	379
4	Quality evaluation of cooked rice .....	390
5	Conclusions .....	397
	References .....	397
<b>17.</b>	<b>Quality Evaluation of Corn/Maize .....</b>	<b>401</b>
	<i>Stephen J. Symons and Muhammad A. Shahin</i>	
1	Introduction .....	401
2	Corn .....	408
3	Machine vision determination of corn quality .....	410
4	Conclusions .....	419
	References .....	419
<b>Part V Quality Evaluation of Other Foods .....</b>		<b>425</b>
<b>18.</b>	<b>Quality Evaluation of Pizzas .....</b>	<b>427</b>
	<i>Cheng-Jin Du and Da-Wen Sun</i>	
1	Introduction .....	427
2	Pizza base production .....	428
3	Pizza sauce spread .....	433
4	Application of pizza toppings .....	438
5	Conclusions .....	444
	Nomenclature .....	444
	References .....	445
<b>19.</b>	<b>Quality Evaluation of Cheese .....</b>	<b>447</b>
	<i>Sundaram Gunasekaran</i>	
1	Introduction .....	447
2	Cheese quality characteristics .....	447
3	Cheese defects .....	462
4	Microstructure evaluation .....	465
5	Conclusions .....	474
	References .....	474
<b>20.</b>	<b>Quality Evaluation of Bakery Products .....</b>	<b>481</b>
	<i>Mohd. Zaid Abdullah</i>	
1	Introduction .....	481
2	Quality characteristics of bakery products .....	484

	3 Computer vision inspection of bakery products .....	495
	4 Conclusions .....	517
	Nomenclature .....	517
	References .....	519
<b>21.</b>	<b>Image Analysis of Oriental Noodles .....</b>	<b>523</b>
	<i>Dave W. Hatcher</i>	
	1 Introduction .....	523
	2 Imaging in noodle quality assessment .....	529
	3 Measuring the impact of external grading factors .....	536
	4 Developments and further applications .....	539
	5 Conclusions .....	542
	References .....	542
<b>22.</b>	<b>Quality Evaluation and Control of Potato Chips and French Fries .....</b>	<b>545</b>
	<i>Franco Pedreschi, Domingo Mery and Thierry Marique</i>	
	1 Introduction .....	545
	2 Computer vision .....	546
	3 Applications .....	550
	4 Conclusions .....	563
	Acknowledgments .....	563
	References .....	563
	<b>Index .....</b>	<b>567</b>
	<b>Series .....</b>	<b>581</b>