



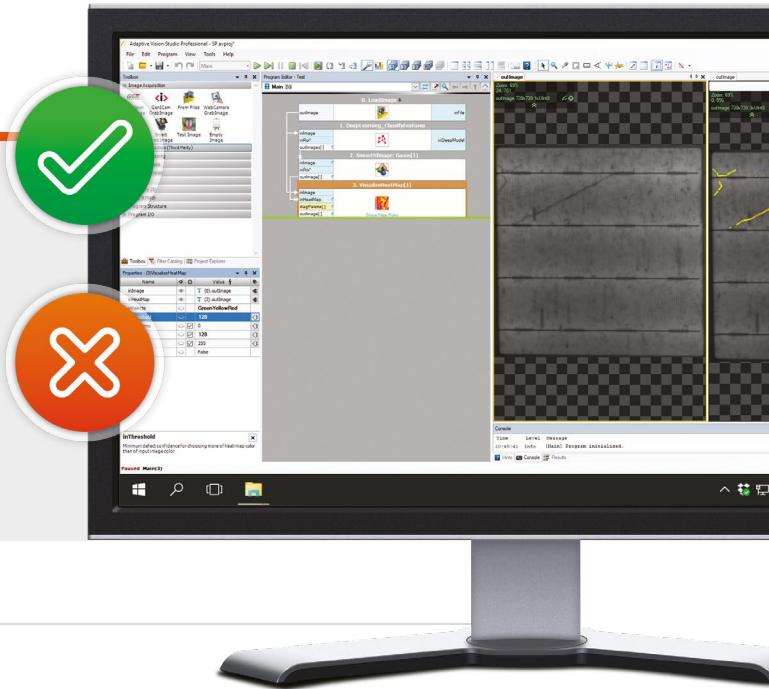
Adaptive Vision

Deep Learning Add-on



Introduction

10 years ago Adaptive Vision has redefined graphical programming for machine vision applications. Now it is time for another breakthrough – detecting defects with no programming at all. By using Deep Learning technology the software tool is trained with Good and Bad samples, and then it automatically classifies input images as accepted or rejected.



Key facts



Typical applications require between 20 and 50 images for training.



A modern GPU is recommended for fast training and execution.



Typical training time is 5 minutes on GPU.



Typical execution time is 200 ms on GPU.

All-in-one software package

Adaptive Vision offers the most comprehensive range of machine vision software tools:



2D & 3D algorithms



HMI Designer



Rapid development environment



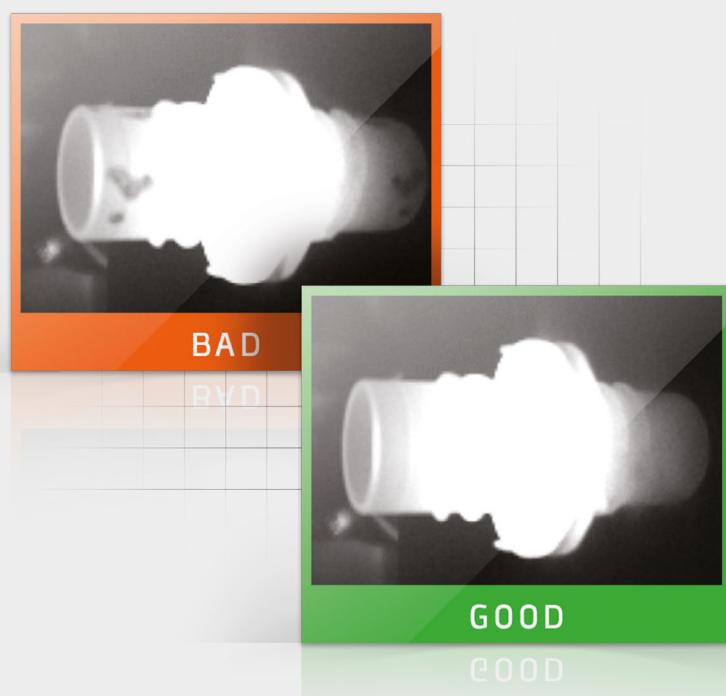
Technical support and know-how



C++ and .NET libraries



Deep Learning

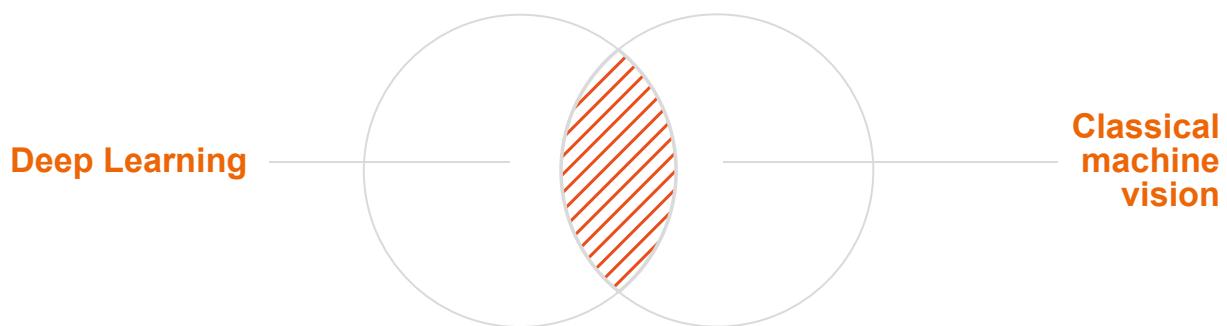




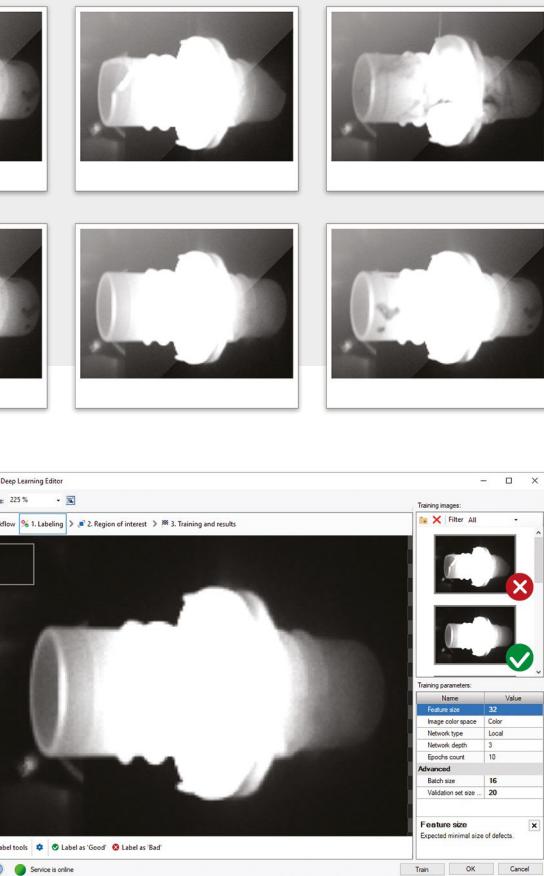
Deep Learning vs Classical Machine Vision

Deep Learning is a new reliable solution for machine vision problems that could not have been solved before. There are, however, applications that still can only be realized with classical methods. How do you know, which approach is better? Here is a quick guide:

Deep Learning	Classical machine vision
<p>Typical applications:</p> <ul style="list-style-type: none">● Surface inspection (cracks, scratches)● Food, plant, wood inspection● Plastics, injection moulding● Textile inspection● Medical imaging	<p>Typical applications:</p> <ul style="list-style-type: none">● Dimensional measurements● Code reading● Presence or absence checking● Robot guidance● Print inspection
<p>Typical characteristics:</p> <ul style="list-style-type: none">● Deformable objects● Variable orientation● Customer provides vague specification with examples of Good and Bad parts● Reliability 99%	<p>Typical characteristics:</p> <ul style="list-style-type: none">● Rigid objects● Fixed orientation● Customer provides formal specification with tolerances● Reliability 100%



Training Procedure



1

Collect and normalize images

- Acquire between **20 and 50 images**, both Good and Bad, representing all possible object variations; save them to disk
- Make sure that the object scale, orientation and lighting are as consistent as possible

2

Training

- Use **DeepLearning_ClassifyFeatures** or **DeepLearning_DetectAnomalies** tools
- Open Deep Learning editor
- Load training images
- Label images as **Good** or **Bad** (unsupervised mode), or mark defects with drawing tools (supervised mode)
- Click “**Train**”



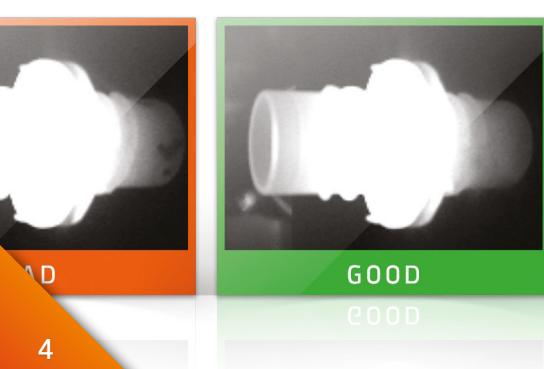
Training and Validation Sets

In Deep Learning, as in all fields of machine learning, it is very important to follow correct methodology. The most important rule is to separate the Training set from the Validation set. The Training set is a set of samples used for creating a model. We cannot use it to measure the model's performance, as this often generates results that are overoptimistic. Thus, we use separate data – the Validation set – to evaluate the model. Our Deep Learning tool automatically creates both sets from the samples provided by the user.

3

Execute

- Run the program and see the results



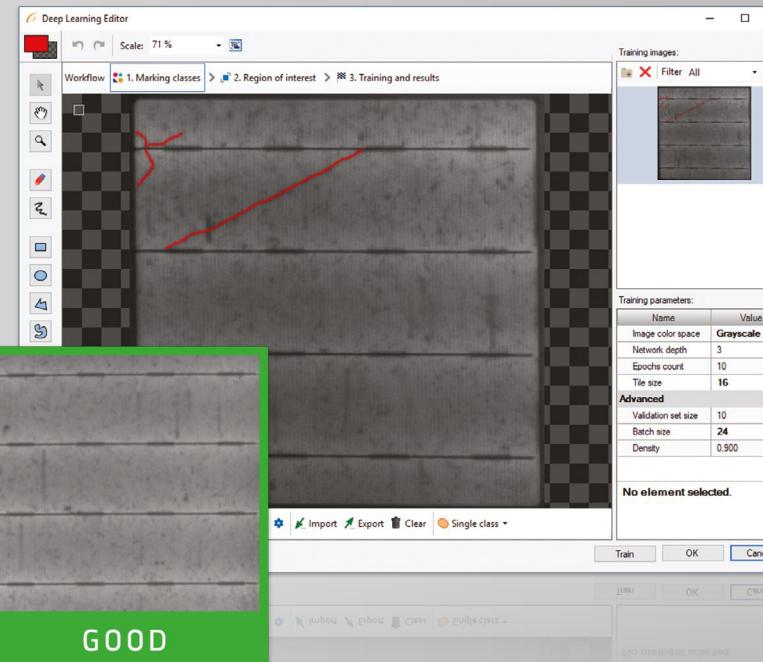
Application Examples

Supervised mode

In the supervised mode the user needs to carefully label pixels corresponding to defects on the training images. The tool then learns to distinguish good and bad features by looking for their key characteristics.

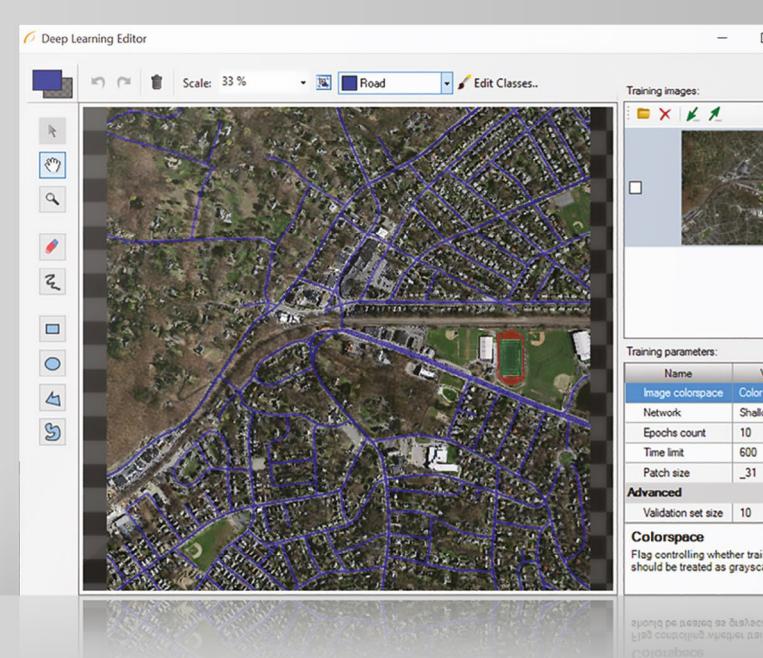
- **Photovoltaics Inspection**

In this application cracks and scratches must be detected on a surface that includes complicated features. With classical methods, this requires complicated algorithms with dozens of parameters which must be adjusted for each type of solar panel. With Deep Learning, it is enough to train the system in the supervised mode, using just one tool.



- **Satellite Image Segmentation**

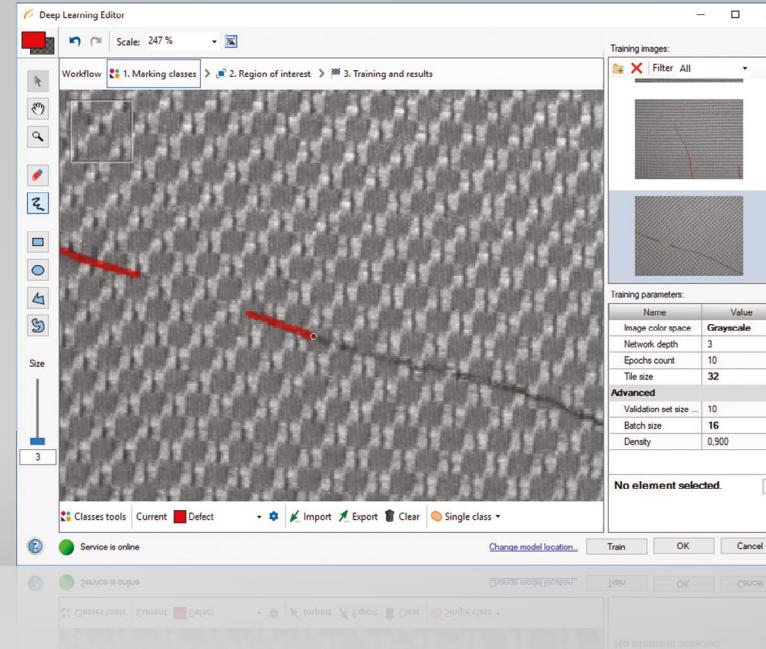
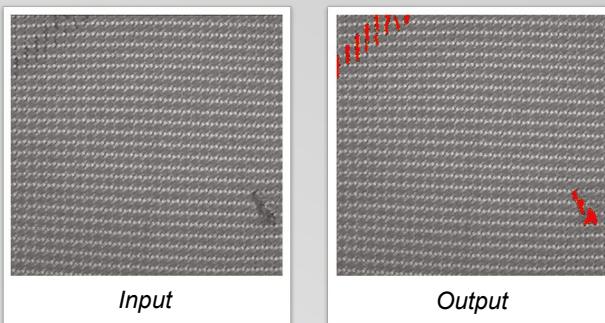
Satellite images are difficult to analyse as they include a huge variety of features. Nevertheless, our Deep Learning Add-on can be trained to detect roads and buildings with very high reliability.



Application Examples

• Textile Inspection

Textile materials come in many different styles, but one thing is common – defects occur on a highly textured background. With Deep Learning technology, the user can define several classes of defects and mark them on sample images. When training is finished, classification is performed automatically, detecting even hardly visible defects.



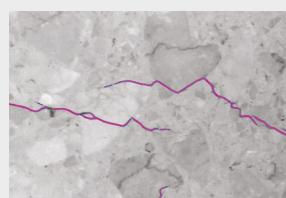
• Cookie Inspection

There are no two cookies that look the same, but customers expect one thing to stay perfect: the chocolate cover. How to define a defect? Simply collect faulty cookies and mark what is wrong with them. Our software learns the differences and reliably finds them on the product.

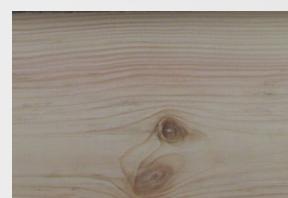


• Other examples

Marble Cracks



Wood Knots



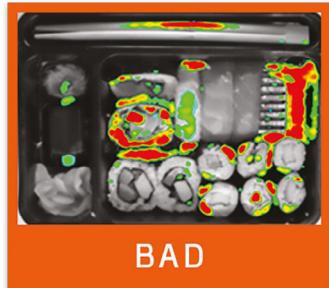
Application Examples

Unsupervised mode

In the unsupervised mode training is simpler. There is no direct definition of a defect – the tool is trained with Good samples and then looks for deviations of any kind.

- **Package Verification**

When a sushi box is delivered to a market, each of the elements must be correctly placed at a specific position. Defects are difficult to define when correct objects may also vary. The solution is to use unsupervised deep learning mode that detects any significant variation from what the tool has seen in the training phase.



- **Plastics, injection moulding**

Injection moulding is a complex process with many possible production problems. Plastic objects may also include some bending or other shape deviations that are acceptable for the customer. Our Deep Learning Add-on can learn all acceptable deviations from the provided samples and then detect anomalies of any type when running on the production line.



Plastic capsule

Hardware requirements

Our Deep Learning Add-on can work on a standard industrial PC, but for better performance we recommend using modern GPU boards from the nVidia® GeForce® and Tesla Series with compute compatibility 3.5 or higher.

Sales

**NET New Electronic
Technology GmbH**
Lerchenberg 7
86923 Finning, Germany
Tel: +49 8806 9234 0
Fax: +49 8806 9234 7 7
info@net-gmbh.com
www.net-gmbh.com

NET USA, Inc.
3037 45th Street
Highland IN 46322, USA
Tel: +1 219 934 9042
Fax: +1 219 934 9047
info@net-usa-inc.com
www.net-usa-inc.com

NET Italia S.r.l.
via Carlo Pisacane, 9
25128 Brescia, Italy
Tel: +39 030 5237 163
Fax: +39 030 5033 293
info@net-italia.it
www.net-italia.it

About us

Adaptive Vision was founded in 2007 as a new brand of Future Processing Sp. z o. o. company. Since then we have been providing machine vision software, libraries and development services. We create effective and user-friendly technology as a reliable partner of machine builders, vision system integrators and industrial end-users.

Adaptive Vision

Future Processing Sp. z o. o.
ul. Bojkowska 37A
44-100 Gliwice, Poland