ZEBRA

Adaptive Vision
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STUDIO + LIBRARY 5.0

Machine Vision Software and Libraries

www.adaptive-vision.com

Introduction

Adaptive Vision Studio

Adaptive Vision Studio software is the most powerful graphical environment for machine vision engineers. It is based on dataflow and comes with a comprehensive set of powerful, ready-for-use image analysis filters.

Its unique strength lies in its focus on professional users – it allows you to create typical applications easily, but at the same time makes it possible to efficiently develop highly customized and large-scale projects.

Features

Intuitive

Drag and drop

All programming is done by choosing filters and connecting them with each other. You can focus all your attention on computer vision.

You can see everything

Inspection results are visualized on multiple configurable data previews; and when a parameter in the program is changed, you can see the previews updated in real time.

HMI Designer + Events NEW

You can easily create custom graphical user interfaces and thus build the entire machine vision application using a single software package.

Powerful

1000 effective filters

There are over 1000 ready-for-use machine vision filters tested and improved in hundreds of applications. They have many advanced capabilities such as outlier suppression, subpixel precision or any-shape region-of-interest.

Hardware acceleration

The filters are aggressively optimized for the SSE/AVX/NEON technologies and for multicore processors. Our implementations are ones of the fastest in the world.

Loops and conditions

The interface is easy to start, but it also includes advanced data-flow constructs: loop, conditions, subprograms (macrofilters), global parameters and even threads. Everything based on graphical programming concepts.

Adaptable

GigE vision and GenTL

Adaptive Vision Studio is a GigE Vision compliant product, supports the GenTL interface, as well as a number of vendor-specific APIs. Thus, you can use it with most cameras available on the market.

User filters

You can use user filters to integrate your own C++ code with the benefits of visual programming. It takes 30 seconds to build first user filter and 5 seconds to update one after recompilation.

C++ and .NET generators

Programs created in Studio can be exported to C++ code or to .NET assemblies. This makes it very easy to integrate your vision algorithms with applications created in C++, C# or VB programming languages.

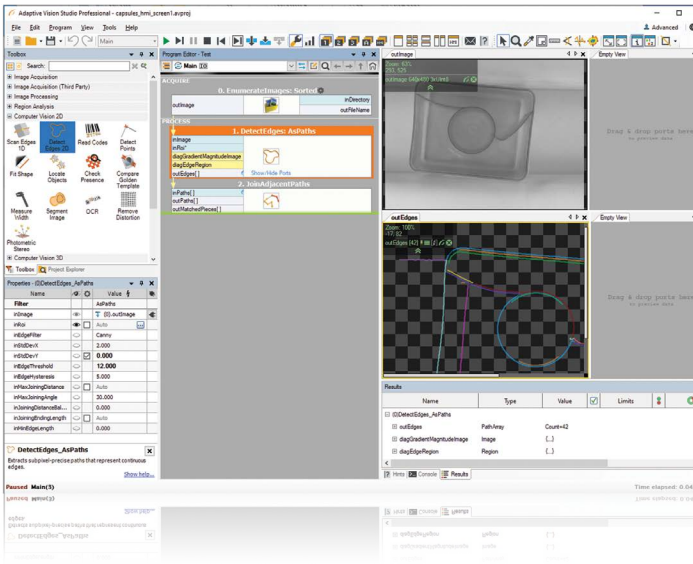
Workflow

Design the algorithm 1

Creating vision algorithms consists of three intuitive steps:

1. Drag & drop filters from the toolbox to the program editor
2. Set parameters and create connections between filters
3. Drag & drop filter outputs to data preview panels for interactive analysis

The only expertise users need to have is about the core art of computer vision – which filters to connect and how. And yet another great feature of Adaptive Vision Studio is that you can develop this competence quickly through intuitive experimentation.

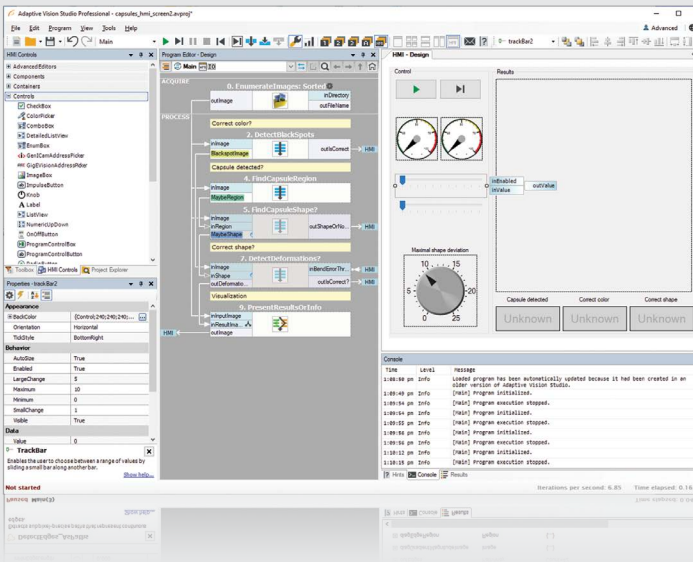


Create a custom HMI 2

Creating a custom graphical user interface is just as easy:

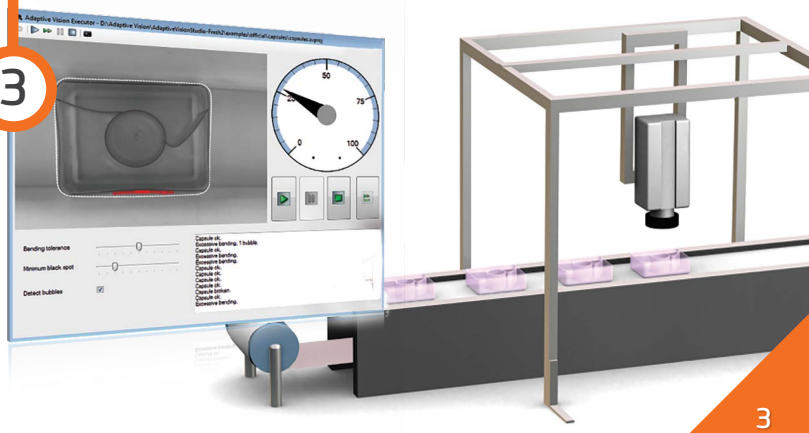
1. Drag & drop controls to the HMI panel
2. Set the controls' properties
3. Create connections with the program
4. Handle events with Event Handlers

Note that you can also easily integrate your algorithm with an HMI created in C++ or C#.



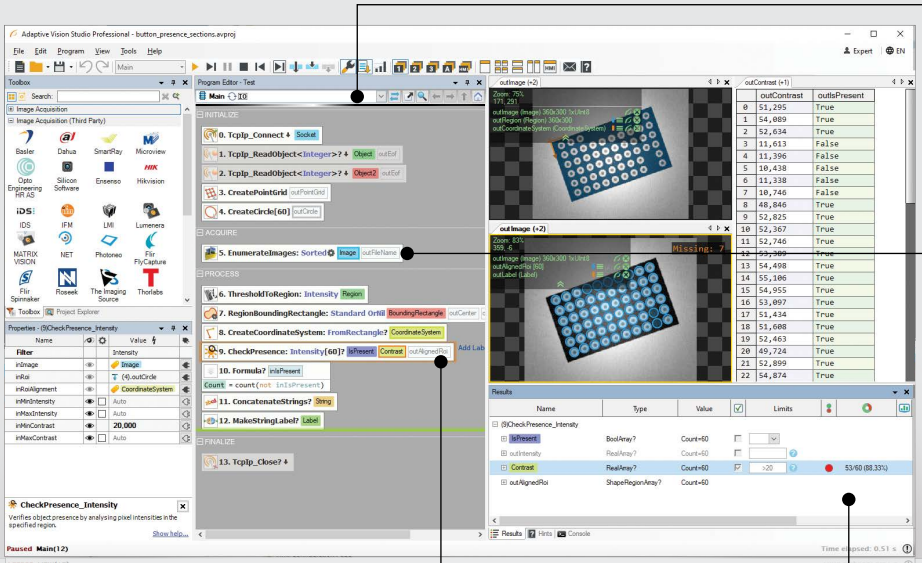
Deploy 3

When the program is ready, you can export it to a runtime executable and deploy it on a PC-based industrial computer or on a smart camera.



New Features in 5.0

Re-designed interface for End Users



Minimal Program View

We have completely re-designed the program editor for easy use in basic applications. Connections are hidden, but many programs can be created in a single view, without macrofilters.

Sections

Program Editor is now divided into four sections: INITIALIZE, ACQUIRE, PROCESS, FINALIZE. This unified program structure greatly simplifies creation of the main program loop.

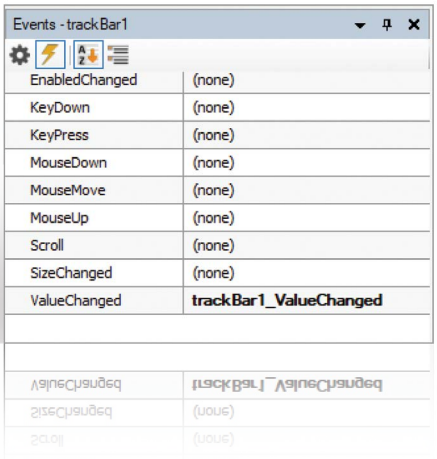
Results control

This new power control is for easy definitions of Pass/Fail criteria. You just select a filter and you set the range for its numeric outputs. What is more, the Results control also collects statistics automatically.

Extremely powerful formulas

Formulas have been here for years, but with version 5.0 they can replace the vast majority of data analysis tasks. This is possible with many new functions for arrays, geometry and with new array execution of expressions (also known as *broadcasting*).

Powerful new features for advanced users



HMI Events

Event-based programming is now possible in our HMI Designer. You can easily create separate subprograms that will be executed when something happens - for example, when the user clicks a button, logs in or changes a specific parameter.

Events are handled in a separate background thread and do not interfere with the main inspection loop!

Parallel Tasks

Before 5.0, you could only have one main loop in the program and everything happened there. Now, it becomes possible to perform many computations in parallel.

For example, you can create one Worker Task for the main image processing and another for handling asynchronous I/O communication.

Adaptive Vision Library

Adaptive Vision Library for C++ and .NET provides a comprehensive set of functions for image analysis applications – from standard-based image acquisition interfaces, through low-level image processing routines, to ready-made tools such as template matching, measurements or code readers. The main strengths of the product include the highest performance, modern design and simple structure making it easy to integrate with the rest of your code.

Operating systems:

- Windows
- Linux
- Linux embedded

Features

Performance

In Adaptive Vision Library careful design of algorithms goes hand in hand with extensive hardware optimizations, resulting in performance that puts the library among the fastest in the world. Our implementations make use of SSE/AVX/NEON instructions and parallel computations on multicore processors.

Modern Design

All types of data feature automatic memory management, errors are handled explicitly with exceptions and optional types are used for type-safe special values. All functions are thread-safe and use data parallelism internally, when possible.

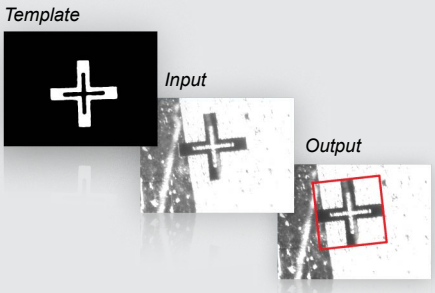
Simplicity & Consistency

The library is a simple collection of types and functions, provided as a single DLL file with appropriate headers. For maximum readability functions follow consistent naming convention (e.g. the VERB + NOUN form as in: SmoothImage, RotateVector). All results are returned via reference output parameters, so that many outputs are always possible.

Example

Edge-based Template Matching

Template Matching techniques make it possible to locate objects at arbitrary locations and rotations. An example of a typical application is detection of fiducial markers on an electronic circuit:




```
Image image1;
LoadImage("fiducial_template.png", false, image1);
Conditional<EdgeModel> model;
CreateEdgeModel(image1, NIL, NIL, 0, NIL, 0.0f, 35.0f, 15.0f, -45.0f, +45.0f, 1.0f, model);

Image image2;
LoadImage("fiducial_input.png", false, image2);
Conditional<Object2D> object;
LocateSingleObject_Edges(image2, NIL, model.Get(), 1, 3, 10.0f, true, 0.7f, object);
if (object != NIL)
{
        DrawingStyle style(DrawingMode::HighQuality, 1.0f, 3.0f, false, NIL, 2.0);
        DrawRectangle(image2, object.Get().Match(), NIL, Pixel(255, 0, 0), style);
}
```

Capabilities

Functions

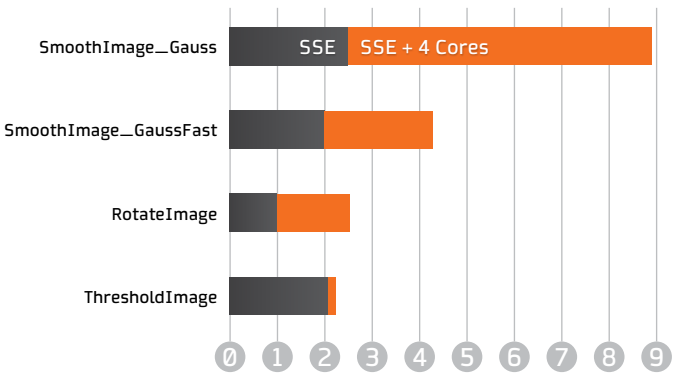
There are over 1000 functions encompassing both basic transforms and specialized machine vision tools.

- Image Processing
- Blob Analysis
- Contour Analysis
- Planar Geometry
- Shape Fitting
- Camera Calibration
- Fourier Analysis
- Hough Transform
- Barcode Reading
- Data Code Reading
- 1D Profile Analysis
- 1D Measurements
- 2D Measurements
- 3D Measurements
- Gray Template Matching
- Edge Template Matching
- Histogram Analysis
- OCR
- Deep Learning
- GigE Vision and GenTL

Performance

The functions of Adaptive Vision Library are highly optimized for modern multicore processors with SSE2/AVX/NEON technologies. Speed-up factors that can be achieved are however highly dependent on the particular operator. Simple pixel-by-pixel transforms after the SSE-based optimizations already reach memory bandwidth limits. On the other hand, more complex filters such as gauss smoothing can achieve even 10 times lower execution times than with C++ optimizations only.

Speed Up Factors



FUNCTION	AVL 5.0	ANOTHER PRODUCT	OPENCV 4.2
Image negation	0.030 ms	0.032 ms	0.025 ms
Add two images (pixel by pixel)	0.029 ms	0.047 ms	0.036 ms
RGB to HSV conversion	0.127 ms	1.026 ms	0.129 ms
Gauss filter 3x3	0.031 ms	0.035 ms	0.037 ms
Gauss filter 5x5	0.033 ms	0.073 ms	0.052 ms
Gauss filter 21x21	0.311 ms	0.355 ms	0.240 ms
Mean filter 21x21	0.100 ms	0.102 ms	1.110 ms
Image erosion 3x3	0.030 ms	0.035 ms	0.050 ms
Image erosion 5x5	0.030 ms	0.036 ms	0.059 ms
Sobel magnitude (sum)	0.032 ms	0.035 ms	
Sobel magnitude (hypot)	0.034 ms	0.040 ms	
Threshold to region	0.043 ms	0.076 ms	
Splitting region into blobs	0.119 ms	0.206 ms	
Bilinear image resize	0.131 ms	0.108 ms	0.052 ms

The above results correspond to 640x480 resolution, 1xUINT8 on an Intel Core i5 - 3.2 GHz machine. Execution times were measured precisely by using a method of fitting a line to a series of results obtained with increasing number of repetitions. To reduce an artificial influence of cache memory, tests were performed on very big images and results were normalized. Note also that the functions from the different libraries do not always produce exactly the same output data, so the results should be considered indicative only.

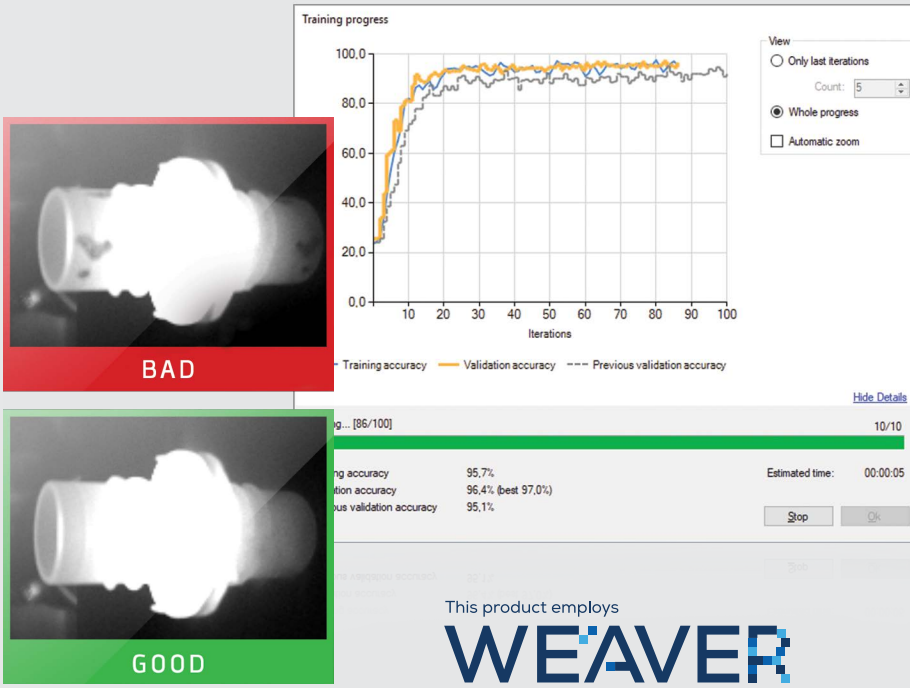
More than great software

Deep Learning Add-on

Deep learning is the most modern approach to creating machine vision applications. With our Deep Learning Add-on, you are getting five ready-for-use tools based on deep neural networks and proprietary WEAVER™ inference engine:

- Object Classification
- Feature Detection
- Anomaly Detection
- Point Location
- Instance Segmentation

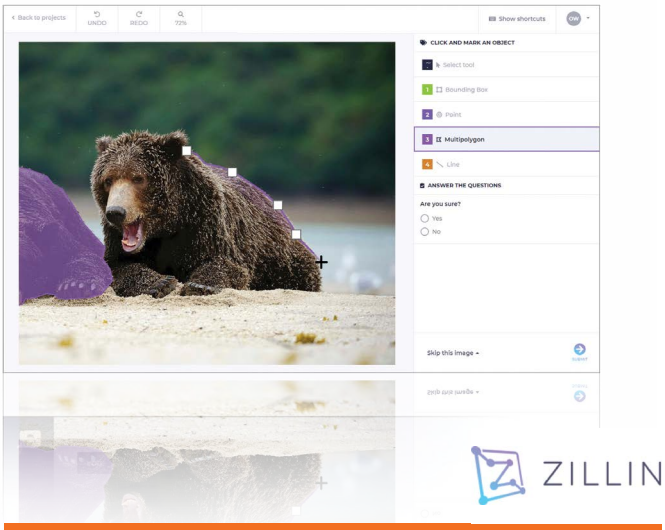
For more information see:
"Deep Learning Add-on" brochure



Online dataset management

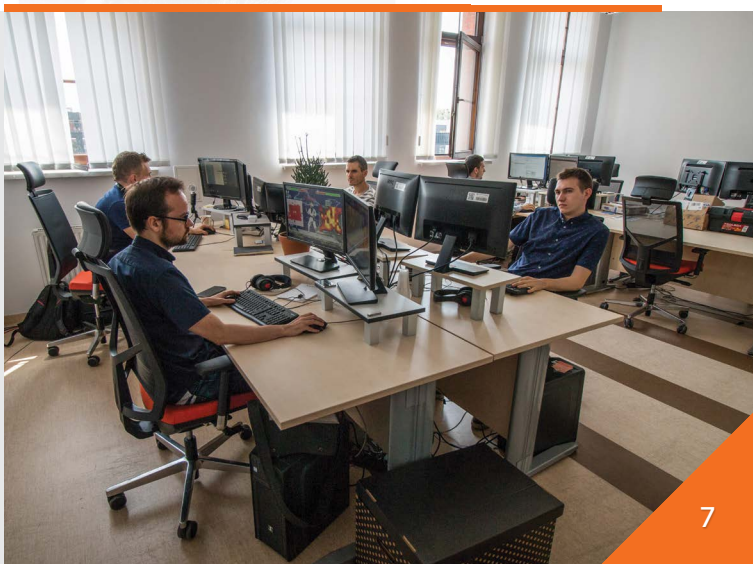
Adaptive Vision uses and recommends Zillin™ online tools for team collaboration and dataset management. For both traditional and deep learning projects, your team is getting a convenient repository for images, together with:

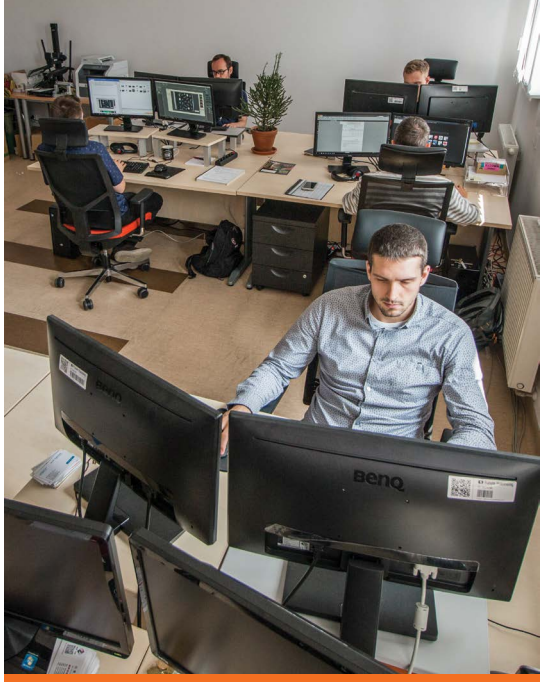
- Protected data storage with role-based access control
- Image annotation tools for any computer vision project
- Import, export and REST API for dataset automation



Support & services

Adaptive Vision also offers technical support and custom software development services for machine builders. With our team working with you on-demand, your full capabilities become virtually unlimited.





About Adaptive Vision

Since 2007 Adaptive Vision has been providing machine vision software, libraries and technical support. We specialize in creating effective and user-friendly technology as a reliable partner of machine builders, vision system integrators and industrial end-users. In 2016 we extended our offer with modern deep learning tools, and in 2019 we introduced further innovation by offering WEAVER™ inference engine for the highest inference performance. In 2021 Adaptive Vision became part of Zebra Technologies, a NASDAQ-listed S&P 500 company.

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version 05/2021