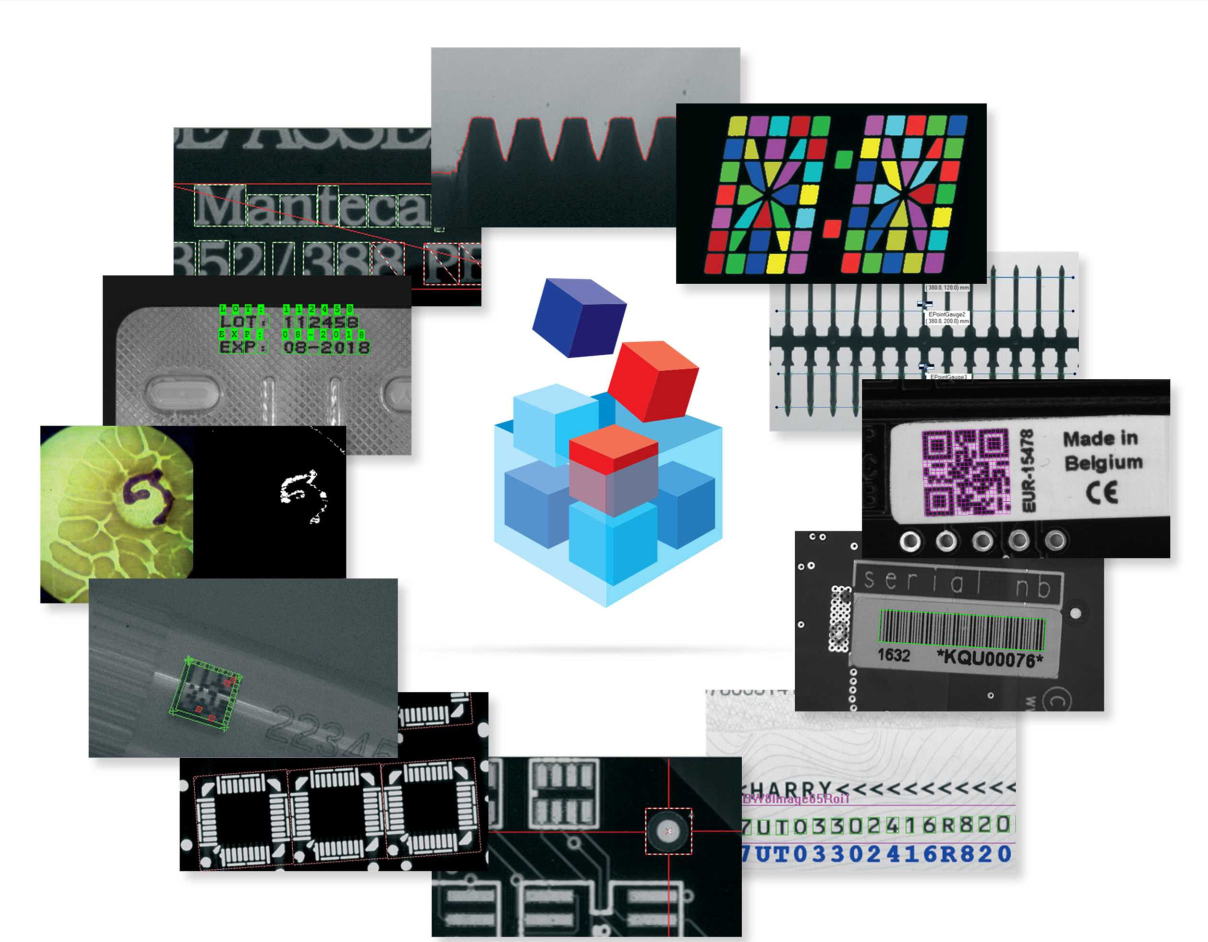
CODE SNIPPETS

Open eVision



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This documentation is provided with Open eVision 2.6.1 (doc build 1110).

Contents

1. Basic Types

1.1. Loading and Saving Images

```
/////////////////////////////////////////////////////////////
// This code snippet shows how to load and save an image. //
/////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// Load an image file
srcImage.Load("mySourceImage.bmp");
```

```
// ...
```

```
// Save the destination image into a file
dstImage.Save("myDestImage.bmp");
```

```
// Save the destination image into a jpeg file
// The default compression quality is 75
dstImage.Save("myDestImage.jpg");
```

```
// Save the destination image into a jpeg file
// set the compression quality to 50
dstImage.SaveJpeg("myDestImage50.jpg", 50);
```

1.2. Interfacing Third-Party Images

```
///////////////////////////////////////////////////////////////
// This code snippet shows how to link an Open eVision image //
// to an externally allocated buffer.                        //
///////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
```

```
// Size of the third-party image
int sizeX;
int sizeY;
```

```
//Pointer to the third-party image buffer
EBW8* imgPtr;
```

```
// ...
// Link the Open eVision image to the third-party image
// Assuming the corresponding  buffer is aligned on 4 bytes
srcImage.SetImagePtr(sizeX, sizeY, imgPtr);
```

1.3. Retrieving Pixel Values

```
////////////////////////////////////////////////////////////////
// This code snippet shows the recommended method (fastest)   //
// to access the pixel values in a BW8 image                  //
////////////////////////////////////////////////////////////////
```

```
EImageBW8 img;
```

```
OEV_UINT8* pixelPtr;
OEV_UINT8* rowPtr;
OEV_UINT8  pixelValue;
OEV_UINT32 rowPitch;
OEV_UINT32 x, y;
```

```
rowPtr = reinterpret_cast <OEV_UINT8*>(img.GetImagePtr());
rowPitch = img.GetRowPitch();
```

```
for (y = 0; y < height; y++)
{
    pixelPtr = rowPtr;

    for (x = 0; x < width; x++)
    {
        pixelValue = *pixelPtr;

        // Add your pixel computation code here

        *pixelPtr = pixelValue;
        pixelPtr++;
    }

    rowPtr += rowPitch;
}
```

1.4. ROI Placement

```
////////////////////////////////////////////////////////////////
// This code snippet shows how to attach an ROI to an image   //
// and set its placement.                                     //
////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 parentImage;
```

```
// ROI constructor
EROIBW8 myROI;
```

```
// ...
// Attach the ROI to the image
myROI.Attach(&parentImage);
```

```
//Set the ROI position
myROI.SetPlacement(50, 50, 200, 100);
```

1.5. Vector Management

```
///////////////////////////////////////////////////////////////
// This code snippet shows how to create a vector, fill it   //
// and retrieve the value of a given element.                //
///////////////////////////////////////////////////////////////
```

```
// EBW8Vector constructor
EBW8Vector ramp;
```

```
// Clear the vector
ramp.Empty();
```

```
// Fill the vector with increasing values
for(int i= 0; i < 128; i++)
{
        ramp.AddElement((EBW8)i);
}
```

```
// Retrieve the 10th element value
EBW8 value= ramp[9];
```

1.6. Exception Management

```
////////////////////////////////////////////
// This code snippet shows how to manage  //
// Open eVision exceptions.               //
////////////////////////////////////////////
```

```
try
{
        // Image constructor
        EImageC24 srcImage;
```

```
        // ...
```

```
        // Retrieve the pixel value at coordinates (56, 73)
        EC24 value= srcImage.GetPixel(56, 730);
}
```

```
catch(Euresys::Open_eVision_1_1::EException exc)
{
        // Retrieve the exception description
        std::string error = exc.What();
}
```

2. EasyImage

2.1. Thresholding

Single Thresholding

```
////////////////////////////////////////////////////////////////
// This code snippet shows how to perform minimum residue     //
// thresholding, absolute thresholding and relative           //
// thresholding operations.                                   //
////////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// ...
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Minimum residue thresholding (default method)
EasyImage::Threshold(&srcImage, &dstImage);
```

```
// Absolute thresholding (threshold = 110)
EasyImage::Threshold(&srcImage, &dstImage, 110);
```

```
// Relative thresholding (70% black, 30% white)
EasyImage::Threshold(&srcImage, &dstImage, EThresholdMode_Relative, 0, 255, 0.7f);
```

Double Thresholding

```
////////////////////////////////////////////////////////////////
// This code snippet shows how to perform a thresholding      //
// operation based on low and high threshold values.          //
////////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// ...
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Double thresholding, low threshold = 50, high threshold = 150,
// pixels below 50 become black, pixels above 150 become white,
// pixels between thresholds become gray
EasyImage::DoubleThreshold(&srcImage, &dstImage, 50, 150, 0, 128, 255);
```

Histogram-Based Single Thresholding

```
////////////////////////////////////////////////////////////////
// This code snippet shows how to perform a minimum residue   //
// thresholding operation based on an histogram.              //
////////////////////////////////////////////////////////////////
```

```
// Images constructor
```

```
EImageBW8 srcImage;
```

```
EImageBW8 dstImage;
```

```
// Histogram constructor
EBWHistogramVector histo;
```

```
// Variables
unsigned int thresholdValue;
float avgBelowThr, avgAboveThr;
```

```
// ...
```

```
// Compute the histogram
EasyImage::Histogram(&srcImage, &histo);
```

```
// Compute the single threshold (and the average pixel values below and above the
threshold)
thresholdValue= EThresholdMode_MinResidue;
EasyImage::HistogramThreshold(&histo, thresholdValue, avgBelowThr, avgAboveThr);
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Perform the single thresholding
EasyImage::Threshold(&srcImage, &dstImage, thresholdValue);
```

Histogram-Based Double Thresholding

```
////////////////////////////////////////////////////////////////////
// This code snippet shows how to perform a double thresholding   //
// operation. The low and high threshold values are computed      //
// according to the minimum residue method based on an histogram. //
////////////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// Histogram constructor
EBWHistogramVector histo;
```

```
// Variables
EBW8 lowThr;
EBW8 highThr;
float avgBelowThr, avgBetweenThr, avgAboveThr;
```

```
// ...
```

```
// Compute the histogram
EasyImage::Histogram(&srcImage, &histo);
```

```
// Compute the low and high threshold values automatically
// (and the average pixel values below, between and above the threshold)
EasyImage::ThreeLevelsMinResidueThreshold(&histo, lowThr, highThr, avgBelowThr,
avgBetweenThr, avgAboveThr);
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Perform the double thresholding
EasyImage::DoubleThreshold(&srcImage, &dstImage, lowThr.Value, highThr.Value);
```

2.2. Arithmetic and Logic Operations

```
////////////////////////////////////////////////////////
// This code snippet shows how to apply miscellaneous //
// arithmetic and logic operations to images.         //
////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcGray0, srcGray1, dstGray;
EImageC24 srcColor, dstColor;
```

```
// ...
```

```
// All images must have the same size
dstGray.SetSize(&srcGray0);
// ...
```

```
// Subtract srcGray1 from srcGray0
EasyImage::Oper(EArithmeticLogicOperation_Subtract, &srcGray0, &srcGray1, &dstGray);
```

```
// Multiply srcGray0 by a constant value
EasyImage::Oper(EArithmeticLogicOperation_Multiply, &srcGray0, (EBW8)2, &dstGray);
```

```
// Add a constant value to srcColor
EasyImage::Oper(EArithmeticLogicOperation_Add, &srcColor, EC24(128,64,196),
&dstColor);
```

```
// Erase (blacken) the destination image where the source image is black
EasyImage::Oper(EArithmeticLogicOperation_SetZero, &srcGray0, (EBW8)0, &dstGray);
```

2.3. Convolution

Pre-Defined Kernel Filtering

```
///////////////////////////////////////////////////////////
// This code snippet shows how to apply miscellaneous    //
// convolution operations based on pre-defined kernels.  //
///////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// ...
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Perform a Uniform filtering (5x5 kernel)
EasyImage::ConvolUniform(&srcImage, &dstImage, 2);
```

```
// Perform a Highpass filtering
EasyImage::ConvolHighpass1(&srcImage, &dstImage);
```

```
// Perform a Gradient filtering
EasyImage::ConvolGradient(&srcImage, &dstImage);
```

```
// Perform a Sobel filtering
EasyImage::ConvolSobel(&srcImage, &dstImage);
```

User-Defined Kernel Filtering

```
//////////////////////////////////////////////////////////
// This code snippet shows how to apply a convolution  //
// operation based on a user-defined kernel.           //
//////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// ...
```

```
// Create and define a user-defined kernel
// (Frei-Chen row gradient, positive only)
EKernel kernel;
kernel.SetKernelData(0.2929f, 0, -0.2929f,
                     0.4142f, 0, -0.4142f,
                     0.2929f, 0, -0.2929f);
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Apply the convolution kernel
EasyImage::ConvolKernel(&srcImage, &dstImage, &kernel);
```

2.4. Non-Linear Filtering

Morphological Filtering

```
//////////////////////////////////////////////////////////
// This code snippet shows how to apply miscellaneous  //
// morphological filtering operations.                 //
//////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// ...
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Perform an erosion (3x3 square kernel)
EasyImage::ErodeBox(&srcImage, &dstImage, 1);
```

```
// Perform a dilation (5x3 rectangular kernel)
EasyImage::DilateBox(&srcImage, &dstImage, 2, 1);
```

```
// Perform an Open operation (5x5 circular kernel)
EasyImage::OpenDisk(&srcImage, &dstImage, 2);
```

Hit-and-Miss Transform

```
//////////////////////////////////////////////////////////////
// This code snippet shows how to highlight the left corner //
// of a rhombus by means of a Hit-and-Miss operation.       //
//////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// ...
```

```
// Create and define a Hit-and-Miss kernel
// corresponding to the left corner of a rhombus
EHitAndMissKernel leftCorner(-1, -1, 1, 1);
```

```
// Left column of the kernel
```

```
leftCorner.SetValue(-1, 0, EHitAndMissValue_Background);
```

```
// Middle column of the kernel
leftCorner.SetValue(0, -1, EHitAndMissValue_Background);
leftCorner.SetValue(0, 0, EHitAndMissValue_Foreground);
leftCorner.SetValue(0, 1, EHitAndMissValue_Background);
```

```
// Right column of the kernel
leftCorner.SetValue(1, -1, EHitAndMissValue_Foreground);
leftCorner.SetValue(1, 0, EHitAndMissValue_Foreground);
leftCorner.SetValue(1, 1, EHitAndMissValue_Foreground);
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Apply the Hit-and-Miss kernel
EasyImage::HitAndMiss(&srcImage, &dstImage, leftCorner);
```

2.5. Vector Operations

Path Sampling

```
//////////////////////////////////////////////////////////////
// This code snippet shows how to retrieve and store the    //
// pixel values along a given path together with the        //
// corresponding pixel coordinates.                         //
//////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ...
```

```
// Vector constructor
EBW8PathVector path;
```

```
// Path definition
path.Empty();
for (int i = 0; i < 100; i++)
{
```

```
  EBW8Path p;
  p.X = i;
  p.Y = i;
  p.Pixel = 128;
  path.AddElement(p);
}
```

```
// Get the image data along the path
EasyImage::ImageToPath(&srcImage, &path);
```

Profile Sampling

```
//////////////////////////////////////////////////////////////
// This code snippet shows how to set, retrieve and store   //
// the pixel values along a given line segment.             //
//////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ...
```

```
// Vector constructor
EBW8Vector profile;
```

```
// Get the image data along segment (10,510)-(500,40)
EasyImage::ImageToLineSegment(&srcImage, &profile, 10, 510, 500, 40);
```

```
// Set all these points to white (255) in the image
EasyImage::LineSegmentToImage(&srcImage, 255, 10, 510, 500, 40);
```

2.6. Statistics

Image Statistics

```
////////////////////////////////////////////////////////////////////
// This code snippet shows how to compute basic image statistics. //
////////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ...
```

```
// Count the number of pixels above the threshold (128)
INT32 count;
EasyImage::Area(&srcImage, 128, count);
```

```
// Compute the pixels' average and standard deviation values
float stdDev, average;
EasyImage::PixelStdDev(&srcImage, stdDev, average);
```

```
// Compute the image gravity center (pixels above threshold)
float x, y;
EasyImage::GravityCenter(&srcImage, 128, x, y);
```

Sliding Windows Statistics

```
////////////////////////////////////////////////////////////////////////
// This code snippet shows how to perform sliding windows statistics. //
////////////////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage0, dstImage1;
```

```
// ...
```

```
// All images must have the same size
dstImage0.SetSize(&srcImage);
dstImage1.SetSize(&srcImage);
```

```
// Local average in a 11x11 window
EasyImage::LocalAverage(&srcImage, &dstImage0, 5, 5);
```

```
// Local deviation in a 11x11 window
EasyImage::LocalDeviation(&srcImage, &dstImage1, 5, 5);
```

Histogram-Based Statistics

```
/////////////////////////////////////////////////////////
// This code snippet shows how to compute statistics   //
// based on an histogram.                              //
/////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ...
```

```
// Histogram constructor
EBWHistogramVector histo;
```

```
// Compute the histogram
EasyImage::Histogram(&srcImage, &histo);
```

```
// Compute the average gray-level value
float average = EasyImage::AnalyseHistogram(&histo, EHistogramFeature_
AveragePixelValue, 0, 255);
```

```
// Compute the gray-level standard deviation
float deviation = EasyImage::AnalyseHistogram(&histo, EHistogramFeature_
PixelValueStdDev, 0, 255);
```

2.7. Noise Reduction by Integration

Temporal Noise Reduction

```
///////////////////////////////////////////////////
// This code snippet shows how to perform noise  //
// reduction by temporal averaging.              //
///////////////////////////////////////////////////
```

```
// Images constructor
EImageBW16 noisyImage, cleanImage;
```

```
// 16 bits work image used as an accumulator
EImageBW16 store;
```

```
// ...
```

```
// All images must have the same size
cleanImage.SetSize(&noisyImage);
store.SetSize(&noisyImage);
```

```
// Clear the accumulator image
EasyImage::Oper(EArithmeticLogicOperation_Copy, (EBW16)0, &store);
```

```
// Accumulation loop
int n;
for (n=0; n < 10; n++)
{
  // Acquire a new image into noisyImage
  // ...

```

```
  // Add this new noisy image into the accumulator
  EasyImage::Oper(EArithmeticLogicOperation_Add, &noisyImage, &store, &store);
}
```

```
// Perform noise reduction
EasyImage::Oper(EArithmeticLogicOperation_Divide, &store, (EBW16)n, &cleanImage);
```

Recursive Average

```
/////////////////////////////////////////////////////
// This code snippet shows how to perform noise  //
// reduction by recursive averaging.             //
/////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 noisyImage, cleanImage;
```

```
// 16 bits work image used as an accumulator
EImageBW16 store;
```

```
// ...
```

```
// All images must have the same size
cleanImage.SetSize(&noisyImage);
store.SetSize(&noisyImage);
```

```
// Clear the accumulator image
EasyImage::Oper(EArithmeticLogicOperation_Copy, (EBW16)0, &store);
```

```
// Prepare the transfer lookup table (reduction factor = 3)
EBW16Vector lut;
EasyImage::SetRecursiveAverageLUT(&lut, 3.f);
```

```
// Perform the noise reduction
EasyImage::RecursiveAverage(&noisyImage, &store, &cleanImage, &lut);
```

2.8. Feature Point Detectors

Harris Corner Detector

```
/////////////////////////////////////////////////////////////////
// This code snippet shows how to retrieve corners' coordinates //
// by means of the Harris corner detector algorithm.            //
/////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ...
```

```
// Harris corner detector
EHarrisCornerDetector harris;
EHarrisInterestPoints interestPoints;
harris.SetIntegrationScale(2.f);
```

```
// Perform the corner detection
harris.Apply(srcImage, interestPoints);
```

```
// Retrieve the number of corners
unsigned int index = interestPoints.GetPointCount();
```

```
// Retrieve the first corner coordinates
EPoint point = interestPoints.GetPoint(0);
float x = point.GetX();
float y = point.GetY();
```

Canny Edge Detector

```
/////////////////////////////////////////////////////
// This code snippet shows how to highlight edges  //
// by means of the Canny edge detector algorithm.  //
/////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// ...
```

```
// Canny edge detector
ECannyEdgeDetector canny;
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Perform the edges detection
canny.Apply(srcImage, dstImage);
```

2.9. Using Flexible Masks

Computing Pixels Average

```
/////////////////////////////////////////////////////////
// This code snippet shows how to compute statistics   //
// inside a region defined by a flexible mask.         //
/////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 mask;
```

```
// ...
```

```
// Compute the average value of the source image pixels
// corresponding to the mask do-care areas only
float average;
EasyImage::PixelAverage(&srcImage, &mask, average);
```

3. EasyColor

3.1. Colorimetric Systems Conversion

```
//////////////////////////////////////////////////////////
// This code snippet shows how to convert a color image //
// from the RGB to the Lab colorimetric system.         //
//////////////////////////////////////////////////////////
```

```
// Images constructor
EImageC24 srcImage;
EImageC24 dstImage;
```

```
// ...
```

```
// Prepare a lookup table for
// the RGB to La*b* conversion
EColorLookup lookup;
lookup.ConvertFromRgb(EColorSystem_Lab);
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Perform the color conversion
EasyColor::Transform(&srcImage, &dstImage, &lookup);
```

3.2. Color Components

```
//////////////////////////////////////////////////////////
// This code snippet shows how to create a color image  //
// from 3 grayscale images and extract the luminance    //
// component from a color image.                        //
//////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 red, green, blue;
EImageC24 colorImage;
EImageBW8 luminance;
```

```
// ...
```

```
// Source and destination images must have the same size
colorImage.SetSize(&red);
```

```
// Combine the color planes into a color image
EasyColor::Compose(&red, &green, &blue, &colorImage);
```

```
// Prepare a lookup table for
// the RGB to LSH conversion
```

```
EColorLookup lookup;
lookup.ConvertFromRgb(EColorSystem_Lsh);
```

```
// Source and destination images must have the same size
luminance.SetSize(&colorImage);
```

```
// Get the Luminance component
EasyColor::GetComponent(&colorImage, &luminance, 0, &lookup);
```

3.3. White Balance

```
/////////////////////////////////////////////////////////////
// This code snippet shows how to perform white balancing. //
/////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageC24 srcImage, dstImage;
EImageC24 whiteRef;
```

```
// ...
```

```
// Create a lookup table
EColorLookup lut;
```

```
// Measure the calibration values from a white reference image
float r, g, b;
EasyImage::PixelAverage(&whiteRef, r, g, b);
```

```
// Prepare the lookup table for
// a white balance operation
lut.WhiteBalance(1.00f, EasyColor::GetCompensateNtscGamma(), r, g, b);
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Perform the white balance operation
lut.Transform(&srcImage, &dstImage);
```

3.4. Pseudo-Coloring

```
/////////////////////////////////////////////////////////////
// This code snippet shows how to perform pseudo-coloring. //
/////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageC24 dstImage;
```

```
// ...
```

```
// Create a pseudo-color lookup table
EPseudoColorLookup pcLut;
```

```
// Define a shade of pure tints, from red to blue
pcLut.SetShading(EC24(255, 0, 0), EC24(0, 0, 255), EColorSystem_Ish);
```

```
// Source and destination images must have the same size
dstImage.SetSize(&srcImage);
```

```
// Generate the pseudo-colored image
EasyColor::PseudoColor(&srcImage, &dstImage, &pcLut);
```

3.5. Bayer Pattern Decoding

```
//////////////////////////////////////////////////////////////////
// This code snippet shows how to perform Bayer pattern decoding. //
//////////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 bayerImage;
EImageC24 dstImage;
```

```
// ...
```

```
// Source and destination images must have the same size
dstImage.SetSize(&bayerImage);
```

```
// Convert to true color with simple interpolation, default parity assumed
EasyColor::BayerToC24(&bayerImage, &dstImage);
```

4. EasyDeepLearning

4.1. Creating a Dataset and Training a Classifier

```
///////////////////////////////////////////////////////////////
// This code snippet shows how to create a dataset, train a  //
// classifier and get the best performance metrics obtained  //
// during the training.                                      //
///////////////////////////////////////////////////////////////
```

```
// Creating dataset and classifier objects
EClassificationDataset dataset;
EClassificationDataset trainingDataset;
EClassificationDataset validationDataset;
EClassifier classifier;
```

```
// Adding images using a glob pattern
dataset.AddImages("*good*.png", "good");
dataset.AddImages("*defective*.png", "defective");
```

```
// Enabling data augmentation on the dataset
dataset.SetEnableDataAugmentation(true);
```

```
// Rotation of up to 90°
dataset.SetMaxRotationAngle(90);
```

```
// Enabling horizontal flips
dataset.SetEnableHorizontalFlip(true);
```

```
// Splitting the dataset with 80% of images for the training dataset
// and 20% for the validation dataset
dataset.Split(trainingDataset, validationDataset, 0.8);
```

```
// Training the classifier for 50 epochs
classifier.Train(trainingDataset, validationDataset, 50);
classifier.WaitForTrainingCompletion();
```

```
// Get the best metrics obtained on the validation dataset
EClassificationMetrics bestMetrics = classifier.GetValidationMetrics
(classifier.GetBestEpoch());
```

4.2. Loading a Classifier and Classifying a New Image

```
///////////////////////////////////////////////////////////////
// This code snippet shows how load a trained classifier and //
// classify a new image.                                     //
///////////////////////////////////////////////////////////////
```

```
// Image and classifier constructor
EClassifier classifier;
EImageBW8 srcImage;
```

```
// String and probability for the most probable result
std::string label;
float probability;
```

```
// Load classifier and image
classifier.Load(...)
srcImage.Load(...)
```

```
// Classify image
EClassificationResult result = classifier.Classify(srcImage);
```

```
// Get the most probable label
label = result.GetBestLabel();
probability = result.GetBestProbability();
```

5. EasyObject

5.1. Constructing the Blobs

Image Encoder

```
///////////////////////////////////////////////////////////////
// This code snippet shows how to build blobs belonging to  //
// the white layer according to the minimum residue method  //
// and how to build blobs belonging to the black layer      //
// according to an absolute threshold.                      //
///////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Build the blobs belonging to the white layer,
// the segmentation is based on the Minimum Residue method
encoder.Encode(srcImage, codedImage);
```

```
// Build the blobs belonging to the black layer,
// the segmentation is based on an absolute threshold (110)
Segmenters::EGrayscaleSingleThresholdSegmenter& segmenter=
encoder.GetGrayscaleSingleThresholdSegmenter();
segmenter.SetBlackLayerEncoded(true);
segmenter.SetWhiteLayerEncoded(false);
```

```
segmenter.SetMode(EGrayscaleSingleThreshold_Absolute);
segmenter.SetAbsoluteThreshold(110);
```

```
encoder.Encode(srcImage, codedImage);
```

Image Segmenter

```
///////////////////////////////////////////////////////////////
// This code snippet shows how to build blobs according to  //
// a user-defined image segmenter.                          //
///////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Set the segmentation method to GrayscaleDoubleThreshold
encoder.SetSegmentationMethod(ESegmentationMethod_GrayscaleDoubleThreshold);
```

```
// Retrieve the segmenter object
Segmenters::EGrayscaleDoubleThresholdSegmenter& segmenter=
encoder.GetGrayscaleDoubleThresholdSegmenter();
```

```
// Set the high and low threshold values
segmenter.SetHighThreshold(150);
segmenter.SetLowThreshold(50);
```

```
// Specify the layers to be encoded (neutral layer only)
segmenter.SetBlackLayerEncoded(false);
segmenter.SetNeutralLayerEncoded(true);
segmenter.SetWhiteLayerEncoded(false);
```

```
// Encode the image
encoder.Encode(srcImage, codedImage);
```

Holes Extraction

```
///////////////////////////////////////////////////////////
// This code snippet shows how to retrieve blobs' holes. //
///////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Encode the image
encoder.Encode(srcImage, codedImage);
```

```
// Retrieve holes for all the blobs
for (unsigned int blobIndex = 0; blobIndex < codedImage.GetObjCount(); blobIndex++)
{
        EObject& blob = codedImage.GetObj(blobIndex);
```

```
        // Browse the holes of the current object
        for (unsigned int holeIndex = 0; holeIndex < blob.GetHoleCount(); holeIndex++)
        {
                // Retrieve a given hole
                EHole& hole = blob.GetHole(holeIndex);
        }
}
```

Continuous Mode

```
/////////////////////////////////////////////////
// This code snippet shows how to build blobs  //
// in the continuous mode context.             //
/////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Enable the continuous mode
encoder.SetContinuousModeEnabled(true);
```

```
// Loop to acquire the different chunks
for (int count = 0; count < MAX_COUNT ; count++)
{
        // Store the new chunk into srcImage
        // ...
```

```
        // Encode the current chunk
        encoder.Encode(srcImage, codedImage);
}
```

```
// Flush the continuous mode
encoder.FlushContinuousMode(codedImage);
```

5.2. Computing Blobs Features

```
//////////////////////////////////////////////////////////////
// This code snippet shows how to retrieve blobs' features. //
//////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Encode the source image
encoder.Encode(srcImage, codedImage);
```

```
for (unsigned int index = 0; index < codedImage.GetObjCount(); index++)
{
        // Retrieve the selected blob gravity center
        EObject& blob = codedImage.GetObj(index);
        float centerX = blob.GetGravityCenter().GetX();
        float centerY = blob.GetGravityCenter().GetY();
}
```

5.3. Selecting and Sorting Blobs

```
/////////////////////////////////////////////////////////
// This code snippet shows how to build blobs, select  //
// some of them and sort the selected ones.            //
/////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Encode the source image
encoder.Encode(srcImage, codedImage);
```

```
// Create a blob selection
EObjectSelection selection;
selection.AddObjects(codedImage);
```

```
// Remove the Small blobs
selection.RemoveUsingUnsignedIntegerFeature(EFeature_Area, 100, ESingleThresholdMode_
Less);
```

```
// Retrieve the number of remaining blobs
unsigned int numBlobs= selection.GetElementCount();
```

```
// Sort the remaining blobs based on their area
selection.Sort(EFeature_Area, ESortDirection_Ascending);
```

```
// Retrieve the selected blobs
for (unsigned int index = 0; index < numBlobs; index++)
{
    float centerX= selection.GetElement(index).GetGravityCenterX();
    float centerY= selection.GetElement(index).GetGravityCenterY();
}
```

5.4. Using Flexible Masks

Constructing Blobs

```
////////////////////////////////////////////////////////
// This code snippet shows how to build blobs inside  //
// a region defined by a flexible mask.               //
////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 mask;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Encode the source image regions
// corresponding to the mask do care areas
encoder.Encode(srcImage, mask, codedImage);
```

Generating a Flexible Mask from an Encoded Image

```
/////////////////////////////////////////////////////////
// This code snippet shows how to generate a flexible  //
// mask from an encoded image.                         //
/////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 mask;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Encode the source image
encoder.Encode(srcImage, codedImage);
```

```
// The source image and the mask must have the same size
mask.SetSize(&srcImage);
```

```
// Create the mask based on the white layer
// of the coded image
codedImage.RenderMask(mask, 1);
```

Generating a Flexible Mask from a Blob Selection

```
/////////////////////////////////////////////////////////
// This code snippet shows how to generate a flexible  //
// mask from a selection of blobs.                     //
/////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 mask;
```

```
// Image encoder
EImageEncoder encoder;
```

```
// Coded image
ECodedImage2 codedImage;
```

```
// ...
```

```
// Encode the source image
encoder.Encode(srcImage, codedImage);
```

```
// The source image and the mask must have the same size
mask.SetSize(&srcImage);
```

```
// Create a blob selection
EObjectSelection selection;
selection.AddObjects(codedImage);
```

```
// Remove the Small blobs
selection.RemoveUsingUnsignedIntegerFeature(EFeature_Area, 100, ESingleThresholdMode_Less);
```

```
// Create the mask based on the blob selection
selection.RenderMask(mask);
```

```
// Sort the remaining blobs based on their area
selection.Sort(EFeature_Area, ESortDirection_Descending);
```

```
// Create the mask corresponding to the largest blob
selection.GetElement(0).RenderMask(mask);
```

6. EasyMatch

6.1. Pattern Learning

```
/////////////////////////////////////////////////////
// This code snippet shows how to learn a pattern  //
// defined by a region of interest (ROI).          //
/////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ROI constructor
EROIBW8 pattern;
```

```
// EMatcher constructor
EMatcher matcher;
```

```
// ...
```

```
// Attach the ROI to the source image
// and set its position
pattern.Attach(&srcImage);
pattern.SetPlacement(214, 52, 200, 200);
```

```
// Learn the pattern
matcher.LearnPattern(&pattern);
```

6.2. Setting Search Parameters

```
//////////////////////////////////////////////////////////
// This code snippet shows how to tune pattern matching //
// search parameters and save them into a file.         //
//////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 pattern;
```

```
// EMatcher constructor
EMatcher matcher;
```

```
// ...
```

```
// Learn the pattern
matcher.LearnPattern(&pattern);
```

```
// Set the maximum number of occurrences
matcher.SetMaxPositions(5);
```

```
// Set the rotation tolerances
matcher.SetMinAngle(-20.f);
matcher.SetMaxScale(20.f);
```

```
// Enable sub-pixel accuracy
matcher.SetInterpolate(true);
```

```
// Set the minimum score
matcher.SetMinScore(0.70f);
```

```
// Save the matching context into a model file
matcher.Save("myModel.mch");
```

6.3. Pattern Matching and Retrieving Results

```
//////////////////////////////////////////////////////
// This code snippet shows how to perform pattern  //
// matching operations and retrieve the results.   //
//////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EMatcher constructor
EMatcher matcher;
```

```
// ...
```

```
// Load a model file
matcher.Load("myModel.mch");
```

```
// Perform the matching
matcher.Match(&srcImage);
```

```
// Retrieve the number of occurrences
int numOccurrences= matcher.GetNumPositions();
```

```
// Retrieve the first occurrence
EMatchPosition myOccurrence= matcher.GetPosition(0);
```

```
// Retrieve its score and position
float score= myOccurrence.Score;
float centerX= myOccurrence.CenterX;
float centerY= myOccurrence.CenterY;
```

7. EasyFind

7.1. Pattern Learning

```
/////////////////////////////////////////////////////
// This code snippet shows how to learn a pattern  //
// defined by a region of interest (ROI).          //
/////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ROI constructor
EROIBW8 pattern;
```

```
// EPatternFinder constructor
EPatternFinder finder;
```

```
// ...
```

```
// Attach the ROI to the source image
// and set its position
pattern.Attach(&srcImage);
pattern.SetPlacement(214, 52, 200, 200);
```

```
// Learn the pattern
finder.Learn(&pattern);
```

7.2. Setting Search Parameters

```
//////////////////////////////////////////////////////////
// This code snippet shows how to tune pattern finding  //
// search parameters and save them into a file.         //
//////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 pattern;
```

```
// EPatternFinder constructor
EPatternFinder finder;
```

```
// ...
```

```
// Learn the pattern
finder.Learn(&pattern);
```

```
// Set the maximum number of occurrences
finder.SetMaxInstances(5);
```

```
// Set the rotation tolerances
finder.SetAngleTolerance(20.f);
```

```
// Set the minimum score
finder.SetMinScore(0.70f);
```

```
// Save the finding context into a model file
finder.Save("myModel.fnd");
```

7.3. Pattern Finding and Retrieving Results

```
////////////////////////////////////////////////////
// This code snippet shows how to perform pattern  //
// finding operations and retrieve the results.    //
////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EPatternFinder constructor
EPatternFinder finder;
```

```
// EFoundPattern constructor
std::vector<EFoundPattern> foundPattern;
```

```
// ...
```

```
// Load a model file
finder.Load("myModel.fnd");
```

```
// Perform the pattern finding
foundPattern= finder.Find(&srcImage);
```

```
// Retrieve the number of instances
int numInstances= foundPattern.size();
```

```
// Retrieve the score and the
// position of the first instance
float score= foundPattern[0].GetScore();
float centerX= foundPattern[0].GetCenter().GetX();
float centerY= foundPattern[0].GetCenter().GetY();
```

8. EasyGauge

8.1. Point Location

```
//////////////////////////////////////////////////////////////////
// This code snippet shows how to create a point location tool, //
// adjust the transition parameters, set the nominal gauge      //
// position, perform the measurement and retrieve the result.   //
//////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EPointGauge constructor
EPointGauge pointGauge;
```

```
// Adjust the transition parameters
pointGauge.SetTransitionType(ETransitionType_Wb);
pointGauge.SetTransitionChoice(ETransitionChoice_Closest);
```

```
// Set the gauge nominal position
pointGauge.SetCenterXY(256.f, 256.f);
```

```
// Set the gauge length to 100 units and the angle to 45°
pointGauge.SetTolerance(100.f, 45.f);
```

```
// Measure
pointGauge.Measure(&srcImage);
```

```
// Get the measured point coordinates
float measuredX = pointGauge.GetMeasuredPoint().GetX();
float measuredY = pointGauge.GetMeasuredPoint().GetY();
```

```
// Save the point gauge measurement context
pointGauge.Save("myPointGauge.gge");
```

8.2. Line Fitting

```
////////////////////////////////////////////////////////////////////
// This code snippet shows how to create a line measurement tool, //
// adjust the transition parameters, set the nominal gauge        //
// position, perform the measurement and retrieve the result.     //
////////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ELineGauge constructor
ELineGauge lineGauge;
```

```
// Adjust the transition parameters
lineGauge.SetTransitionType(ETransitionType_Bw);
lineGauge.SetTransitionChoice(ETransitionChoice_NthFromEnd);
lineGauge.SetTransitionIndex(2);
```

```
// Set the line fitting gauge position,
// length (50 units) and orientation (20°)
EPoint center(256.f, 256.f);
ELine line(center, 50.f, 20.f);
lineGauge.SetLine(line);
```

```
// Measure
lineGauge.Measure(&srcImage);
```

```
// Get the origin and end point coordinates of the fitted line
EPoint originPoint = lineGauge.GetMeasuredLine().GetOrg();
EPoint endPoint = lineGauge.GetMeasuredLine().GetEnd();
```

```
// Save the point gauge measurement context
lineGauge.Save("myLineGauge.gge");
```

8.3. Circle Fitting

```
//////////////////////////////////////////////////////////////////////
// This code snippet shows how to create a circle measurement tool, //
// adjust the transition parameters, set the nominal gauge          //
// position, perform the measurement and retrieve the result.       //
//////////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ECircleGauge constructor
ECircleGauge circleGauge;
```

```
// Adjust the transition parameters
circleGauge.SetTransitionType(ETransitionType_Bw);
circleGauge.SetTransitionChoice(ETransitionChoice_LargestAmplitude);
```

```
// Set the Circle fitting gauge position, diameter (50 units),
// starting angle (10°), and amplitude (270°)
EPoint center(256.f, 256.f);
ECircle circle(center, 50.f, 10.f, 270.f);
circleGauge.SetCircle(circle);
```

```
// Measure
circleGauge.Measure(&srcImage);
```

```
// Get the center point coordinates and the radius of the fitted circle
float centerX = circleGauge.GetMeasuredCircle().GetCenter().GetX();
float centerY = circleGauge.GetMeasuredCircle().GetCenter().GetY();
float radius = circleGauge.GetMeasuredCircle().GetRadius();
```

```
// Save the point gauge measurement context
circleGauge.Save("myCircleGauge.gge");
```

8.4. Rectangle Fitting

```
/////////////////////////////////////////////////////////////////////////
// This code snippet shows how to create a rectangle measurement tool, //
// adjust the transition parameters, set the nominal gauge position,   //
// perform the measurement and retrieve the result.                    //
/////////////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// ERectangleGauge constructor
ERectangleGauge rectangleGauge;
```

```
// Adjust the transition parameters
rectangleGauge.SetTransitionType(ETransitionType_Bw);
rectangleGauge.SetTransitionChoice(ETransitionChoice_LargestAmplitude);
```

```
// Set the rectangle fitting gauge position,
// size (50x30 units) and orientation (15°)
EPoint center(256.f, 256.f);
ERectangle rectangle(center, 50.f, 30.f, 15.f);
rectangleGauge.SetRectangle(rectangle);
```

```
// Measure
rectangleGauge.Measure(&srcImage);
```

```
// Get the size and the rotation angle of the fitted rectangle
float sizeX = rectangleGauge.GetMeasuredRectangle().GetSizeX();
float sizeY = rectangleGauge.GetMeasuredRectangle().GetSizeY();
float angle = rectangleGauge.GetMeasuredRectangle().GetAngle();
```

```
// Save the point gauge measurement context
rectangleGauge.Save("myRectangleGauge.gge");
```

8.5. Wedge Fitting

```
/////////////////////////////////////////////////////////////////////
// This code snippet shows how to create a wedge measurement tool, //
// adjust the transition parameters, set the nominal gauge         //
// position, perform the measurement and retrieve the result.      //
/////////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EWedgeGauge constructor
EWedgeGauge wedgeGauge;
```

```
// Adjust the transition parameters
wedgeGauge.SetTransitionType(ETransitionType_Bw);
wedgeGauge.SetTransitionChoice(ETransitionChoice_NthFromBegin);
wedgeGauge.SetTransitionIndex(0);
```

```
// Set the wedge fitting gauge position, diameter (50 units),
// breadth (-25 units), starting angle (0°) and amplitude (270°)
EPoint center(256.f, 256.f);
```

```
EWedge wedge(center, 50.f, -25.f, 0.f, 270.f);
wedgeGauge.SetWedge(wedge);
```

```
// Measure
wedgeGauge.Measure(&srcImage);
```

```
// Get the inner and outer radius of the fitted wedge
float innerRadius = wedgeGauge.GetMeasuredWedge().GetInnerRadius();
float outerRadius = wedgeGauge.GetMeasuredWedge().GetOuterRadius();
```

```
// Save the point gauge measurement context
wedgeGauge.Save("myWedgeGauge.gge");
```

8.6. Gauge Grouping

Gauge Hierarchy

```
//////////////////////////////////////////////////////////////
// This code snippet shows how to create a gauge hierarchy  //
// and save it into a file.                                 //
//////////////////////////////////////////////////////////////
```

```
// EWorldShape constructor
EWorldShape worldShape;
```

```
// Gauges constructor
ERectangleGauge rectangleGauge;
ECircleGauge circleGauge1, circleGauge2;
```

```
// ...
```

```
// Attach the rectangle gauge to the EWorldShape
rectangleGauge.Attach(&worldShape);
```

```
// Attach the circle gauges to the rectangle gauge
circleGauge1.Attach(&rectangleGauge);
circleGauge2.Attach(&rectangleGauge);
```

```
// Set the first circle gauge name
circleGauge1.SetName("myCircleGauge1");
```

```
// ...
```

```
// Save worldShape together with its daughters
worldShape.Save("myWorldShape.gge", true);
```

Complex Measurement

```
////////////////////////////////////////////////////////////
// This code snippet shows how to trigger the measurement //
// of a whole gauge hierarchy and retrieve the results.   //
////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EWorldShape constructor
EWorldShape worldShape;
```

```
// Load the EWorldShape together with its daughters
worldShape.Load("myWorldShape.gge", true);
```

```
// Retrieve the number of worldShape's daughters
int numDaughters= worldShape.GetNumDaughters();
```

```
// ...
```

```
// Trigger the measurement of all the
// gauges attached to the EWorldShape
worldShape.Process(&srcImage, true);
```

```
// Retrieve the measurement result of
// the first daughter (a rectangle gauge)
ERectangleGauge* rectangleGauge= (ERectangleGauge*)worldShape.GetDaughter(0);
float sizeX= rectangleGauge->GetMeasuredRectangle().GetSizeX();
```

```
// Retrieve the measurement result of a
// daughter gauge called "myCircleGauge1"
ECircleGauge* circleGauge= (ECircleGauge*)worldShape.GetShapeNamed
("myCircleGauge1");
EPoint center= circleGauge->GetMeasuredCircle().GetCenter();
```

8.7. Calibration using EWorldShape

Calibration by Guesswork

```
//////////////////////////////////////////////////////////
// This code snippet shows how to perform a calibration //
// by guesswork.                                         //
//////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EWorldShape constructor
EWorldShape worldShape;
```

```
// ...
```

```
// Compute the calibration coefficients
// Field of view: 32x24 mm
worldShape.SetSensor(srcImage.GetWidth(), srcImage.GetHeight(), 32.f, 24.f);
```

```
// Retrieve the spatial resolution
float resolutionX= worldShape.GetXResolution();
float resolutionY= worldShape.GetYResolution();
```

Landmark-Based Calibration

```
/////////////////////////////////////////////////////////////
// This code snippet shows how to perform a landmark-based //
// calibration.                                            //
/////////////////////////////////////////////////////////////
```

```
// EWorldShape constructor
EWorldShape worldShape;
```

```
// ...
```

```
// Reset the calibration context
worldShape.EmptyLandmarks();
```

```
// Loop on the landmarks
for(int index= 0; index < numLandmarks; index++
{
        // Get the I-th landmark as a pair of EPoint(x, y)
        EPoint sensorPoint, worldPoint;

        // Retrieve and store the relevant data into worldPoint and sensorPoint
        // ...
```

```
        // Add the I-th pair
        worldShape.AddLandmark(sensorPoint, worldPoint);
}
```

```
// Perform the calibration
worldShape.Calibrate(ECalibrationMode_Skewed);
```

Dot Grid-Based Calibration

```
/////////////////////////////////////////////////////////////
// This code snippet shows how to perform a dot grid-based //
// calibration.                                            //
/////////////////////////////////////////////////////////////
```

```
// EWorldShape constructor
EWorldShape worldShape;
```

```
// ...
```

```
// Reset the calibration context
worldShape.EmptyLandmarks();
```

```
// Loop on the dots
for(int index= 0; index < numDots; index++)
{
        // Get the I-th dot as an EPoint(x, y)
        EPoint dotPoint;
```

```
        // Retrieve and store the relevant data into dotPoint
        // ...
```

```
        // Add the I-th dot
        worldShape.AddPoint(dotPoint);
}
```

```
// Reconstruct the grid topology
// pitch X and Y = 5 units
worldShape.RebuildGrid(5, 5);
```

```
// Perform the calibration
// the calibration modes are computed automatically
worldShape.AutoCalibrate(true);
```

Coordinates Transform

```
/////////////////////////////////////////////////////////////
// This code snippet shows how to convert coordinates from //
// the Sensor space to the World space and conversely.     //
/////////////////////////////////////////////////////////////
```

```
// EWorldShape constructor
EWorldShape worldShape;
```

```
// EPoint constructor
EPoint sensor;
EPoint world;
```

```
// ...
```

```
// Perform the calibration
worldShape.Calibrate(ECalibrationMode_Scaled | ECalibrationMode_Skewed);
```

```
// Retrieve the world coordinates of a point, knowing its sensor coordinates
world= worldShape.SensorToWorld(sensor);
```

```
// Retrieve the sensor coordinates of a point, knowing its world coordinates
sensor= worldShape.WorldToSensor(world);
```

Image Unwarping

```
//////////////////////////////////////////////////////////
// This code snippet shows how to unwarp an image based //
// of the computed calibration coefficients.            //
//////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 srcImage;
EImageBW8 dstImage;
```

```
// EWorldShape constructor
EWorldShape worldShape;
```

```
// Lookup table constructor
EUnwarpingLut lut;
```

```
// ...
```

```
// Perform the calibration
worldShape.Calibrate(ECalibrationMode_Tilted | ECalibrationMode_Radial);
```

```
// Setup the lookup table for unwarping
worldShape.SetupUnwarp(&lut, &srcImage, true);
```

```
// Perform the image unwarping
worldShape.Unwarp(&lut, &srcImage, &dstImage, true);
```

9. EasyOCR

9.1. Learning Characters

```
//////////////////////////////////////////////////////
// This code snippet shows how to learn characters  //
// based on an image featuring a known text and     //
// save the corresponding font file.                //
//////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EOCR constructor
EOCR ocr;
```

```
// Text to be learned (all digits)
// Assuming the image contains this text
const std::string text= "0123456789";
```

```
// ...
```

```
// Create a new fon
ocr.NewFont(8, 11);
```

```
// Adjust the segmentation parameters
ocr.SetTextColor(EOCRColor_BlackOnWhite);
ocr.SetMinCharWidth(15);
ocr.SetMinCharWidth(50);
ocr.SetMinCharHeight(15);
ocr.SetMinCharHeight(75);
ocr.SetNoiseArea(15);
```

```
// Segment the characters
ocr.BuildObjects(&srcImage);
ocr.FindAllChars(&srcImage);
```

```
// Learn the characters
ocr.LearnPatterns(&srcImage, text, EOCRClass_Digit);
```

```
// Save the font into a file
ocr.Save("myFont.ocr");
```

9.2. Recognizing Characters

```
///////////////////////////////////////////////////////
// This code snippet shows how to load a font file,  //
// perform a default character recognition operation //
// and perform a character recognition operation     //
// using a class filter.                          //
//////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EOCR constructor
EOCR ocr;
```

```
// Load the font file
ocr.Load("myFont.ocr");
```

```
// ...
```

```
// Recognize the characters
std::string text= ocr.Recognize(&srcImage, 10, EOCRClass_AllClasses);
```

```
// Alternatively
// Define the character filter (2 letters and 3 digits)
std::vector<UINT32> charFilter;
charFilter.push_back(EOCRClass_UpperCase);
charFilter.push_back(EOCRClass_UpperCase);
charFilter.push_back(EOCRClass_Digit);
charFilter.push_back(EOCRClass_Digit);
charFilter.push_back(EOCRClass_Digit);
```

```
// Recognize the characters with class filtering
text= ocr.Recognize(&srcImage, 10, charFilter);
```

10. EasyOCR2

10.1. Detecting Characters

```
/////////////////////////////////////////////////////////
// This code snippet shows how to detect characters   //
// in an image, using a few parameters and a topology //
/////////////////////////////////////////////////////////
```

```
// Load an Image
EImageBW8 image;
image.Load("image.tif");
```

```
// Attach a ROI to the image
EROIBW8 roi;
roi.Attach(&image, 50, 224, 340, 96);
```

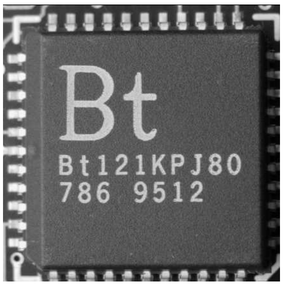
```
// Create an EOCR2 instance
EOCR2 ocr2;
```

```
// Set the expected character sizes
ocr2.SetCharsWidthRange(EIntegerRange(25,25));
ocr2.SetCharsHeight(37);
```

```
// Set the text polarity, in this case WhiteOnBlack
ocr2.SetTextPolarity(EasyOCR2TextPolarity_WhiteOnBlack);
```

```
// Set the topology
ocr2.SetTopology(".{10}\n.{3} .{4}");
```

```
// Detect the text in the image. The output Text structure contains:
// - an individual textbox for each character
// - an individual bitmap image for each character
// - a threshold value to binarize the bitmap image for each character
// All structured in a hierarchy with Lines -> Words -> Characters
EOCR2Text text = ocr2.Detect(roi);
```



The image used in this code snippet

10.2. Learning Characters

```
//////////////////////////////////////////////////////
// This code snippet shows how to learn characters  //
// based on an image featuring a known text and     //
// save the corresponding character database        //
//////////////////////////////////////////////////////
```

```
// Load an Image
EImageBW8 image;
image.Load("image.tif");
```

```
// Attach a ROI to the image
EROIBW8 roi;
roi.Attach(&image, 50, 224, 340, 96);
```

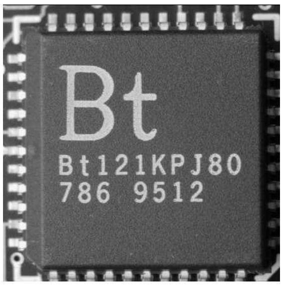
```
// Create an EOCR2 instance
EOCR2 ocr2;
```

```
// Set the required parameters
ocr2.SetCharsWidthRange(EIntegerRange(25,25));
ocr2.SetCharsHeight(37);
ocr2.SetTextPolarity(EasyOCR2TextPolarity_WhiteOnBlack);
ocr2.SetTopology(".{10}\n.{3} .{4}");
```

```
// Learn from the reference image:
//   1) Detect the text in the image
EOCR2Text text = ocr2.Detect(roi);
//   2) Set the true values of the text
text.SetText("Bt121KPJ80\n786 9512");
//   3) Add the characters to the character database
ocr2.Learn(text);
```

```
// Save the character database
ocr2.SaveCharacterDatabase("myDB.o2d");
```

```
// Alternatively, save the model file.
// This will store the character database and the parameter settings
Ocr2.Save("myModel.o2m");
```



The image used in this code snippet

10.3. Reading Characters

Reading using TrueType fonts

```
//////////////////////////////////////////////////////////
// This code snippet shows how to                       //
// - create a character database from TrueType fonts   //
// - read the text in an image                          //
//////////////////////////////////////////////////////////
```

```
// Load an image
EImageBW8 image;
image.Load("image.tif");
```

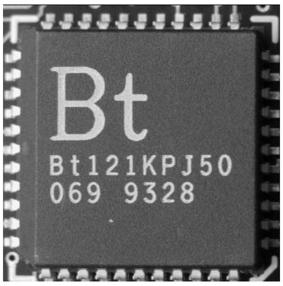
```
// Attach an ROI
EROIBW8 roi;
roi.Attach(&src, 50, 224, 340, 96);
```

```
// Create an EOCR2 instance
EOCR2 ocr2;
```

```
// Set the required parameters
ocr2.SetCharsWidthRange(EIntegerRange(25,25));
ocr2.SetCharsHeight(37);
ocr2.SetTopology("[LN]{10}\nN{3} N{4}");
ocr2.SetTextPolarity(EasyOCR2TextPolarity_WhiteOnBlack);
```

```
// Add TrueType character to the character database
ocr2.AddCharactersToDatabase("C:\\Windows\\Fonts\\calibrib.ttf");
ocr2.AddCharactersToDatabase("C:\\Windows\\Fonts\\yugothb.ttc");
```

```
// Read text from the image
std::string result = ocr2.Read(roi);
```



The image used in this code snippet

Reading using EOCR2 Character Database

```
//////////////////////////////////////////////////////////
// This code snippet shows how to                       //
// - load a pre-made character database                 //
// - read the text in an image                          //
//////////////////////////////////////////////////////////
```

```
// Load an image
EImageBW8 image;
image.Load("image.tif");
```

```
// Attach an ROI
EROIBW8 roi;
roi.Attach(&src, 50, 224, 340, 96);
```

```
// Create an EOCR2 instance
EOCR2 ocr2;
```

```
// Set the required parameters
ocr2.SetCharsWidthRange(EIntegerRange(25,25));
ocr2.SetCharsHeight(37);
ocr2.SetTopology("[LN]{10}\nN{3} N{4}");
ocr2.SetTextPolarity(EasyOCR2TextPolarity_WhiteOnBlack);
```

```
// Add a pre-made character database to the EOCR2 instance
ocr2.AddCharactersToDatabase("myDB.o2d");
```

```
// Read text from the image
std::string result = ocr2.Read(roi);
```

Reading using EOCR2 Model file

```
////////////////////////////////////////////////////////
// This code snippet shows how to                     //
// - load a pre-made model file                       //
// - read the text in an image                        //
////////////////////////////////////////////////////////
```

```
// Load an image
EImageBW8 image;
image.Load("image.tif");
```

```
// Attach an ROI
EROIBW8 roi;
roi.Attach(&src, 50, 224, 340, 96);
```

```
// Create an EOCR2 instance
EOCR2 ocr2;
```

```
// Load a pre-made model file, this will:
// - (re)set all parameters
// - add the character database in the model file to the EOCR2 instance
ocr2.Load("myModel.o2m");
```

```
// Read text from the image
std::string result = ocr2.Read(roi);
```

11. EasyOCV

11.1. Creating an OCV Model

```
////////////////////////////////////////////////////////
// This code snippet shows how to create an OCV model //
// from a golden template and save it into a file.    //
////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EOCV constructor
EOCV ocv;
```

```
// ECodedImage constructor
ECodedImage blobs;
```

```
// ...
```

```
// Reset the OCV context
ocv.DeleteTemplateTexts();
ocv.DrawTemplateChars();
ocv.DeleteTemplateObjects();
ocv.ClearStatistics();
```

```
// Set the OCV context
ocv.SetTemplateImage(&srcImage);
```

```
// Segment the source image
blobs.SetThreshold(EThresholdMode_MinResidue);
blobs.BuildObjects(&srcImage);
```

```
// Compute blobs area and unselect small objects
blobs.AnalyseObjects(ELegacyFeature_Area);
blobs.SelectObjectsUsingFeature(ELegacyFeature_Area, 0, 50, ESelectOption_
RemoveLesserOrEqual);
```

```
// Add remaining blobs to the OCV context
ocv.CreateTemplateObjects(&blobs);
```

```
// Add all selected free objects
ocv.CreateTemplateChars(ESelectionFlag_True, ECharCreationMode_Separate);
```

```
// Group all selected free characters in a single text
ocv.CreateTemplateTexts();
```

```
// Perform the learning
ocv.Learn(&srcImage);
```

```
// Save the ocv model into a file
```

```
ocv.Save("myModel.ocv");
```

11.2. Inspecting

```
//////////////////////////////////////////////////////
// This code snippet shows how to load an OCV model //
// file and perform an inspection.                  //
//////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EOCV constructor
EOCV ocv;
```

```
// ...
```

```
// Load an EasyOCV model file
ocv.Load("myModel.ocv");
```

```
// Perform the inspection
ocv.Inspect(&srcImage, EThresholdMode_MinResidue);
```

11.3. Setting Inspection Parameters

```
///////////////////////////////////////////////////
// This code snippet shows how to set characters //
// and texts inspection parameters.              //
///////////////////////////////////////////////////
```

```
// EOCV constructor
EOCV ocv;
```

```
// Temporary EOCVText object for parameters modification
EOCVText text;
```

```
// Reset the text parameters
text.ResetParameters();
```

```
// Set the text shift tolerance
text.SetShiftXTolerance(30);
text.SetShiftYTolerance(20);
```

```
// Apply the new parameters to all the texts of the ocv context
ocv.ScatterTextsParameters(text, ESelectionFlag_Any);
```

```
// Retrieve the first text (index 0) parameters
text.ResetParameters();
ocv.GetTextParameters(text, 0);
```

```
// Double the shift tolerance
text.SetShiftXTolerance(text.GetShiftXTolerance() * 2);
text.SetShiftYTolerance(text.GetShiftYTolerance() * 2);
```

```
// Apply the new parameters to the ocv context first text only
ocv.SetTextParameters(text, 0);
```

```
// Temporary OCVChar object for parameters modification
EOCVChar ch;
```

```
// Reset the character parameters
ch.ResetParameters();
```

```
// Set the character shift tolerance
ch.SetShiftXTolerance(15);
ch.SetShiftYTolerance(10);
```

```
// Apply the new parameters to all the characters of the ocv context
ocv.ScatterTextsCharsParameters(ch, ESelectionFlag_Any, ESelectionFlag_True);
```

11.4. Retrieving Diagnostics

```
/////////////////////////////////////////////////////////////
// This code snippet shows how to perform an inspection //
// and retrieve the diagnostics.                         //
/////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EOCV constructor
EOCV ocv;
```

```
// ...
```

```
// Load an EasyOCV model file
ocv.Load("myModel.ocv");
```

```
// Perform the inspection
ocv.Inspect(&srcImage, EThresholdMode_MinResidue);
```

```
// Retrieve the OCV inspection diagnostics
if(ocv.GetDiagnostics() != EDiagnostic_Undefined)
{
```

```
        // Check if texts have been found
        bool bTextNotFound= ((ocv.GetDiagnostics() & EDiagnostic_TextNotFound) > 0);
```

```
        // Check if there is text mismatch
        bool bTextMismatch= ((ocv.GetDiagnostics() & EDiagnostic_TextMismatch) > 0);
```

```
        // Check if there is text overprinting
        bool bTextOverprinting= ((ocv.GetDiagnostics() & EDiagnostic_TextOverprinting) > 0);
```

```
        // Check if there is text underprinting
        bool bTextUnderprinting= ((ocv.GetDiagnostics() & EDiagnostic_TextUnderprinting) >
0);
```

```
        // Check if characters have been found
        bool bCharNotFound= ((ocv.GetDiagnostics() & EDiagnostic_CharNotFound) > 0);
```

```
        // Check if there is character mismatch
        bool bCharMismatch= ((ocv.GetDiagnostics() & EDiagnostic_CharMismatch) > 0);
```

```
        // Check if there is character overprinting
        bool bCharOverprinting= ((ocv.GetDiagnostics() & EDiagnostic_CharOverprinting) > 0);
```

```
        // Check if there is character underprinting
        bool bCharUnderprinting= ((ocv.GetDiagnostics() & EDiagnostic_CharUnderprinting) >
0);
}
```

11.5. Statistical Learning

```
///////////////////////////////////////////////////////////
// This code snippet shows how to perform a statistical  //
// learning based on several good quality templates.     //
///////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// EOCV constructor
EOCV ocv;
```

```
// ...
```

```
// Clear the statistics
ocv.ClearStatistics();
```

```
// Loop on the number of good quality sample images
for(int i= 0; i < numSampleImages; i++)
{
        // acquire the next sample image into srcImage
        // ...
```

```
        // Perform the inspection
        ocv.Inspect(&srcImage, EThresholdMode_MinResidue);
```

```
        // Update the statistics
        ocv.UpdateStatistics();
}
```

```
// Adjust the tolerance values based on
// the inspected good quality sample images
ocv.AdjustTextsQualityRanges(3.3f, ESelectionFlag_Any);
ocv.AdjustTextsQualityRanges(3.3f, ESelectionFlag_Any, ESelectionFlag_Any);
```

12. EasyBarCode

12.1. Reading a Bar Code

```
/////////////////////////////////////////////////////
// This code snippet shows how to read a bar code  //
/////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Bar code reader constructor
EBarCode reader;
```

```
// String for the decoded bar code
std::string result;
```

```
// ...
```

```
// Read the source image
result = reader.Read(&srcImage);
```

12.2. Reading a Bar Code Following a Given Symbology

```
///////////////////////////////////////////////////////////////
// This code snippet shows how to enable a given symbology,  //
// enable the checksum verification, perform the bar code    //
// detection and retrieve the decoded string.                //
///////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Bar code reader constructor
EBarCode reader;
```

```
// String for the decoded bar code
std::string result;
```

```
// ...
```

```
// Disable all standard symbologies
reader.SetStandardSymbologies(0);
```

```
// Enable the Code32 symbology only
reader.SetAdditionalSymbologies(ESymbologies_Code32);
```

```
// Enable checksum verification
reader.SetVerifyChecksum(true);
```

```
// Detect all possible meanings of the bar code
reader.Detect(&srcImage);
```

```
// Retrieve the number of symbologies for
// which the decoding process was successful
int numDecoded = reader.GetNumDecodedSymbologies();
```

```
if(numDecoded > 0)
{
        // Decode the bar code according to the Code32 symbology
        result = reader.Decode(ESymbologies_Code32);
}
```

12.3. Reading a Bar Code of Known Location

```
//////////////////////////////////////////////////////////
// This code snippet shows how to specify the bar code  //
// position and perform the bar code reading.           //
//////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Bar code reader constructor
EBarCode reader;
```

```
// String for the decoded bar code
std::string result;
```

```
// ...
```

```
// Disable automatic bar code detection
reader.SetKnownLocation(TRUE);
```

```
// Set the bar code position
reader.SetCenterXY(450.0f, 400.0f)
reader.SetSize(250.0f, 110.0f);
reader.SetReadingSize(1.15f, 0.5f);
```

```
// Read the bar code at the specified location
result = reader.Read(&srcImage);
```

12.4. Reading a Mail Bar Code

```
////////////////////////////////////////////////////////
// This code snippet shows how to read Mail Barcodes  //
// and retrieve the decoded data.                     //
////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Mail barcode reader constructor
EMailBarcodeReader reader;
```

```
// Select expected symbologies and orientations (optional)
reader.SetExpectedSymbologies(...);
reader.SetExpectedOrientations(...);
```

```
// ...
```

```
// Read
std::vector<EMailBarcode> codes = reader.Read(srcImage);
```

```
// Retrieve the data included in found mail barcodes
for (unsigned int index= 0; index < codes.size(); index++)
{
    std::string text = codes[index].GetText();
    std::vector<EStringPair> components = codes[index]. GetComponentStrings();
}
```

13. EasyMatrixCode

13.1. Automatic Reading

```
/////////////////////////////////////////////////////////////
// This code snippet shows how to read a data matrix code  //
// and retrieve the decoded string.                        //
/////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Matrix code reader constructor
EMatrixCodeReader reader;
```

```
// Matrix code constructor
EMatrixCode mxCode;
```

```
// String for the decoded information
std::string result;
```

```
// ...
```

```
// Read the source image
mxCode = reader.Read(srcImage);
```

```
// Retrieve the decoded string
result = mxCode.GetDecodedString();
```

13.2. Reading with Prior Learning

```
//////////////////////////////////////////////////////////////
// This code snippet shows how to learn a given data matrix //
// code type (except its flipping status), perform the      //
// reading and retrieve the decoded string.                 //
//////////////////////////////////////////////////////////////
```

```
// Images constructor
EImageBW8 model;
EImageBW8 srcImage;
```

```
// Matrix code reader constructor
EMatrixCodeReader reader;
```

```
// Matrix code constructor
EMatrixCode mxCode;
```

```
// String for the decoded information
std::string result;
```

```
// ...
```

```
// Tell the reader not to take the flipping into account when learning
reader.SetLearnMaskElement(ELearnParam_Flipping, false);
```

```
// Learn the model
reader.Learn(model);
```

```
// Read the source image
mxCode = reader.Read(srcImage);
```

```
// Retrieve the decoded string
result = mxCode.GetDecodedString();
```

13.3. Advanced Tuning of the Search Parameters

```
////////////////////////////////////////////////////////////////
// This code snippet shows how to explicitly specify the data //
// matrix code logical size and family, perform the reading   //
// and retrieve the decoded string.                           //
////////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Matrix code reader constructor
EMatrixCodeReader reader;
```

```
// Matrix code constructor
EMatrixCode mxCode;
```

```
// String for the decoded information
std::string result;
```

```
// ...
```

```
// Remove the default logical sizes
reader.GetSearchParams().ClearLogicalSize();
```

```
// Add the 15x15 and 17x17 logical sizes
reader.GetSearchParams().AddLogicalSize(ELogicalSize__15x15);
reader.GetSearchParams().AddLogicalSize(ELogicalSize__17x17);
```

```
// Remove the default families
reader.GetSearchParams().ClearFamily();
```

```
// Add the ECC050 family
reader.GetSearchParams().AddFamily(EFamily_ECC050);
```

```
// Read the source image
mxCode = reader.Read(srcImage);
```

```
// Retrieve the decoded string
result = mxCode.GetDecodedString();
```

13.4. Retrieving Print Quality Grading

```
////////////////////////////////////////////////////////////
// This code snippet shows how to read a data matrix code //
// and retrieve its print quality grading.                //
////////////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// Matrix code reader constructor
EMatrixCodeReader reader;
```

```
// Matrix code constructor
EMatrixCode mxCode;
```

```
// ...
```

```
// Enable grading computation
reader.SetComputeGrading(TRUE);
```

```
// Read the source image
mxCode = reader.Read(srcImage);
```

```
// Retrieve the print quality grading
int axialNonUniformityGrade= mxCode.GetAxialNonUniformityGrade();
int contrastGrade= mxCode.GetContrastGrade();
int printGrowthGrade= mxCode.GetPrintGrowthGrade();
int unusedErrorCorrectionGrade= mxCode.GetUnusedErrorCorrectionGrade();
```

14. EasyQRCode

14.1. Automatic Reading of a QR Code

```
////////////////////////////////////////////////////
// This code snippet shows how to read a QR code  //
// and retrieve the decoded data.                 //
////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// QR code reader constructor
EQRCodeReader reader;
```

```
// ...
```

```
// Set the source image
reader.SetSearchField(srcImage);
```

```
// Read
std::vector<EQRCode> qrCodes = reader.Read();
```

```
// Retrieve the data of the first QR code found if
// one was found and decoding went ok
if ((qrCodes.size() > 0) &&
   (qrCodes[0].GetUnusedErrorCorrection() >= 0))
{
    EQRCodeDecodedStream stream = qrCodes[0].GetDecodedStream();
}
```

14.2. Retrieving Information of a QR Code

```
////////////////////////////////////////////////////
// This code snippet shows how to read a QR code  //
// and retrieve the associated information.       //
////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// QR code reader constructor
EQRCodeReader reader;
```

```
// ...
// Set the source image
reader.SetSearchField(srcImage);
```

```
// Read
std::vector<EQRCode> qrCodes = reader.Read();
```

```
// Retrieve version, model and position information
// of the first QR code found, if one was found
if (qrCodes.size() > 0)
{
    int version = qrCodes[0].GetVersion();
    EQRCodeModel model = qrCodes[0].GetModel();
    EQRCodeGeometry geometry = qrCodes[0].GetGeometry();
}
```

14.3. Decoding the First QR Code Detected

```
/////////////////////////////////////////////////////
// This code snippet shows how to decode a QR code //
// from a list of detected ones.                   //
/////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// QR code reader constructor
EQRCodeReader reader;
```

```
// ...
```

```
// Set the source image
reader.SetSearchField(srcImage);
```

```
// Detect QR Codes
std::vector<EQRCodeGeometry> qrCodeGeometries = reader.Detect();
```

```
// Decode first QR Code
EQRCode qrCode = reader.Decode(qrCodeGeometries[0]);
```

```
// Retrieve the data from the QR Code
EQRCodeDecodedStream stream = qrCode.GetDecodedStream();
```

14.4. Tuning the Search Parameters

```
////////////////////////////////////////////////////
// This code snippet shows how to read a QR code  //
// and retrieve the decoded data after setting a  //
// number of search parameters.                   //
////////////////////////////////////////////////////
```

```
// Image constructor
EImageBW8 srcImage;
```

```
// QR code reader constructor
EQRCodeReader reader;
```

```
// ...
```

```
// Set the source image
reader.SetSearchField(srcImage);
```

```
// Set the search parameters
reader.SetMaximumVersion(7);
reader.SetMinimumIsotropy(0.9f);
```

```
// Set the searched models
std::vector<EQRCodeModel> models;
models.push_back(EQRCodeModel_Model2);
reader.SetSearchedModels(models);
```

```
// Read
std::vector<EQRCode> qrCodes = reader.Read();
```

```
// Retrieve the data of the first QR code found
EQRCodeDecodedStream stream = qrCodes[0].GetDecodedStream();
```