Index

a
area of interest (AOI) 9, 10
audio video interleaved
  – file creation, using image files 249–251
  – file format 249, 254
  – IMAQ AVI close 251
  – IMAQ AVI2 Close 251
  – IMAQ AVI2 Create function 249, 250
  – IMAQ AVI2 Get Codec Names function 249
  – IMAQ AVI Get Info 252
  – IMAQ AVI Open function 252
  – IMAQ AVI2 read frame 253
  – IMAQ AVI2 Write Frame 250
  – IMAQ AVI Write Frame function 250, 251
  – New AVI File 254
  – read frame from files 252–254
  – read procedure 252
  – real-time image acquisition, file creation 251
automated data collection 270
Automated Imaging Association (AIA) 11
AVI. See audio video interleaved
AVI Read Frame function 252

b
binary image 2, 3
  – conversion 33, 40–43, 52, 62, 191, 274
  – from color to grayscale image 41
  – from grayscale to binary image 42, 43
binary particle classification 191
  – main VI for classification 206–208
  – overlay for classification 204–206
  – Vision Acquisition Express to load image files 192–194
  – Vision Assistant Express for classification 194–199
BMP, image format 241–243
Build Path function 244
calibration. See also LabVIEW Vision
  – axis 233
  – setup 234
  – image 229
  – results 233
  – setup, image 230
  – type 231
camera 6
  – analog 10, 11
  – area scan vs. line scan 7, 8
  – bus 10
  – IEEE 1394 camera vs. USB 12, 13
  – color and monochrome 6
  – GigE 13
  – IEEE 1394 12, 13
  – intelligent surveillance 271, 272
  – lens selection 9
  – line scan 6
  – misalignment, image distortion 228
  – monochrome analog 10
  – sensors 8, 9
  – USB 4, 13, 17
  – image acquisition 210
Camera Link 5, 11
  – cable 11
  – camera description files 12
  – NI software, to acquire camera image 12
CCTV (closed circuit television) 271
  – AVI file 271
collision analysis 266
color extraction 266
color image 3
  – acquired 4
  – 32 bit 3
  – pixel location 4
  – RGB values 4
color pattern matching 105, 106
– example patterns for 106
– Main VI 112–116
– Vision Acquisition Express 107, 108
– – image acquisition 107
– – saving image to a file 107
– Vision Assistant Express 105, 108–112
– – image acquisition 107
Color Plane Extraction function 41, 213
continuous image acquisition 20, 49, 50, 85, 119, 136, 137, 158, 212, 228
contour analysis 209, 210
– defect detection
– – Analyze Curvature tab 215
– – by comparing contours 216–219
– – contour template 217, 218
– – curvature profile 215, 219, 222
– – reference image for 214
– result 221
– setup 213, 215, 217
– USB camera, image acquisition 210–212
– using Vision Assistant 212–215, 218
– VI creation 219–225
– Vision Assistant Express 218
Contour Defect Inspection.vi 209, 226
defect detection. See also contour analysis
– block diagram 224
– distance, threshold value 222, 224
– example images for 226
– on threshold value 225
– using contour 211
– – difference 210
– using curvature 215, 216
– – profile 211
– using template contour 218
deletion, folder 244. See also reading image
digital color images 3
Distortion Model (Grid) 229
d edge detection 75
– IMAQ ExtractSingleColorPlane function 83
– via Vision Assistant 75–78
– VI for real-time-based 81–85
– Vision Assistant Express 85, 86
Ethernet, communication interface 5
Exists.vi folder, checking 244
e file/folder exists, Boolean output 244
FireWire 5, 12
focal length, calculation 15
folder creation 244, 245
– SubVI, block diagram 243
folder deletion 244
frame grabbers 5, 8, 10–13
frame rate 6, 11, 24, 29, 250, 251
frames per second 6, 250
frame trigger 8
g geometric matching 149, 150
– for circles 151–155
– for ellipses 155–158
– shape matching
– – functions 160
– – results for ellipse 164
– using Vision Assistant Express 150, 151
Gigabit Ethernet (GigE) 5, 10, 13
Grab function 20, 23, 251
graph properties 220
grayscale image 1, 2, 6, 33, 39–41, 40, 42, 52, 60, 76, 81, 83, 85, 86, 89, 101, 102, 105, 120, 137, 149, 150, 165, 170, 171, 191, 229, 231, 252
grid
– calibration 238
– – distortion model/camera model 230
– features, extract 231, 232
– image, nonlinear 239
– pattern 227
– spacing, specify 233, 237
h HSL (hue, saturation, and luminance) 4, 5
i IEEE 1394 10, 12, 13
image acquisition 7–10, 12, 30, 31, 35, 228
– AVI file creation based on real-time 251
– continuous 20, 28, 68, 85, 212, 228
– Gigabit Ethernet 13
– Grab function 20, 24
– IMAQ Create function 22
– IMAQ image save (BMP) 243
– making AVI file 251
– USB camera 17–31, 181, 210
– Vision Acquisition Express 26–31
image calibration 227–240. See also
calibration; image correction
image correction 237
– comparison 236
– real-time
– – results 239
– – VI for 238
– setup 237
Index

– using Vision Assistant Express 234–237
– VI creation for 237–240
Image Create function 22, 238
– IMAQ 101
image distortion 225, 227
– calibration file, creation 228, 229
– due to camera misalignment 228
– due to perspective error 226
image management functions 21
– IMAQ Create 22
– IMAQ Dispose 22
image pixel
– binary 2
– value 1–4
image quality 241
image read
– block diagram for 245, 246
– from file 245–248
– – Image Read function 246, 247, 249
– – IMAQ Readfile 245
– Recursive File List.vi 247
– saving part of image defined by ROI 247
image resolution 8, 9
– calculation 9
image save 247, 248
– image defined by ROI 247
imaging system, components of 5, 6
IMAQ Extract Tetragon function 248
IMAQ Overlay Multiple Line 2 224
IMAQ Readfile 245–246
IMAQ write file 241

JPEG
– image format 241, 242
– IMAQ Write file 241, 242
– JPEG2000, IMAQ Write file 241, 242

LabVIEW 4, 255
– acquiring images using 19
– – block diagram 23
– – IMAQdx Close Camera 21
– – IMAQdx Configure Grab 20
– – IMAQdx functions 19
– – IMAQdx Grab 20
– – IMAQdx Open Camera 19, 20
– code (See LabVIEW code creation)
– – image acquisition with 17, 23–25
– – machine vision applications (See LabVIEW Machine Vision applications)
– – particle analysis provided by 34
– – using vision assistant 34

– Vision Acquisition Module 17
– Vision Development Module 3
– vision function palettes 19
LabVIEW code creation 47–49, 145. See also
– Vision Assistant
– block diagram 50
– – of created VI from Vision Assistant 50
– – modification of Image Read or Image Acquisition Code 50
– code generation 47
– created LabVIEW software 49
– VI creation wizard 47, 48
LabVIEW Machine Vision applications 263
– automobile industry 264–266
– industrial printing 269, 270
– inspection 268, 269
– – of defects 264
– – medical/bio applications 266, 267
– – semiconductor manufacturing 263, 264
– – semiconductor wafer alignment 264
lens 13
– focal length 15
lightings 14, 15
– back 14
– DC/high-frequency 15
– diffused 14
– importance of 15
– ring 14
– strobe 14, 15
List.vi, recursive file 247

Measurement & Automation Explorer (MAX) 17
– acquiring images with 17, 18
– – steps 18
– – imaging system configuration via 18
morphology functions 2, 3, 33, 39, 43, 44, 52, 66, 170

National Instruments LabVIEW software 17
NI Vision Calibration tools 227
NI Vision Development Module 2
nonlinear grid image 239

object tracking setup 256
OCR. See Optical Character Recognition
Optical Character Recognition 177
– character training using Vision Assistant 177–181
– – edit character set file 181
– OCR/OCV function 179
– OCR setup 180
– OCR training interface 180
– open image file of characters to be trained 179
– OCR VI creation for Using Vision Assistant 185
– block diagram 186

p
particle analysis 33
– binary image conversion 40–43
– morphology 43, 44
– Particle Analysis function 44, 45
pattern matching 89, 137
– Matches 101
– Matches array 99
– using Vision Assistant 90–95
pixels 259. See also color image; grayscale image; image resolution
– conversion to real-world units 71–74
– image pixel to distance conversion using line ROI 72
– IMAQ convert ROI to Line function 72
– pixel to distance ratio calculation 73
– value 1, 2, 42, 44, 75, 79
PNG, image format 241, 242

r
reading image
– frame from AVI file and saving 254
– from image files 246
real-time image correction 238–239
Recursive File List function 246, 247
reference coordinate system 135–145
region of interest 9, 99, 119, 127, 146
– Image Mask function 38
– image mask setup 40
– image size reduction due to 41
RGB values 4, 22, 39
ROI. See region of interest

s
saving image 68, 107, 241–245
sensor size 9, 15
shape detection 159–163
standard analog video 11
strip path function 243, 244
student projects
– driving a LEGO NXT car 273
– intelligent surveillance camera 271, 272
– noncontact motion measurement 271
– piano keyboard using machine vision 273, 274
subfolder generation, from current folder 244

\text{t}

– target points, contour analysis 220, 221
– template points, contour analysis 220, 221
– TIFF, image format 241, 242
– tracking 259, 260
– algorithm 255
– block diagram for 259, 260
– Vision Assistant 255–259

u
USB communication interfaces 5, 10

v
– VI creation 31, 47, 48, 96, 97, 126–127, 158–159, 172, 185, 199–200, 219, 237, 259
Vision Acquisition Express 26–31
Vision Assistant 35–50
– edge detection 75–78
– pattern matching 90–96
– for contour analysis 218
– conversion to a Standard VI 145–148
– exercise for tracking via 261

w
waveform graph, cursor creation from 223
working distance 15, 73

z
Zoom to Fit menu 25
zoom tool 24