

Sapera Vision Software

Sapera™ Essential

Easy-to-use, versatile software for Industrial Imaging



945 East 11th Avenue Tampa, FL 33605

Phone: (813) 984-0125

Contact: Sales@pyramidimaging.com

<https://pyramidimaging.com>

As the core development platform within Teledyne DALSA's Sapera Vision Software family, Sapera Essential bundles image acquisition and control with image processing tools to provide developers with the critical functionality to design, develop and deploy high-performance machine vision systems.



Key Features

Performance

- Cost effective packaging for machine vision applications combines powerful image acquisition, processing and analysis functions
- Delivers maximum performance using MMX, SSE and SSE2 supports both 32-bit and 64-bit¹ Microsoft Windows® platform
- Incorporates Trigger-to-Image Reliability—Teledyne DALSA's proprietary engineering frame work to ensure reliability of the image acquisition process

Flexibility

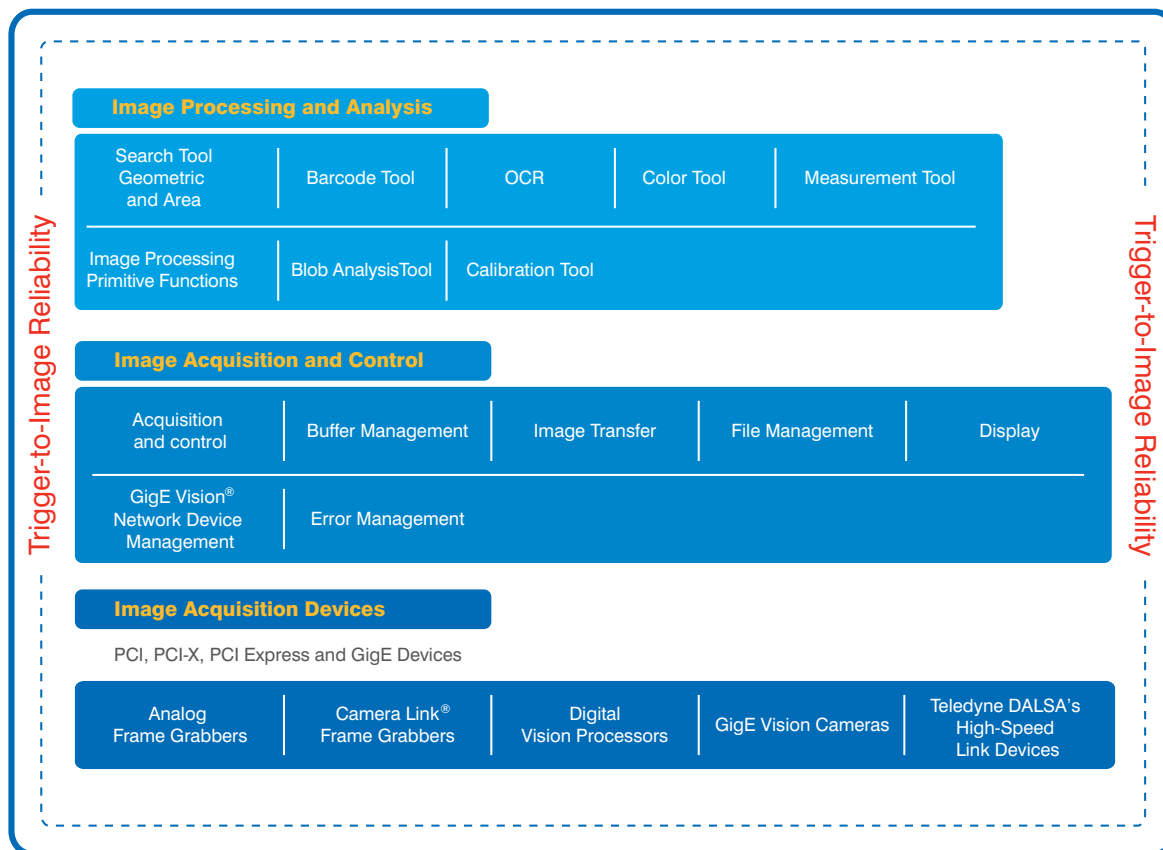
- Hardware independence for maximum flexibility
- High-level C++ classes and .NET™ support to simplify application development on Windows® 7, Windows® XP and Vista platforms

Scalability

- Application specific tools perform Search, OCR, 1D/2D Barcode decoding, Color, Blob analysis and Measurement
- Modular components help reduce application footprint and deployment costs

¹ Some conditions and limitations apply, contact Teledyne DALSA sales for details.

Sapera Essential offers quick and easy access to software functions to control image acquisition, manage image memory and facilitate image processing and analysis tasks. Sapera Essential includes a powerful frame grabber configuration and camera setup utility plus a suite of image processing tools including a highly advanced, yet cost effective, Search package that supports both area and edge-based pattern finding, a versatile Barcode tool for both 1-D and 2-D decoding, Blob Analysis capability for defect detection and Calibration tool for lens correction.



Sapera Essential Overview

Advanced Image Acquisition and Control

Sapera Essential delivers a full suite of software libraries for image acquisition, display and control and includes an extensive list of image processing functions. The Sapera Essential feature set includes program portability, versatile camera controls, functions for display management and easy-to-use application development wizards. Machine vision applications using Sapera Essential can be developed with conventional unmanaged C++ or managed C++, C# and Visual Basic® on Microsoft Windows® 7, Windows® XP, Windows® Vista Business Edition (32/64-bit) platforms. These applications can be developed using either Microsoft Visual Studio .NET or Borland C++ Builder.

Camera Configuration Utility—CamExpert

Sapera Essential comes bundled with a redesigned version of CamExpert; a newly enhanced proprietary camera configuration utility specifically designed for Teledyne DALSA frame grabbers. This Windows-based program provides an interactive environment to create a new, or modify an existing, configuration file for area and line scan applications. CamExpert provides a comprehensive feature set including:

- Enhanced Graphical User Interface with camera centric parameters
- Live grab and display window for online parameter fine tuning
- Sophisticated waveform display to improve understanding of signal inter-relationships



TRIGGER-TO-IMAGE
RELIABILITY

Like all Teledyne DALSA software products Sapera Essential is built to deliver Trigger-to-Image Reliability (T2IR). T2IR leverages Teledyne DALSA's hardware and software innovations to control, monitor and recover the image acquisition process from the time that an external trigger event occurs to the moment the data is sent to the PCI bus. T2IR enables efficient and reliable machine vision inspections by securing the image acquisition process, providing traceability and recovery when errors do occur.

The screenshot displays the CamExpert software interface. The main window is titled 'CamExpert [Untitled]' and contains several panes: 'Device' (listing camera models like Genie_J1640_1), 'Basic Timing Parameters' (with fields for Camera Type, Color Type, Pixel Depth, etc.), 'Display' (showing a live image of a camera lens), 'Camera' (listing various camera models), and 'Output Messages' (showing log entries for grab and freeze button clicks). Overlaid on the main window are two 'Statistics' dialog boxes. The first dialog shows 'Gray level profile on a line' with a graph of intensity vs. pixel position and a table of statistics: Minimum value: 18, Maximum value: 170, Max - Min: 152, Average value: 63, Standard deviation: 52.43. The second dialog shows a 'Histogram' of the selected area with a graph of pixel count vs. intensity and a table of statistics: Minimum value: 0, Maximum value: 255, Max - Min: 255, Average value: 114, Standard deviation: 64.77.

★ Teledyne DALSA CamExpert is more than a simple configuration tool, it offers live image display, camera signal status and powerful image analysis functions to ease system setup, calibration and diagnostics.

Point-and-Click Image Processing Evaluation Tool

Sapera Architect—is a GUI based application that allows construction of sequence of operations to perform image processing tasks without writing a single line of code. Its intuitive interface allows users to gain insight into inter-relationship between various parameters by adjusting them in real-time. Sapera Architect permits users to obtain a fine balance between speed, accuracy and repeatability of the results by providing information about the execution time of a function or a sequence of operations.

Rapid Development Using .NET and Application Wizard

Support for .NET platform within Sapera Essential, permits rapid application development using Microsoft Visual Basic, C#, or C++ programming languages. Sapera Essential .NET supports image acquisition, control, display, image processing, calibration, color, barcode, blob analysis and area and shape based search functions.

Sapera Essential includes a Microsoft Visual Studio 6.0 compatible application wizard to kick start the development process and shortens the learning curve. The Sapera Essential wizard supports both area and line scan cameras and generates code that conforms to Teledyne DALSA's Trigger-to-Image Reliability framework to control and monitor the image acquisition and transfer process. The Sapera Essential wizard allows operators to quickly create an image application project using various Sapera Essential components.

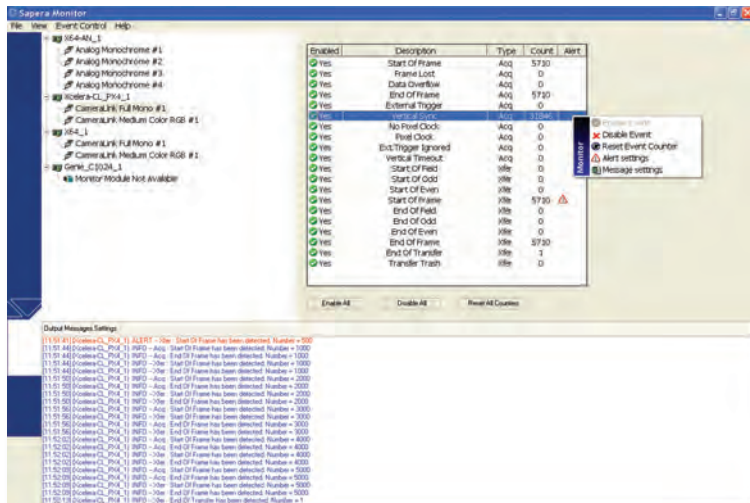
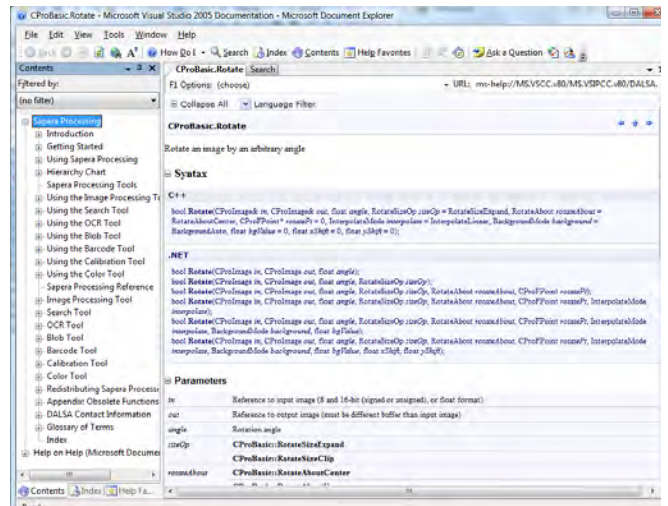
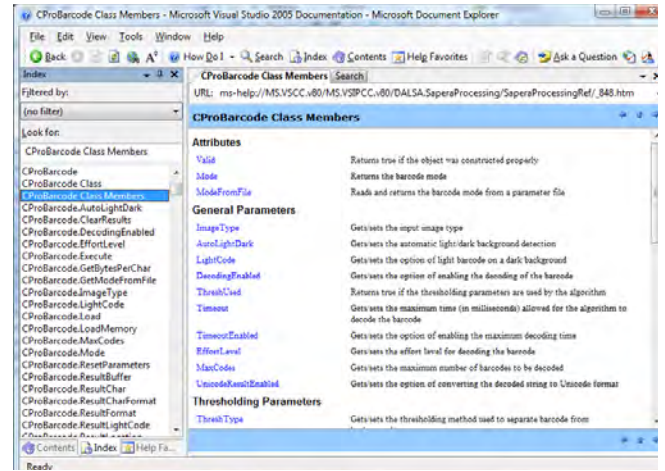
Sapera Essential Integrated Help

Sapera Essential Help is now fully integrated with Microsoft® Visual Studio® 2005 and above and is also compatible with Visual Studio 2003 allowing programmers quick access to Sapera's reference manual from within Visual Studio IDE.

Sapera Essential provides detailed information about Sapera concepts and includes extensive examples of source code.

Built-in Productivity tools:

Sapera Monitor is a powerful, non-intrusive, performance analysis and optimizing tool to derive the best results from hardware based Sapera applications.



- * Sapera Monitor is non-intrusive application that helps users monitor and verify critical system events such as start/end frames/lines, number of frame/lines acquired/transferred, external trigger received/acknowledged/lost, pixel clock status etc.



Image Processing and Analysis Libraries

Sapera Essential includes a powerful frame grabber configuration and camera set-up utility plus a suite of image processing tools including a highly advanced, yet cost effective, geometric Search package that supports both area and edge-based pattern finding, a versatile Barcode tool for both 1-D and 2-D decoding, Blob Analysis and Calibration tools.

Image Processing Primitives

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

Filters

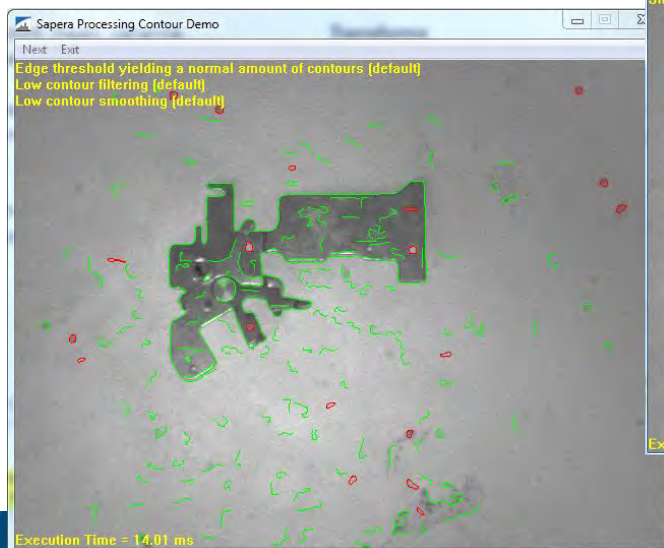
- Generalized convolution 1-D, 2-D
- Low and high-pass filters 1-D, 2-D
- Laplacian
- Gaussian
- Compass: eight-direction edge enhancement
- Gradient: magnitude and phase
- Edge and line detection

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 sub-pixel accuracy)
- Linear and circular regression



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

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

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



■ Search (Pattern Finding Tool)

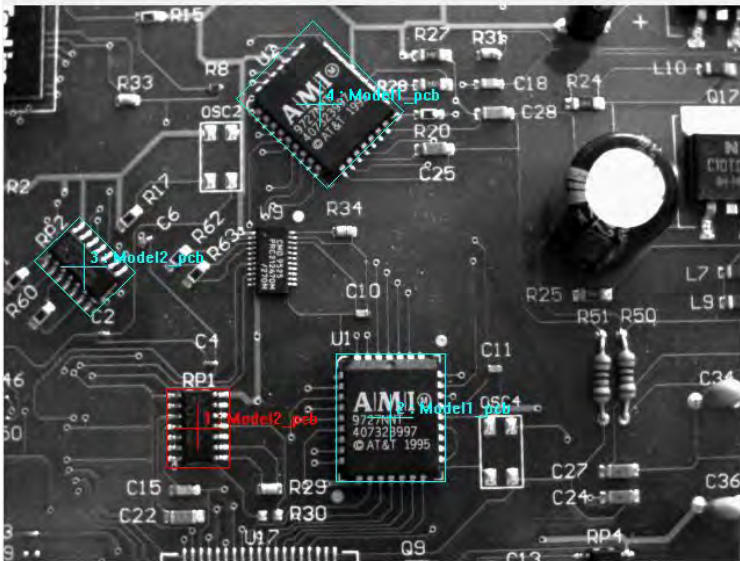
A crucial performance component of Sopera Essential is a highly advanced Search tool that quickly and accurately recognizes multiple objects and patterns, regardless of orientation and scale. This high-level image analysis tool can locate arbitrary user-specified models in a target image at very high 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.

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

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



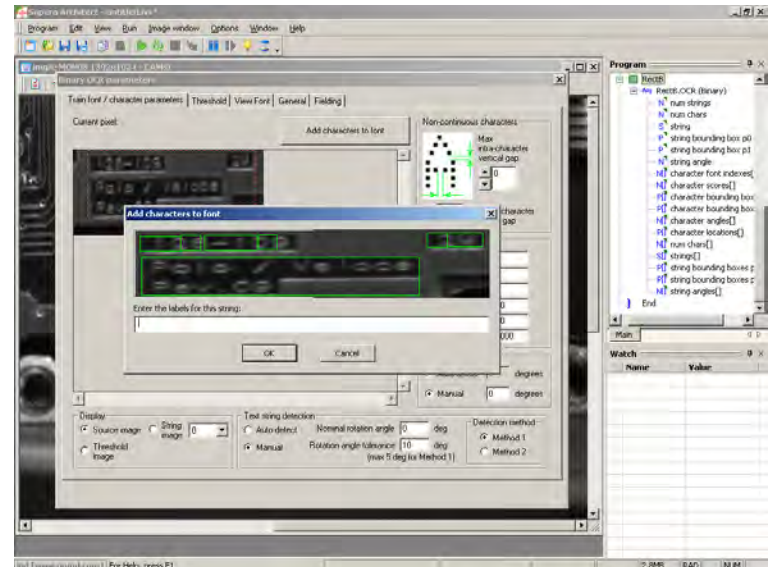
Sopera Search Tool supports rotation independent, simultaneous multiple target detection.

■ 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 font set
- Supports solid and dot-matrix fonts including italic fonts
- Tolerates non-linear background variations
- Supports training of touching characters
- Two algorithms: binary-based (speed), greyscale-based (tolerant to extreme noise).
- Resolution level adjustment (robustness versus speed)
- Rotation, scale and aspect ratio invariance.
- Multi-string support (reads more than one string of characters in single execution).
- Support of Asian characters (output in Unicode mode).
- Adjustable effort level
- Alphabetical font sorting
- Automatic string detection



Sopera OCR Tool support user trainable fonts

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 Search. Sapera Essential Barcode tool uses sub-pixel accuracy for symbology detection and decoding and can output decoded strings in Asian native languages or as Unicode characters.

1-D barcodes

- Code 39
- Code 128
- Codabar
- Interleaved 2 of 5
- BC-412
- EAN13
- EAN8
- UPC-A
- UPC-E
- Intelligent Mail Barcode 4-State
- Pharmacode (standard, wide space, complimentary)
- Postnet/Planet
- Code93
- RSS (Regular, limited, expanded and composite)

2-D barcodes

- Data Matrix (ECC200)
- QR Code
- PDF417

Common Features

- 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)
- Print Quality measurement (ISO15415, 15416) for 1D and AS9132 for 2-D

Calibration

Calibration tool provides functions to compensate for geometrical distortions caused by camera lens, camera positioning or any other kind of arbitrary image distortion.

- Correction of perspective, radial (barrel or pin-cushion), combined or arbitrary distortions
- Automated calibration:
- Supported targets: checkerboard, grid of lines or dots, and randomly distributed points
- Fully automated detection of target shading (black/white or white/black), rotation, scaling, grid size and cell spacing
- Optional assisted calibration by specifying approximate target description
- Manual calibration: provide exact image and world grids
- Restoration of full image, single point or vector of points
- Forward (image to world) or reverse (world to image) restoration
- Different restoration modes to adjust speed versus accuracy

The screenshot displays the Sapera Architect software interface. The main window shows an image of a circular object with a Data Matrix barcode. A 'Barcode Parameters' dialog box is open, showing settings for Matrix Size, Cell Size, Symbol Quality, and Matrix ECC Type. The 'Watch' window on the right displays the decoded results, including the string 'PKG010' and various location and matrix size parameters.

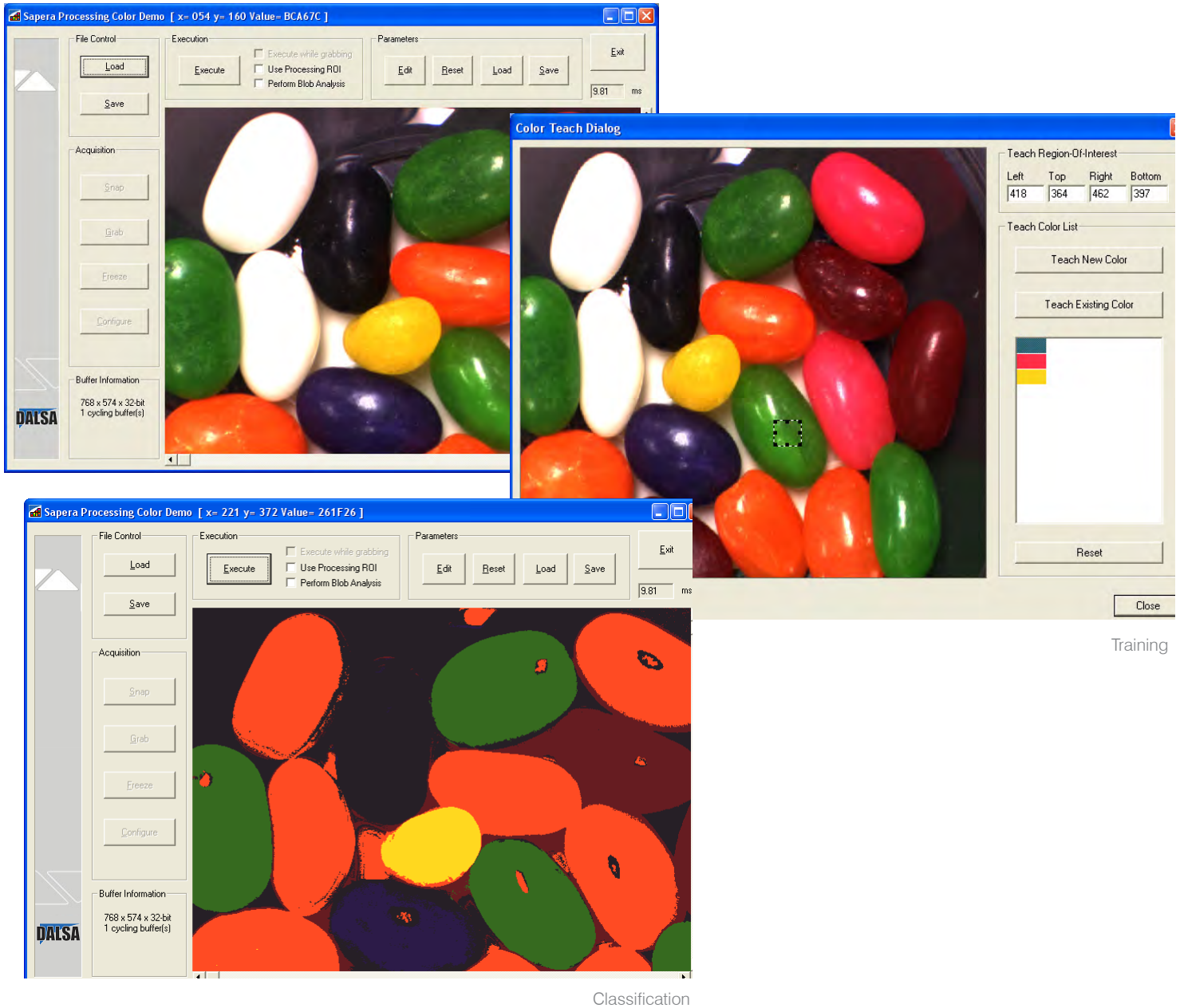
Name	Value
S RectA.Barcode (DataMatrix).string	PKG010
P RectA.Barcode (DataMatrix).location p0	(266.00, 189.00)
P RectA.Barcode (DataMatrix).location p1	(323.00, 246.00)
P RectA.Barcode (DataMatrix).location p2	(271.00, 297.00)
P RectA.Barcode (DataMatrix).location p3	(212.00, 243.00)
S RectA.Barcode (DataMatrix).matrix size	16 x 16
S RectA.Barcode (DataMatrix).overall grade	D

* Decode barcode and 2D matrix codes using Sapera Architect. The full suite of Sapera barcodes (both 1D and 2D) are accessible from the Sapera Architect Gui.

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Color Tool

Sapera Essential features an advanced color tool for machine vision that delivers speed, accuracy and flexibility to applications that require color inspection. Ideal for sorting, verification and inspection in food, packaging, print, textile and electronics inspection, this powerful tool supports multiple color spaces such as HSI, CIELAB, RGB, and YUV and can perform color classification in native color space. With built-in support for color calibration, user trainable color classifier, Delat-E measurement and lookup table operations, the Sapera Essential Color tool augments the performance of Sapera Essential image processing and analysis libraries.

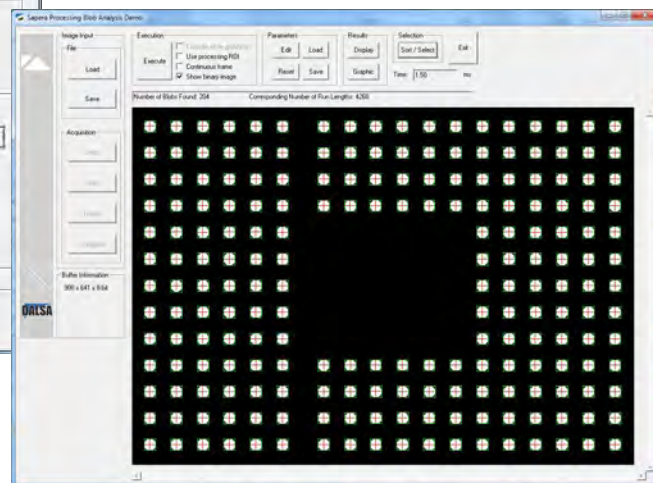
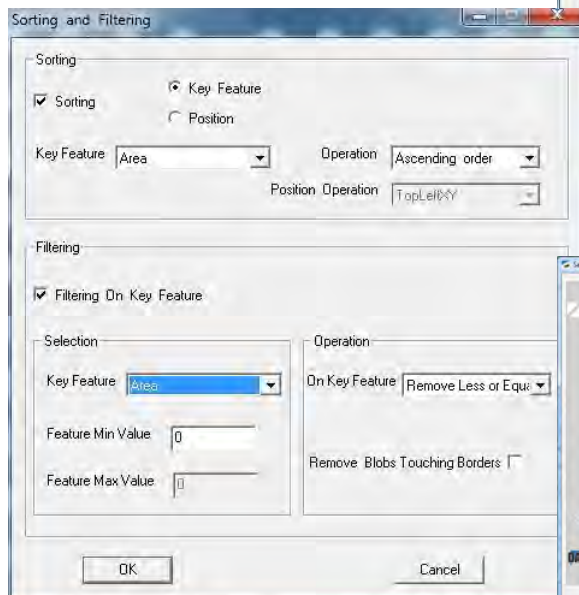
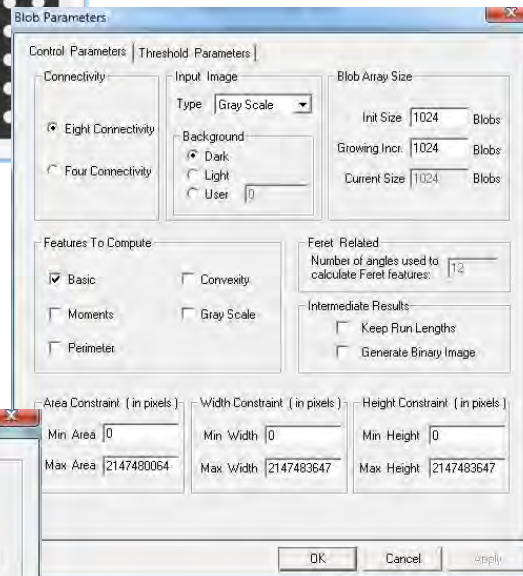
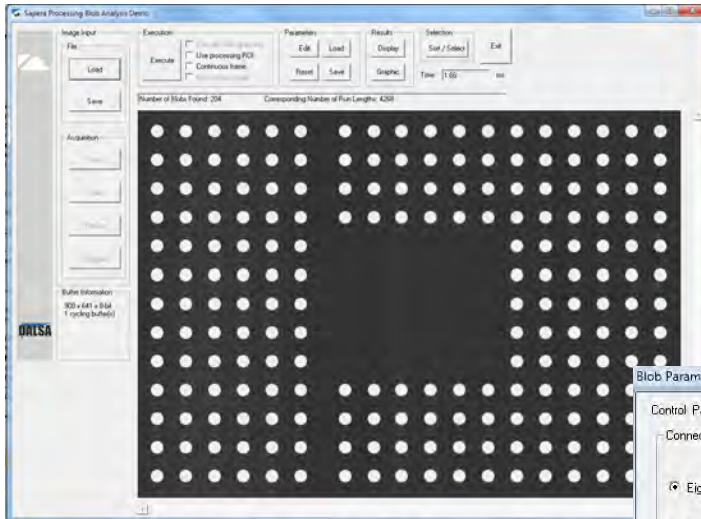


Blob Analysis

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.

Tool features:

- Supports 1-bit, 8-bit, 16-bit, binary or grayscale input
- Supports infinite frame size when using line scan cameras
- Supports hardware accelerated blob analysis operations
- Spatial and grayscale blob features include:
 - Blob centroid, area, and perimeter length
 - Bounding box location and size, number of holes
 - Best-fitting oriented ellipse with axes lengths
 - Blob roundness and elongation
 - Convex area and solidity (ratio of net area to convex area)
 - Feret diameters, bounding box location, size and orientation
 - External and internal perimeter points, filled area
 - Minimum, maximum, standard deviation of all pixels
 - Gray scale centroid
 - Sorting and blob selection based on calculated feature
 - Robust automatic threshold algorithms
 - Optional output of RLE (Run-Length-Encoding) for user-defined feature calculations



■ Measurement Tool (Preliminary)

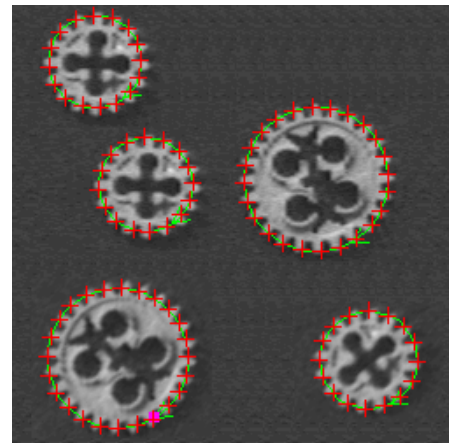
Key Features:

- Highly optimized execution
- Automatic simultaneous multiple measurements
- Sub-pixel Accuracy
- Measurement statistics for distances and angles.
- Built-in calibration tools ensure accurate real-world measurements
- Extensive set of markers include single or multiple points, lines, arcs and circles

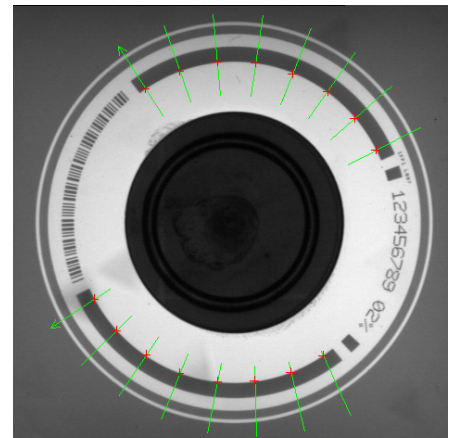
Sapera Essential's Measurement Tool is a video metrology tool for machine vision inspection applications including positioning, identification, and guidance. The measurement tool features a wide selection of image markers to facilitate multiple simultaneous measurements from one or more selected paths including point, line, polyline, arc, circle, spoke, and many more. The highly accurate results are computed with sub-pixel accuracy and can be combined with Sapera Essential's calibration tool to obtain consistent and accurate measurements.

Specifications:

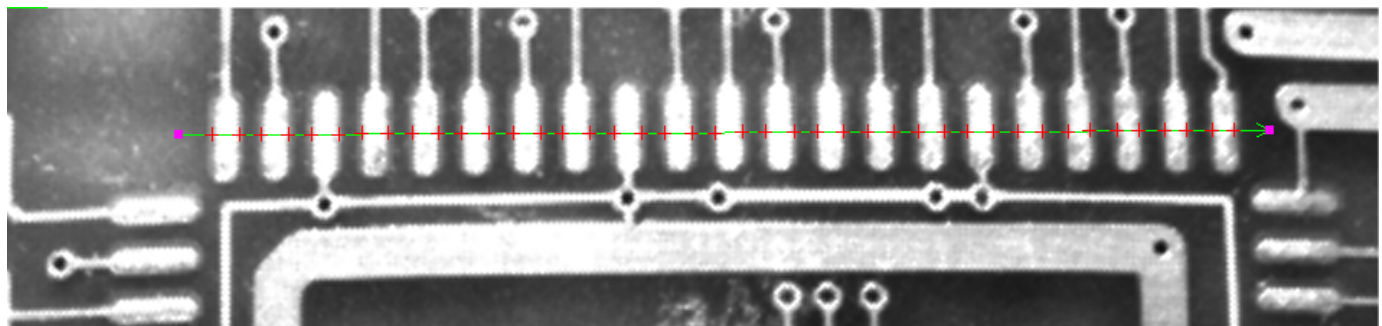
- Image acquisition
 - Supports 8, 10, 12-bit images
 - Supports area and line-scan cameras
- Accuracy
 - Sub-pixel accuracy
 - Corrects for lens, perspective and arbitrary distortion
- Measurements:
 - Distance
 - Radii
 - Diameter
 - Angle
 - Width
 - Intersections
 - Circularity
 - Straightness
 - Markers:
 - Point, Line, Polyline, Arc, Circle, Rake, Spoke, Bullseye



Multiple measurements on circular path



Multiple Measurements using Partial Spoke



Multiple Measurements across a line path

■ About Sapera Vision Software

Sapera Essential is part of a Teledyne DALSA's field-proven Sapera Vision Software family. Sapera Vision Software offers image acquisition, control, and processing and analysis functions to design, develop and deploy high performance machine vision applications. Sapera's advanced functionality is delivered in three powerful packages including Sapera™ Essential, Sapera™ Nitrous, and Sapera™ Architect Plus.

Sapera Nitrous accelerates Sapera Essential applications by providing seamless support for graphical processing units (GPU) and multi-core CPU optimization (MCO).

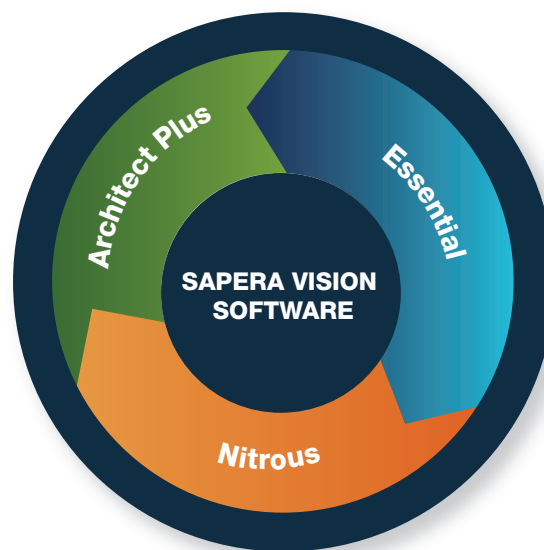
Sapera Architect Plus gives system integrators and industrial vision automation specialists a user-friendly, non-programming graphical environment to quickly prototype and test drive application specific imaging tools within Sapera Essential.

Image Acquisition and Display

Like all Sapera Vision Software platforms Sapera Essential has the ability to grab images from wide range of area and line scan color and monochrome camera. In addition, it supports image acquisition from standard format cameras like GigE Vision, Camera Link, analog, and LVDS. The acquired images can be displayed with non-destructive overlaid graphical annotations.

Comprehensive Hardware Support

As a value-add platform within the Sapera Vision Software family, Sapera Essential supports Teledyne DALSA cameras and frame grabbers as well as hundreds of 3 party camera models across all common interfaces formats like GigE Vision®, Camera Link®, as well as emerging new image acquisition standards. Sapera Vision Software offers royalty free run-time licenses for select image processing functions when combined with Teledyne DALSA hardware products.



Multi-Processing/Multi-Threading Compliant

Multi-processing and multi-threading capability improves application performance and productivity, while making efficient use of available CPU time and system resources by executing multiple routines concurrently. Often developers are burdened with the delicate and time-consuming task of thread management when sharing a common set of data.

Supported Teledyne DALSA Image Acquisition and Processing Hardware

- X64 Xcelera-Series** - High performance PCIe frame grabbers
- X64-Series** - high performance PCI and PCIe frame grabbers for asynchronous image acquisition from multiple cameras
- PC2-Series** - machine vision frame grabbers, ideal for cost sensitive applications
- Genie** - High performance GigE Vision area scan camera
- Spyder 3** - Dual Line scan GigE Vision camera

System Requirements

- P4 or higher class CPU
- Microsoft Windows 7, Windows XP Professional or Vista 32-bit/64 bit
- Minimum 64MB of system memory, 100MB of free hard drive space
- Microsoft Visual Studio C/C++ 6.0 or higher for C++, Microsoft .NET compilers with .NET 2.0 or higher, or Borland C++ Builder 2006 or higher

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Contact: Sales@ pyramidimaging.com

<https://pyramidimaging.com>

www.teledynedalsa.com

Americas

Boston, USA
Tel: +1 978-670-2000
sales.americas@teledynedalsa.com

Europe

Munich, Germany
Tel: +49 8142-46770
sales.europe@teledynedalsa.com

Asia Pacific

Tokyo, Japan
+81 3-5960-6353
sales.asia@teledynedalsa.com

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