

Sapera™ Processing 5.4



KEY BENEFITS

Performance

- Optimized using MMX, SSE and SSE2 for maximum performance

Rapid Development

- High-level C++ classes to simplify application development

Flexibility

- Hardware independence for maximum flexibility

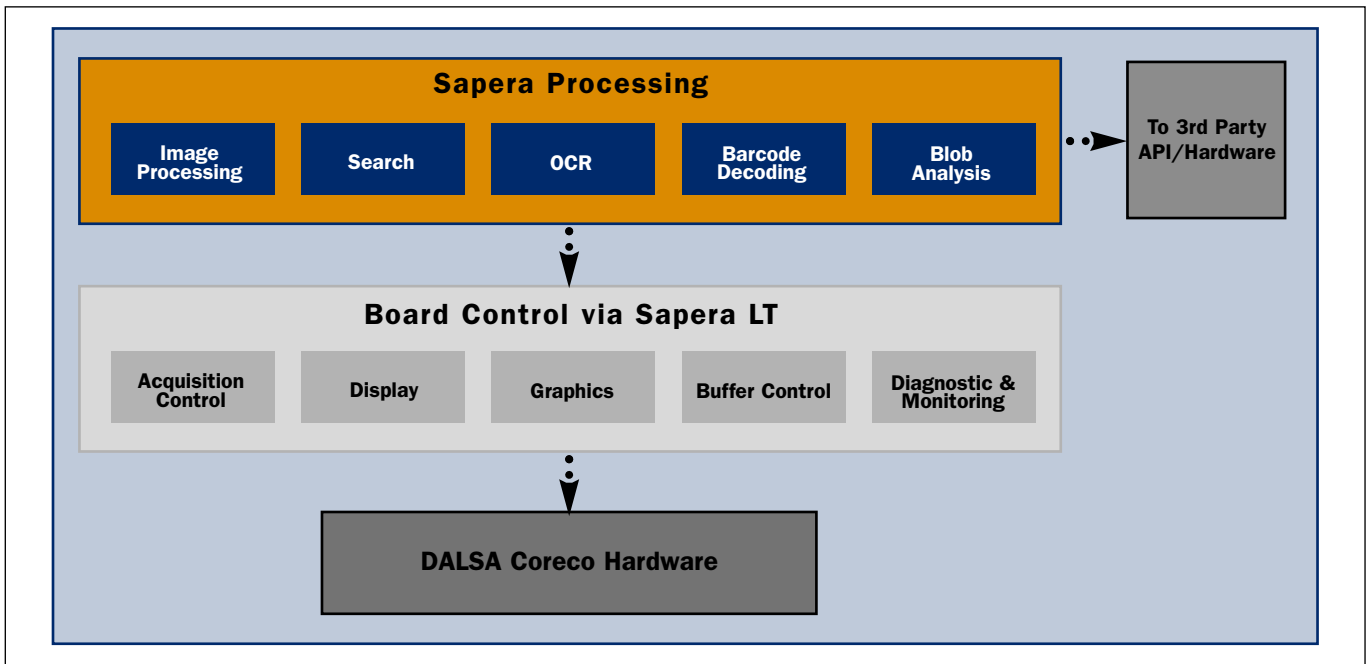
Scalability

- Application specific tools perform Search, OCR, I-D/2-D Barcode decoding and Blob analysis

OVERVIEW

Image processing and analysis library

Sapera Processing is a Windows® based comprehensive programming library for image processing and analysis. Hardware independent and designed to simplify vision application development, Sapera Processing is based on a set of high performance C++ classes and uses MMX, SSE™ (streaming SIMD Extensions), and SSE2 to meet the challenging operational requirements of today's imaging systems. Scalable in design, Sapera Processing offers a comprehensive set of optimized tools, (as a suite or standalone) including Image Processing, Search (pattern matching), OCR, Blob analysis and Barcode decoding. Sapera Processing supports DALSA Coreco's current vision hardware. Moreover, the software is hardware independent to ensure an efficient migration path to future DALSA Coreco frame grabbers and vision processors, as well as portability across third party platforms.



Sapera Software Architecture

Sapera Processing Optimized Tools

Modular in design, Sapera Processing includes several tools for image processing and analysis including: Search, OCR, Blob analysis and Barcode decoding.

Image Processing

Sapera Processing provides a series of highly optimized basic image processing functions categorized in several groups including:

Filters

- Generalized convolution 1-D, 2-D
- Low and high-pass filters 1-D, 2-D
- Laplacian
- Gaussian
- Compass: eight-direction edge enhancement
- Gradient: magnitude and phase
- Edge and line detection

Geometry

- Flipping: horizontal, vertical, transpose and 90-degree rotation
- Rotation by an arbitrary angle
- Translation: pan and scroll at integer or sub-pixel precision
- Zooming by image dimensions or scaling factor
- Shearing: horizontal and vertical
- Affine and perspective calibration and warping
- Polar coordinate transform

Measurement

- Basic statistics such as histogram, pixel count, mean, variance, minimum and maximum based on the pixel values of an image
- Horizontal and vertical projections
- Histogram processing: smoothing and peak detection
- Normalized and non-normalized cross-correlation
- Sum-of-difference
- Vector difference
- Variance filter (variance computed on each pixel's neighborhood)
- Pixel sampling on a path (with subpixel accuracy)

Morphology

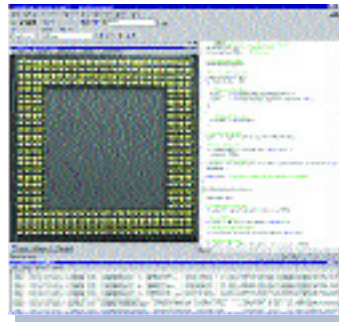
- Binary dilation, erosion, opening, closing and median on 1 or 8-bit images
- Grayscale dilation, erosion, opening, closing and median on 8 or 16-bit images
- Labeled dilation and erosion
- Outline, skeleton, thinning and thickening filters
- Conditional binary dilation
- Morphological gradient
- Rank filter
- Hit-or-miss transform
- Top-hat transform

Image Enhancement



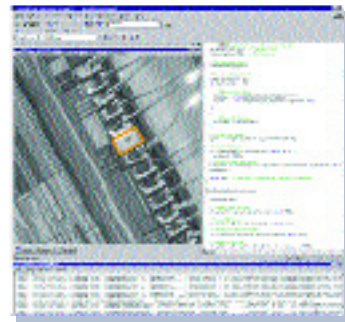
Sapera allows the use of look-up-tables and histograms to improve contrast images, and the application of a Sobel or gradient high-pass filter to increase the edge strength on the region-of-interest or the entire image for enhanced visualization.

BGA Inspection



Sapera can be used to perform feature extraction from RLE data. Developers can use thresholding on the extracted features like area, circularity, etc., to find the objects with the predefined criteria.

Semiconductor Lead Inspection



Sapera detects defects by subtracting pre-aligned images from a reference image.

Sapera Processing Applications

Point-to-Point

- Arithmetic operations on one or two images: add, subtract, multiply, divide, absolute subtract, minimum, maximum and user-defined expression
- Logical operations on one or two images: AND, OR and XOR
- Fixed and adaptive thresholding
- Gaussian noise generation
- Lookup table transformation
- Contrast equalization manual or histogram-based

Segmentation

- Distance map
- Directional edge detection
- K-means clustering
- Local peak detection
- Region-growing
- Watershed transform
- Zero-crossing detection

Transforms

- Spectral transforms: FFT (Fourier), DCT (Cosine), DHT (Hadamard)
- Hough transform: direct and reverse

Miscellaneous Features

- Subpixel edge crossing on a path
- Contour Following tool
- Frame averaging (true and recursive)

Search (Pattern Matching)

A crucial performance component of Sapera Processing is a highly advanced geometric location (Search) tool that quickly and accurately recognizes multiple objects and patterns, regardless of their orientation and scale. This high-level image analysis tool can locate arbitrary user-specified models in a target image at very high speeds at resolutions of up to 1/50th of a pixel. Designed to work under poor and uneven lighting conditions, the Search tool's fast, robust and accurate algorithms are well suited for demanding alignment applications in semiconductor and electronics manufacturing.

General Features

- User-selectable algorithm (area-based or edge-based)
- Train and search on an adjustable rectangular ROI
- Multi-model training
- Adjustable rotation and scaling range

Area-based Algorithm Features:

- Algorithm based on normalized cross-correlation (NCC)
- Extremely fast when no rotation and scale is involved
- Tolerant to extreme noise
- Position accuracy up to 1/25th pixel

Edge-based Algorithm Features:

- Algorithm based on object contours
- Rotation, scale and contrast independent
- Tolerant to extensive occlusion
- Great for contrast reversal
- Great for overlapping and touching objects
- User-selectable model contours
- Position accuracy up to 1/50th pixel
- Angle accuracy up to 1/80th degree

OCR (Optical Character Recognition)

A highly integrated optical character recognition tool that is scale and contrast invariant, the OCR tool supports both solid and dot matrix fonts and can be trained on user fonts. Its robust recognition technique is optimized for speed and accuracy. The ability of the OCR tool to operate on significantly degraded images makes it ideal for repetitive inspection tasks performed in the pharmaceutical, electronics and semiconductor industries.

Features

- User-trainable (more than one character at a time)
- Solid and dot matrix fonts (may be tilted to support italic fonts)
- Scale invariant (up to 400%)
- Tolerant to non-linear background variations
- Supports training of touching characters
- Optimizations: three different algorithms, three resolution levels
- Fielding: restricts the range of acceptable characters at a specific position
- Time deterministic execution

Blob Analysis

Blob analysis allows for the separating (segmenting) of objects in a scene from the background and then computes a series of geometric and grayscale features. Blob analysis is ideal for defect detection in the electronic and semiconductor industries.

Features

- Supports 1-bit, 8-bit, 16-bit, binary or grayscale input images
- Different levels of input (grayscale image, binarized or labeled image)
- Calculation of over 50 spatial and grayscale blob features including the following:
 - Basic Features
 - Area
 - Bounding box location and size
 - Centroid
 - Perimeter length
 - Number of holes
 - Form factor (ratio of area to the square of perimeter)
 - Elongation
 - Moments related
 - Best-fitting ellipse
 - Ratio of best-fitting ellipse axes
 - Orientation
 - Roundness
 - Convexity related
 - Convex area
 - Minimum bounding box location, size and orientation
 - Feret diameters at different angles
 - Convexity (ratio of convex perimeter to raw perimeter)
 - Solidity (ratio of net area to convex area)

- Perimeter related
 - Perimeter points (blob's boundary and holes)
 - Filled area
- Gray scale related
 - Minimum, maximum, standard deviation of all pixels of the blob
 - Gray scale centroid

- Sorting and selecting blobs based on any calculated feature
- User selection of group of features to calculate
- Automatic threshold of input grayscale images using global, local, fixed or adaptive thresholds
- Optional output of RLE (Run-Length-Encoding) allowing user-defined feature calculation

Barcode (1-D and 2-D barcodes)

The Barcode tool is a set of functions used to decode 1-D and 2-D barcodes and provide support for a variety of standard codes commonly used in the industry. Designed to operate on degraded and poorly illuminated images, the Barcode tool includes fast and robust algorithms and functions. Image-based, the barcode tool performs significantly faster than a laser-based scanner and gives you the flexibility to operate in tandem with other tools such as OCR and Search.

Features

- 1-D barcodes
 - Code 39
 - Code 128
 - Codabar
 - Interleaved 2 of 5
 - BC-412
 - EAN13
 - EAN8
 - UPC-A
 - UPC-E
 - Pharmacode (standard, wide space, complimentary)
 - Postnet/Planet
- 2-D barcodes
 - Data Matrix (ECC200)
 - QR Code
- General
 - Automatic location of barcode (no need to specify region of interest)
 - Fully invariant to rotation and scaling
 - Tolerant to non-linearly varying background
 - All algorithm parameters automatically computed from the image
 - Automatic detection of background tone (dark or white)
 - Automatic detection of 1-D barcode type
 - Robust algorithms optimized for speed
 - Read multiple barcodes in the same execution
 - Adjustable timeout for deterministic execution
 - Adjustable effort level
 - Tolerant to cylindrical deformation (Data Matrix only)

Sapera™ LT

Powerful Acquisition and Control

Sapera Processing provides advanced image acquisition and control functionality through Sapera LT. Sapera Processing and Sapera LT combine to deliver a powerful and easy to use development resource for advanced image acquisition, processing, and analysis. Sapera LT is a suite of hardware-independent C and C++ software libraries for image acquisition, display and control that supports all DALSA Coreco hardware platforms. Its comprehensive feature set includes program portability, versatile camera controls, flexible display functionality, management and easy-to-use application development wizards. Sapera LT is compatible with Microsoft® Visual Studio® 6.0 C/C++, .NET®, Visual C/C++® 6.0 and Borland® C++ Builder™ and supports Windows XP, 2000 and NT platforms. Key Sapera LT features include:

Trigger-to-Image Reliability™

- Controls, monitors and corrects the entire image acquisition process
- Enables more efficient and reliable machine vision inspections
- Immune to false triggers
- File Save and Load - Supports BMP, TIFF, AVI, RAW, JPEG, JPEG 2000 and DALSA Coreco custom formats

Performance

- Multi-threading and multi-processing compliant
- Built-in support for pixel format conversion
- Powerful Bayer filter decoding algorithms

Rapid Development

- Simplified programming interface
- High-level C++ classes simplify application development
- Application wizard quick-starts the development process

Flexibility

- Hardware independent
- Ability to create custom camera configuration files
- Supports DirectDraw® and ActiveX Controls
- TWAIN and DirectShow support

Trigger-to-Image Reliability



Our powerful hardware/software platforms are the foundation for our Trigger-to-Image Reliability technology framework. Trigger-to-Image Reliability leverages DALSA Coreco's hardware and software innovations to control, monitor and correct the image acquisition process from the time that an external trigger event occurs to the moment the data is sent to the PCI bus. Trigger-to-Image Reliability enables more efficient and reliable machine vision inspections by securing the image acquisition process, providing traceability when errors do occur and permitting recovery from those errors.

System Requirements

- PCI-bus computer with Pentium III or later processor
- Windows NT 4.0 (Service Pack 6), 2000 or XP
- One of the following development tools for compiling with the C++ libraries:
 - Microsoft Visual C++6 or later
 - Borland C++ Builder 6 or later
- One of the following development tools for compiling with the ActiveX controls:
 - Microsoft Visual Basic 6
 - Microsoft Visual Studio .NET 2002 or later
 - Borland Delphi 7 or later
- Optionally, Sapera LT 5.20 (or higher) for executing/recompiling the acquisition-based demos

Last updated June 2005



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