Application Software for Industrial Vision Systems

NeuroCheck 6.0
Getting Started

NEURO
CHECK
Industrial Vision Systems

Trademarks and Imprint

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www.neurocheck.com

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Welcome

Welcome to NeuroCheck, the leading platform for machine vision on Microsoft Windows. With NeuroCheck you have chosen a professional software product that has stood the test in thousands of industrial vision applications.

What's new in NeuroCheck 6.0?

With NeuroCheck 6.0 we're presenting our latest product version providing new functionality as well as optimizing and extending existing and proven functions. More than 2,000 suggestions from our customers and business partners were collected systematically and implemented in the new software version by our development team.

In the following you'll find an overview of the new functionality and improvements in NeuroCheck 6.0:

- NeuroCheck 6.0 uses the Microsoft .NET framework and supports the 64-bit edition of the Windows 7 and Windows 8 operating systems.

- The software's multi-threading architecture and many image processing algorithms utilize the computing power of modern multi core CPUs.

- The user interface of manual mode of operation has been optimized according to ergonomic criteria providing new wizards and improved dialogs.

- The user interface and visualization of the automated inspection process can be adjusted to specific needs and designed freely using integrated graphic design tools.

- 25 new check functions have been added to the software. More than 20 check functions have been extended and improved. All image processing check functions now fully support color images.

- The communication interface for data and signal exchange has been significantly extended and provides quick and flexible integration into networked production environments.

The Getting Started Guide

This introduction to NeuroCheck will help you to install the system, will show you how to create your first image processing application using NeuroCheck, and how to get further information regarding working with NeuroCheck. The Getting Started Guide is the ideal starting point for your entry into working with the NeuroCheck software when creating your first visual inspection application interactively.

Content

This Getting Started Guide is organized as follows:

- Chapter 1 („Getting Help") contains information on how to get assistance for your work with NeuroCheck.

- Chapter 2 („Installing NeuroCheck and start-up") guides you through the installation process of NeuroCheck and shows you the first configuration steps.

- Chapter 3 („NeuroCheck Overview") provides an overview of the general concept of the software and introduces you to the most important terms.

- Chapter 4 („Creating a new Check Routine") gives you a quick guide on how to construct visual inspection applications with NeuroCheck.

We wish you fun reading the manual and success with your work with the NeuroCheck software!
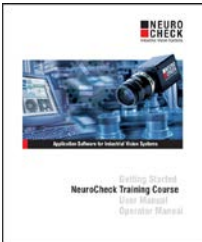
1. Getting Help

NeuroCheck is universal and very powerful machine vision software. It provides thousands of functions for all areas of automatic visual inspection in industrial manufacturing. You can configure and operate the software by more than 350 dialogs.

This chapter will show you how to get assistance while you work with the NeuroCheck software. It lists the available printed manuals, explains how to make use of built-in help features of the software, and whom to contact for technical support.

1.1 Printed Documentation (Manuals)

Several NeuroCheck software manuals are available, individually optimized for a specific target readership. This page gives you an overview as well as a short description of each manual to help you choosing the appropriate one.

Depending on the license level of your NeuroCheck software copy not all printed documentation may be enclosed. All manuals listed here are also enclosed in PDF format with every copy of NeuroCheck on DVD.

Manual	Description
	Getting Started (the book you are reading right now) This short introduction to NeuroCheck will help you to install the system, will show you how to create your first image processing application using NeuroCheck, and how to get further information regarding working with NeuroCheck. The Getting Started manual is the ideal starting point for your entry into working with the NeuroCheck software when creating your first visual inspection application interactively. A printed copy is included with every NeuroCheck edition.
	Training Course This manual will acquaint you with the operation of the NeuroCheck software and present you the many fields of application in detail. It will guide you step by step through configuring automatic visual inspection applications for different application areas. The Training Course manual is suitable for self study but also as a supporting document in a seminar. A printed copy is included with the NeuroCheck Professional and Premium Edition.

NOTICE
For the benefit of the environment, we will no longer print and mail manuals.

Please find the manuals as PDF documents on your installation medium or in the service area under downloads on our website.
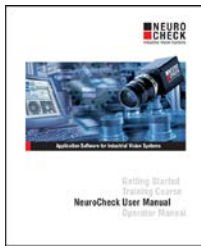
User Manual

This manual describes all program functions of NeuroCheck in detail and provides a comprehensive reference document for the NeuroCheck software. The manual is not only intended as a reference tool but also provides detailed understanding of the program concepts.

Because of the extensive functionality of the NeuroCheck software, the printed manual is limited to frequently used program functions. A detailed description of all program functions can be found in the online version of the manual that you can access by clicking on the menu item ‚**?'** ▶ **Help Topics** ▶ **User Manual**.

A printed copy is included with the NeuroCheck Professional and Premium Edition.

Operator Manual (in preparation)

This manual will introduce you to NeuroCheck and show you how to gain comprehensive information about working with NeuroCheck; it will help you to start up a visual inspection system and support you if errors occur. It focuses on process optimization, error diagnostics, data safety, maintenance and support.

The Operator Manual is intended for commissioning engineers and operators of NeuroCheck visual inspection systems.

A printed copy is included with every NeuroCheck edition.

1.2 Help System

The help system provides you with the information you need and where you need it when working with the NeuroCheck software, whether in the lab or on the line. In contrast to the printed manuals that focus on the frequently used program functions or work flows, the help system provides a detailed description of all program functions.

Starting the help system

You have several ways to open the help system:

- After starting the NeuroCheck DVD: by selecting the command **Product Documentation** in the NeuroCheck Installation Menu.

- After software installation: by selecting the Windows start menu item **NeuroCheck 6.0 ▶ Help System**.

- After starting the software: by clicking on the software menu item **‚?' ▶ Help Topics**.

- From the NeuroCheck Automatic mode of operation: by selecting the **Help** command (availability depends on your configuration).

The NeuroCheck help system will open and display its welcome page:
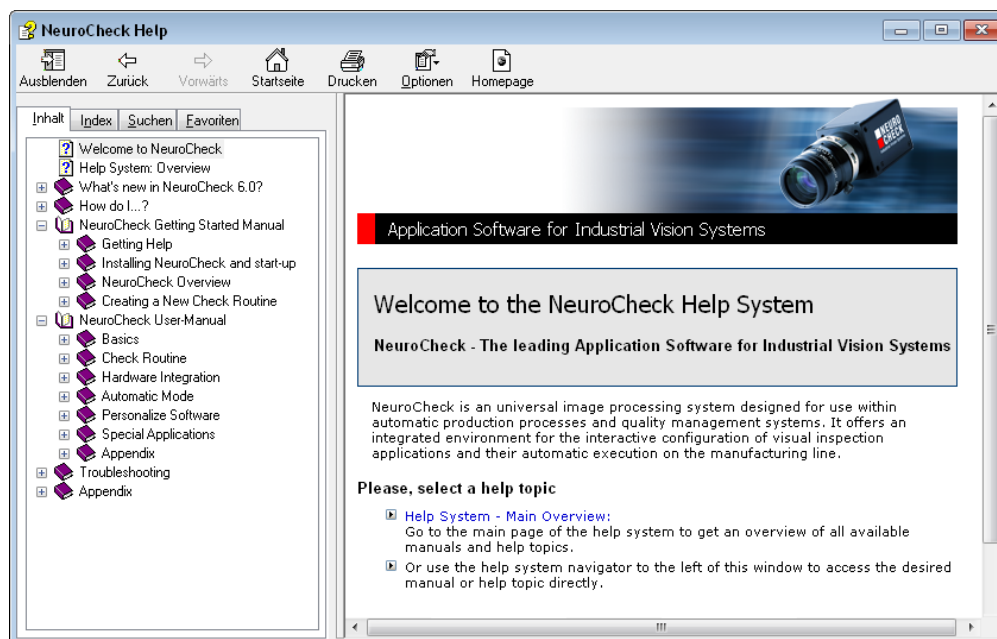
1.3 Contextual Help

Besides calling the help system directly, there are several interesting ways of accessing help information relating to different types of information and different work situations.

Reference Information

The most extensive section of the help system is the check function reference explaining the operation and parameters of every check function used to build visual inspection routines in NeuroCheck. Since this information is frequently needed when configuring check routines, it can be reached directly by several links from the context of a check function, for example by this command button:
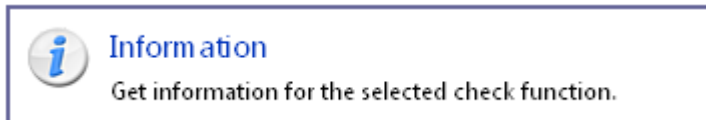
Status Messages

Another very important means of providing help related to the current context of your work are the status messages given by check functions during development of a check routine in manual mode. For all status messages issued by check functions in NeuroCheck, the help system provides a detailed description of possible causes of the error and offers direct links to correct the problem immediately. You can access this information directly by a command button:

Dialog related help
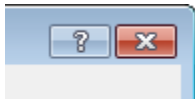
 All check function parameter and target value dialogs offer a **Question mark** button in the caption of the dialog. If you press on it, the help system will open and present a description of the current check function dialog.
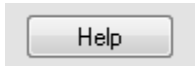
 Many important dialogs offer a **Help** button. If you press on it, the help system will open and present a description of the current dialog and its elements.

1.4 Literature

Christian Demant, Bernd Streicher-Abel, Peter Waszkewitz,

Industrial Image Processing – Visual Quality Control in Manufacturing,

Springer (Berlin, Heidelberg, New York), 1999, ISBN 3-540-66410-6

Gives a practical introduction to the automated solutions of real life industrial inspection tasks. It focuses on the combination of procedures in an integrated image processing system, utilizing the NeuroCheck software.
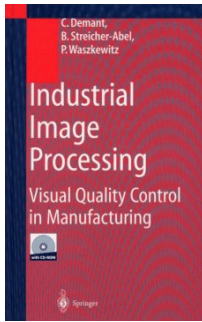
This is the definitive text book on automatic visual inspection covering industrial and machine vision solutions. In contrast to other digital image processing books on the market, this volume demonstrates how the various methods work together in real-world applications instead of stringing together isolated algorithms and formulas.

The author's years of experience in developing industrial vision systems resulted in a completely new kind of introduction to the practical application of digital image processing. Treatment throughout the book is based on real-world problems, addressing the industrial practitioner as well as the student interested in modern methods of automated production and quality control. Of course, theory and algorithms are not neglected, but the focus is always on the practical application.

A demo version of NeuroCheck together with comprehensive image material enables the reader to do his own experiments on real-world images from industrial production.

1.5 Product Support

If neither documentation nor web resources provide a solution for your particular problem, contact your local NeuroCheck support office. The preferred method of contact is via email as this enables content-rich information about problems and solutions, frequently including camera images, check routines, log files and so on.

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Phone: +44 (0) 1865 823322
Fax: +44 (0) 1865 823393
e-mail: support@industrialvision.co.uk

Other Countries

Please refer to our web site http://www.neurocheck.com for information about local support offices in other countries.

2. Installing NeuroCheck and start-up

This chapter guides you through the installation process of NeuroCheck and shows you the first configuration steps.

2.1 System Requirements

Installing and using NeuroCheck requires a computer running Microsoft Windows. NeuroCheck's minimum system requirements are the following:

- Operating system: Windows 8 (32-bit/64-bit), Windows 7 (32-bit/64-bit), Windows Vista (32-bit) or Windows XP (32-bit) service pack 3 or higher
- Processor: 1.5 GHz (2.0 GHz multi-core CPU recommended)
- System memory: 1 GB RAM (4 GB or more recommended)
- Hard disk space: 2 GB on system partition
- SVGA monitor and graphics adapter (preferred resolution at least 1024 × 768 pixels, true color)
- Drive: DVD or Blu-ray
- Interface: USB or Parallel Port

> We strongly recommend using the 64-bit edition of the operating system if your demands on system resources are high, especially when using line-scan cameras, very high-resolution cameras or multiple cameras with one system.

This configuration is sufficient for using NeuroCheck as a development system in an image processing laboratory. Applying NeuroCheck as a completely automated inspection system requires the following additional NeuroCheck compatible hardware components:

- Digital camera or frame grabber board with camera
- Digital I/O board, field bus board, ethernet interface or serial interface for communication with PLC or master control computer

> Please note that you need specific drivers to use these hardware components. Please contact the Technical Support to verify if these drivers are available for your version and edition of the operating system.

2.2 Before Installation

Security key (dongle)

Every NeuroCheck license comes with a security key (called a "dongle"). Licensing is completed before delivery of the software package by programming the security key. The security key constitutes the actual value of the purchased NeuroCheck license.

First, please connect the dongle to the USB or parallel port of your PC. The installation program does not need the dongle, but if you want to test NeuroCheck immediately, it will start with unrestricted functionality only when the security key is present.

"Readme" file

In the root directory of the NeuroCheck DVD you will find the file `Readme.pdf`. Alternatively – if you don't have the Adobe Acrobat Reader installed – you can open the file `Readme.txt`.

The "Readme" file contains helpful hints about the contents of the DVD and for installing the software. Please note that the Windows user executing the setup needs full Administrator permissions.

NeuroCheck DVD Auto start

If the CD/DVD-autostart option of your system is activated, the installation program should start automatically after inserting the NeuroCheck DVD. Otherwise, please start the `Start.exe` program in the root directory of the DVD manually. In some instances you will be asked immediately to install certain components needed for the next installation steps.

The installation menu

The installation menu of the NeuroCheck DVD will be opened automatically:

Besides the **Install NeuroCheck** command the installation menu provides options for viewing the NeuroCheck software product documentation or viewing the contents of the NeuroCheck DVD in Windows Explorer.

2.3 Installation Procedure

2.3.1 Starting the Installation

In the installation menu of the NeuroCheck DVD, please click on the **Install NeuroCheck** command button. This will start the NeuroCheck installation wizard ("Setup").
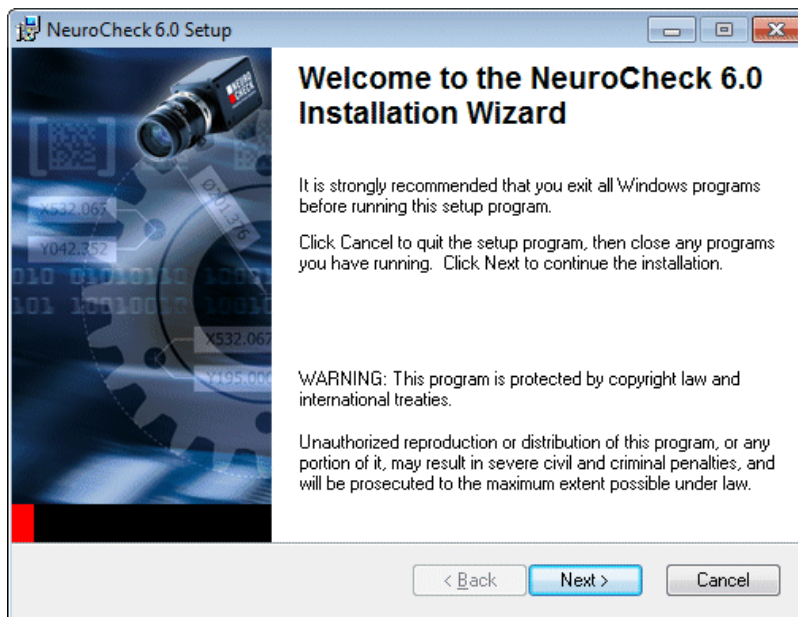

The welcome screen of Setup prompts you to close other Windows applications first. This is recommended because some shared resources have to be installed into the Windows system directory along with NeuroCheck. If no other programs are running, you can continue by choosing **Next**.

2.3.2 Choosing the Installation Folder

In the next step, the setup asks you whether you want to install NeuroCheck as suggested into the standard folder on the Windows system drive. You can select a different folder by choosing **Browse**, but we recommend that you simply confirm the default selection which is based on the Windows setup guidelines. To confirm the default selection, simply choose **Next**.
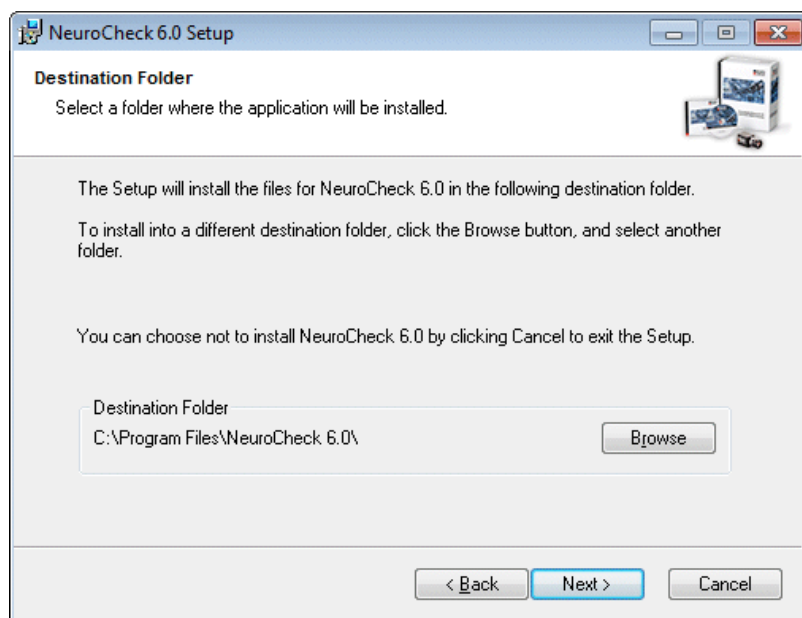
2.3.3 Copying Files

When all settings have been made, the setup wizard will ask you one final time whether you want to continue the installation or change your settings. If you confirm with the **Install** button, NeuroCheck will be installed on your System.

A progress dialog informs you about the steps currently being taken. The installation program will automatically detect your operating system and if it is a 32-bit or 64-bit system, and then install the correct files. The software will be optimized for the target system and registered within the operating system. In addition, several sample files are copied to the hard disc.

2.3.4 Completing the Installation

The setup informs you about completion of the installation in a final dialog box. Please confirm this dialog box with the **Finish** button to close the wizard.
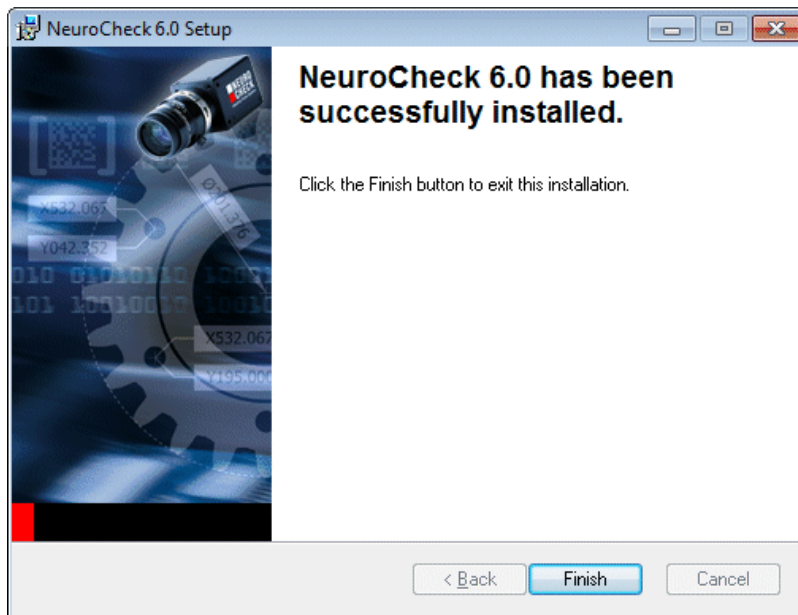
After finishing the installation and before you run NeuroCheck for the first time, the computer has to be rebooted:
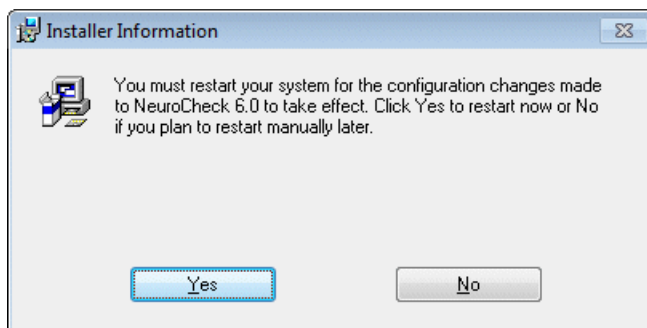
2.4 Starting the NeuroCheck software

Now you can run NeuroCheck like any other Windows program from Windows. For the operating systems Windows 7, Vista and XP, the Windows Start menu contains entries for the NeuroCheck software, for its help system, additional documentation and tools. For Windows 8, you will find the equivalent shortcuts as Windows tiles.
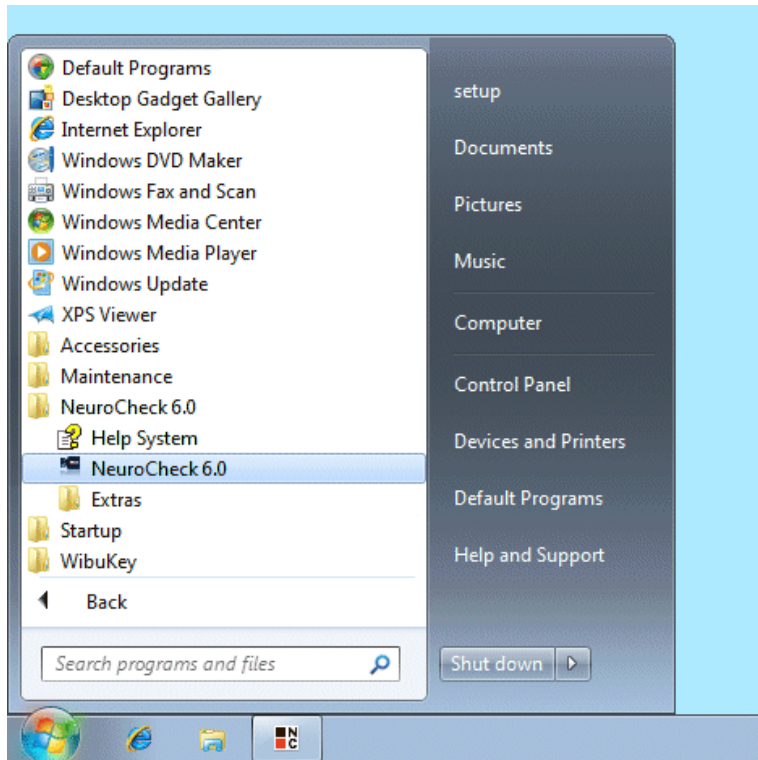
The installation program also creates a desktop shortcut which you can use to start NeuroCheck directly:
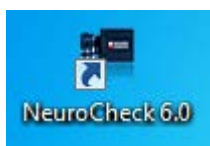
License check

On program start, NeuroCheck checks for the availability of a valid license security key (dongle). If this check fails, it will present this message:
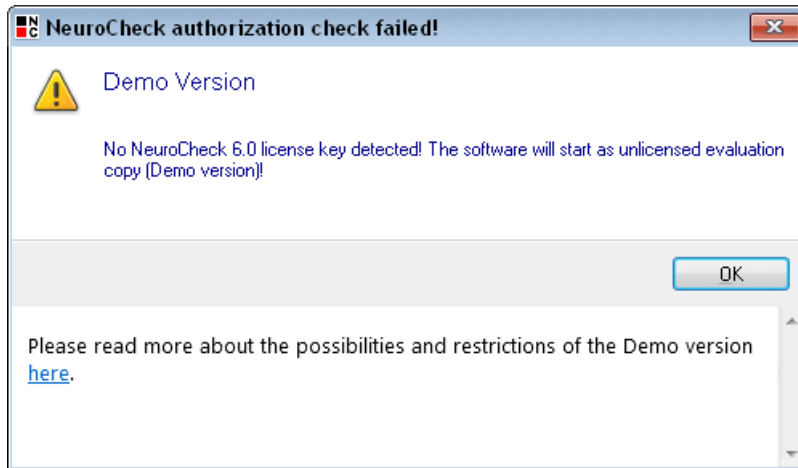
Certain legal and technical restrictions apply to the use of the Demo version of NeuroCheck. Use the link "**here**" in this dialog to open the help system and read more details about these restrictions.

2.5 The NeuroCheck Intro Screen

On its first start, the so-called NeuroCheck Intro screen will be displayed, which serves as entrance page for the software. It contains clearly laid-out status information as well as command buttons for quick access to important software functions.
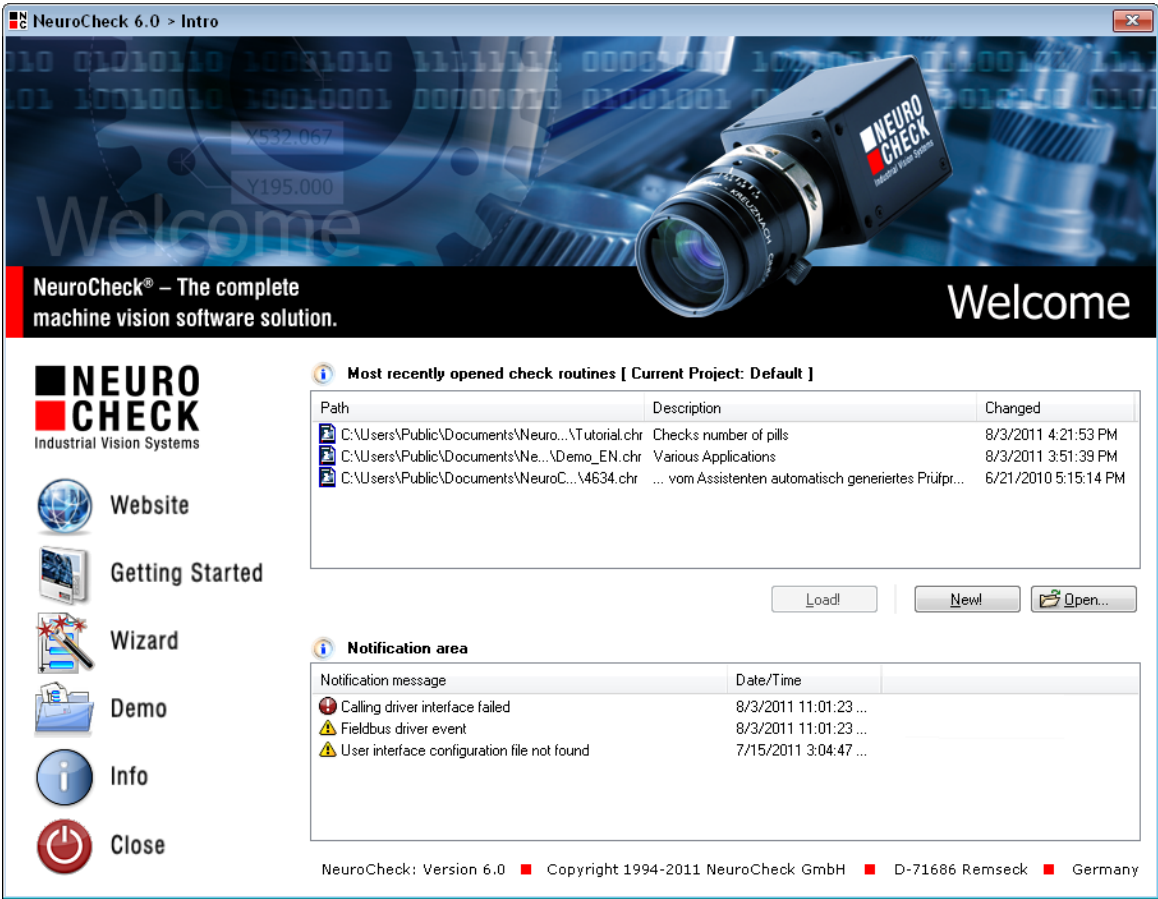
Command buttons

The Intro screen offers you the following options by selecting a command button to the left side of the window:

- **Website**
  Starts a web browser and opens the NeuroCheck web site.

- **Getting Started**
  Opens the Getting Started help file.

- **Wizard**
  Starts the check routine wizard to easily create a first check routine.

- **Demo**
  Loads a prepared extensive check routine that demonstrates the possibilities and application areas of the NeuroCheck software.

- **Info**
  Opens a dialog and displays information about the current software version and the state of your license.

- **Close**
  Closes the software.

Status information

On the right side of the Intro screen you will find two list fields. In the screenshot displayed here both list fields already contain entries. If this is the first time you have started NeuroCheck, you should find both list fields empty.

- **Most recently opened check routines**
  This list provides you a quick access to the most recently opened check routines. By clicking on one of the buttons **Load**, **New** or **Open** you will be able to work with check routines in the Manual mode of operation. The following chapters will deal with these topics.

- **Notification area**
  This list displays the most recent important system events. Recording these events helps you on system diagnosis. Double-click a list entry to open the **Event viewer** providing more details about the event.

3. NeuroCheck Overview

This chapter provides an overview of the general concept of the system and introduces you to the most important terms of the NeuroCheck software.

3.1 What is NeuroCheck?

NeuroCheck is a universal machine vision software for all areas of automatic visual inspection in industrial manufacturing. NeuroCheck offers an integrated environment for the interactive configuration of visual inspection applications and their fully automated execution on the manufacturing line.

With its broad selection of image processing functions, NeuroCheck can be used in a wide range of application areas. Highly automated check routine configuration and an intuitive graphical user interface help to solve visual inspection problems. NeuroCheck reduces cost by easy set-up, reconfiguration and rapid turn-around.

The following simplified figure shows the basic setup of a visual inspection system:

PLC   Industrial PC running NeuroCheck   Camera

The main features of NeuroCheck are:

Machine Vision Functions

The software encapsulates thousands of powerful and long-proven machine vision functions of the NeuroCheck image processing library. The check functions are logically grouped into categories such as image capturing, image pre-processing, machine vision analysis and measuring.

Camera integration

NeuroCheck supports a large number of modern digital cameras according to FireWire™ a/b and Gigabit Ethernet standards with various resolutions. The unique NeuroCheck device manager makes setup and configuration of cameras simple and easy.

Manual Mode

Manual mode presents a development interface for creating an inspection solution with an interactive graphical approach. Here you can determine the logical structure of the check procedure and the parameters for executing the inspection process.

Automatic Mode

In automatic mode, the previously configured check runs automatically. The system monitor visualizes status and inspection results in freely configurable windows. Process control is effected via PLC or master computer or manual intervention by an operator.

Process integration

For communicating with a supervisory control system, a number of modern standard interfaces are available. Execution of the inspection procedure can be affected dynamically by the process peripherals. NeuroCheck also sends the inspection results and measurement values to the peripherals.

> The NeuroCheck software is available in several licensing levels. These licensing levels differ in the features they provide.

3.2 Application Areas

This section gives a brief introduction to typical visual inspection tasks NeuroCheck can be used for. You will find examples for all these application areas on the NeuroCheck Web site http://www.neurocheck.com and in the reference book **Industrial Image Processing** (please refer to chapter "Literature"), which presents solutions from all areas of industrial visual inspection created with NeuroCheck.

Presence Verification / Completeness Check

Use NeuroCheck to detect the presence of all required parts and components easily and reliably. The same functions can be applied to make sure that certain objects, for instance damaged parts, are not present.
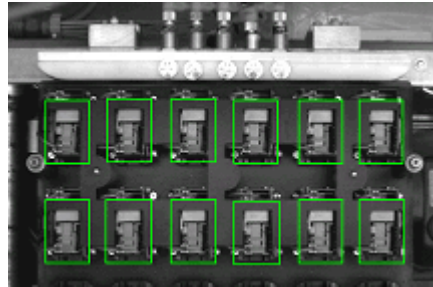
Gauging / Dimensional Inspection

You can use NeuroCheck to check every aspect of the geometry of a work piece, e.g. distances between objects, angles between edges, parallelism or concentricity.
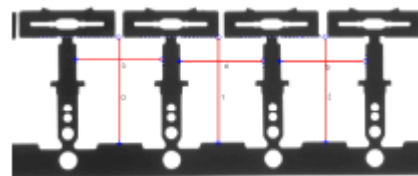
Character Recognition (OCR, OCV)

NeuroCheck uses adaptive classifiers for character recognition. They can be trained to recognize characters in fonts created by marking technology used in industry, for example laser-engraving, stamping, printing…
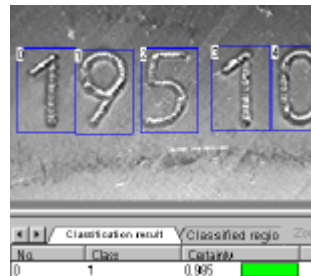
Bar Code and DataMatrix Code Identification

Different types of bar codes and the two-dimensional DataMatrix code are used for the identification of all kinds of products in packaging, logistics and manufacturing control. NeuroCheck's configurable code identification functions detect and decode such codes at any angle of rotation, in negative or positive print and under difficult surface conditions.

Pattern Recognition

Parts can also be identified by readable letters or arbitrary symbols instead of bar codes. The neural networks used by NeuroCheck can learn from examples to recognize arbitrary patterns, enabling you to fine tune the recognition process to your particular application.

Color Processing / Color Recognition

All NeuroCheck image processing functions provide an extensive support for color images. Color processing is especially interesting if objects have to be distinguished based on their color or if segmentation of the objects is not possible in the gray scale range because they do not exhibit a brightness contrast.

Surface Inspection

Surface inspection applications frequently use line-scan cameras to scan the surface of large or cylindrical parts in order to check for scratches, holes, rough areas etc. Using linescan cameras in NeuroCheck is just as simple as using area-scan cameras. The same image processing functionality is available.
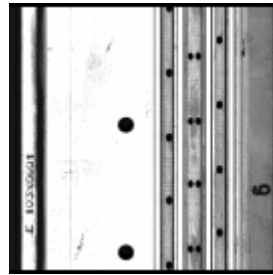
Position verification and robot guidance

This topic summarizes all applications in which an image processing system is used to determine the position and orientation of an object and outputs this position in order to enable another machine to handle the object. A robot gripper can thus be enabled to grab work pieces from a conveyor belt. Another application is palletizing or depalletizing of crates containing assembly parts, packages or bottles.
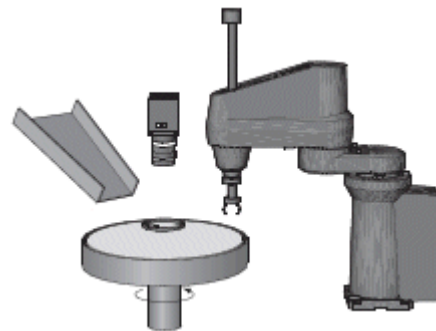
Print Inspection

The most typical application of image comparison methods is print quality inspection. In contrast to optical character recognition, the objective here is checking the quality of the print by evaluating the correspondence of the print to a reference image.

3.3 Modes of Operation

NeuroCheck integrates both the development and runtime environment. On the one hand it offers a comfortable and powerful user interface for the interactive configuration of check routines, on the other hand it contains all features necessary to use the system in an automated production environment.

That's why there are two different modes of operation in NeuroCheck, each with its own particular user interface and with its own special purpose:

Manual mode is the "development environment" and provides a user interface for check routine editing. In Manual mode you construct check routines, set check function parameters and test the inspection step by step.

The following chapter "Manual Mode Screen" will give you more details about Manual mode.
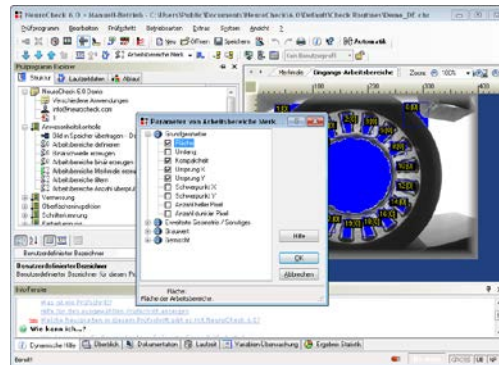
Automatic mode is the "runtime environment" for executing the check routine, fully integrated into the manufacturing line. In Automatic mode, NeuroCheck is typically controlled from the outside, for example by a PLC via digital I/Os or Ethernet. The user interface of the NeuroCheck screen in Automatic mode is highly configurable.

Options for Automatic mode include:

- Start of check by external signal
- Executing certain actions upon external signals
- Report of result data to PLC or master computer

Chapter "Automatic Execution" provides a quick view into Automatic mode.

NeuroCheck has been designed to fulfill automatic visual inspection tasks integrated into modern manufacturing systems. Although it can be put to good use in a research laboratory or for interactive sample tests, where its unique user interface helps to solve varying tasks very quickly, the main focus is automatic operation on the production line. Consequently the program structure has been optimized for working in an industrial environment.

To use the NeuroCheck software in **Manual mode** of operation, you need a license of the level **Professional** or **Premium**.

3.4 Manual Mode Screen

In operation mode **Manual** the NeuroCheck window is the development interface for your check routine. The windows is divided into the following sections:
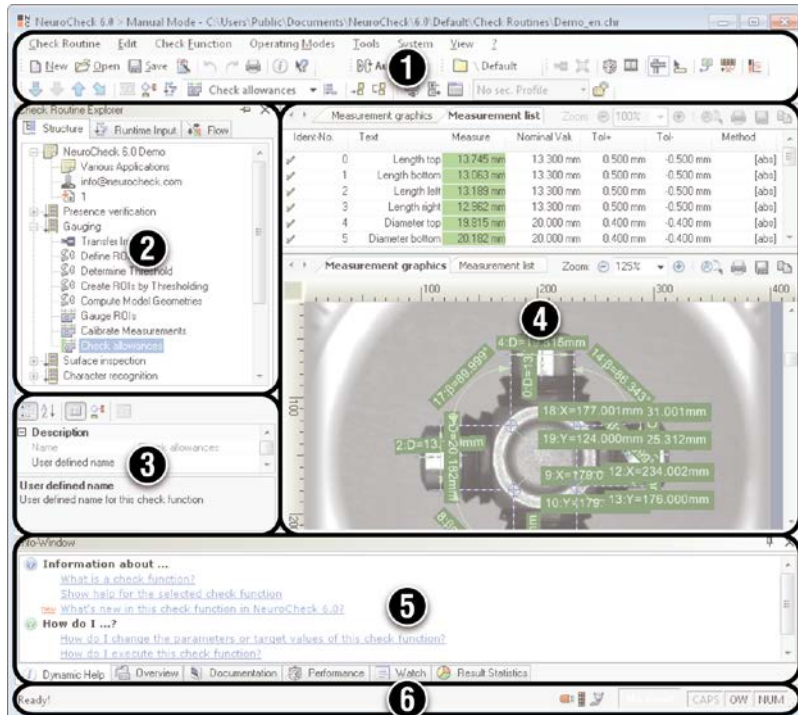
❶   **Main menus and toolbars**

Creating and managing check routines, configuring automatic mode, hardware configuration etc. is done using the commands from the menu or toolbars.

❷   **Check routine explorer**

The check routine explorer is used for the configuration of the check routine. It is divided into three tabs. The **Structure** tab is the default view.

- **Structure:**
  Determining each image processing step using a number of checks and check functions (you will get more information in the following section "Check Routine Structure".

- **Runtime Input:**
  Editing input data configuration of check functions. This determines the data to be used by a check function.

- **Flow:**
  Editing conditional execution of checks depending on the results of other checks.

❸ Quick edit table

On the **Structure** tab of the check routine explorer you can use the **Quick Edit Table** to edit selected parameters or properties of check routine tree objects directly, without the need to open a dialog.

❹ Result view

The result view shows the results of the last check function executed or various other types of status information. It can be split into two areas, for instance to view a result image and a result table simultaneously.

❺ Check routine Information window

This window helps you to create a check routine. Here you will get context-sensitive dynamic help and detailed information about the selected object in the check routine explorer.

❻ Status bar

The **Status bar** shows you several symbols indicating the availability and current state of hardware components and other important information.

Chapter „Creating a New Check Routine" gives an introduction to the process of building a check routine in manual mode.

3.5 Check Routine structure

This section explains some of the basics regarding the overall structure of visual inspection processes in NeuroCheck.

Check Routine

The **check routine** is the central element of every image processing application realized using NeuroCheck. Its role can be compared to that of a text document in a word processor or a source code in a development environment. It defines the structure and sequence of the complete visual inspection of one work piece.
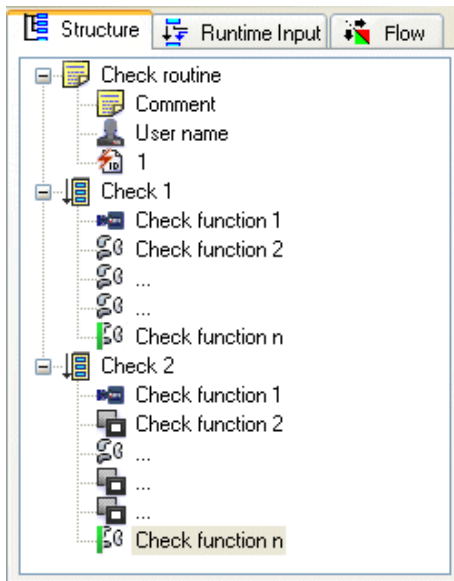
A **check routine** typically consists of several individual checks (or simply: **checks**) inspecting different aspects of the work piece.

Each individual check is made up of several **check functions**. Check functions are image processing, analysis, communication or system functions.

The image shows the entire hierarchy tree of a check routine with several individual checks and their check functions. Every object of this check routine structure has its own property and parameter dialog in which you can configure its individual behaviour.

When you execute a check routine, all its contained checks and check functions are executed sequentially.

Individual Check

Individual checks inspect different aspects of a work piece. In multi camera systems each check is usually assigned to a certain camera. A check might:

- Measure a bore hole.
- Verify the presence of a component.
- Read a line of characters.

After all checks have been carried out for a work piece, their results are combined to form the final result of the check routine.

Checks are usually independent of each other, they do not exchange data. Usually checks are executed in the order from top to bottom in which they appear in the check routine structure. The sequence of checks in the tree view can be altered by simply dragging checks to a new position with the left mouse button pressed on the **Structure** page of the check routine tree view shown above.

However, it is also possible to execute a check depending on the result of some other check, i.e., the "O.K." or "not O.K." result of a check can be used to decide which check to perform next. This is configured on the **Flow** page of the check routine tree view shown above.

Check Function

Check functions are image processing, analysis, communication or system functions that can be inserted into a check to carry out specific tasks. NeuroCheck provides check functions for various tasks, such as filtering entire images, searching and measuring individual objects etc. NeuroCheck has more than 80 different types of check functions.

The check functions of a check are executed in sequence in the order from top to bottom. They exchange data through the data pool of the check. Usually a check function gets its input data from the preceding function, but this assignment can be changed on the **Runtime Input** page of the check routine tree view shown above.

The parameters and target values of every check function can be set individually in a parameter dialog, giving extensive visual assistance to the user. To be able to open the dialog, all preceding check functions of the current check have to be executed without an error.

3.6 Setting up Hardware

An image processing system intended to perform automatic quality inspection depends on several hardware devices, some of them not found in ordinary PC systems. In substance these are cameras for image acquisition and communication devices required for the software's interaction with the manufacturing process.

The NeuroCheck Device Manager

Before you can use cameras and communication devices from NeuroCheck, you have to include them into NeuroCheck and configure them accordingly. For this the software provides the NeuroCheck **Device Manager** dialog. You can open it by using the menu **System ▶ Device Manager**.
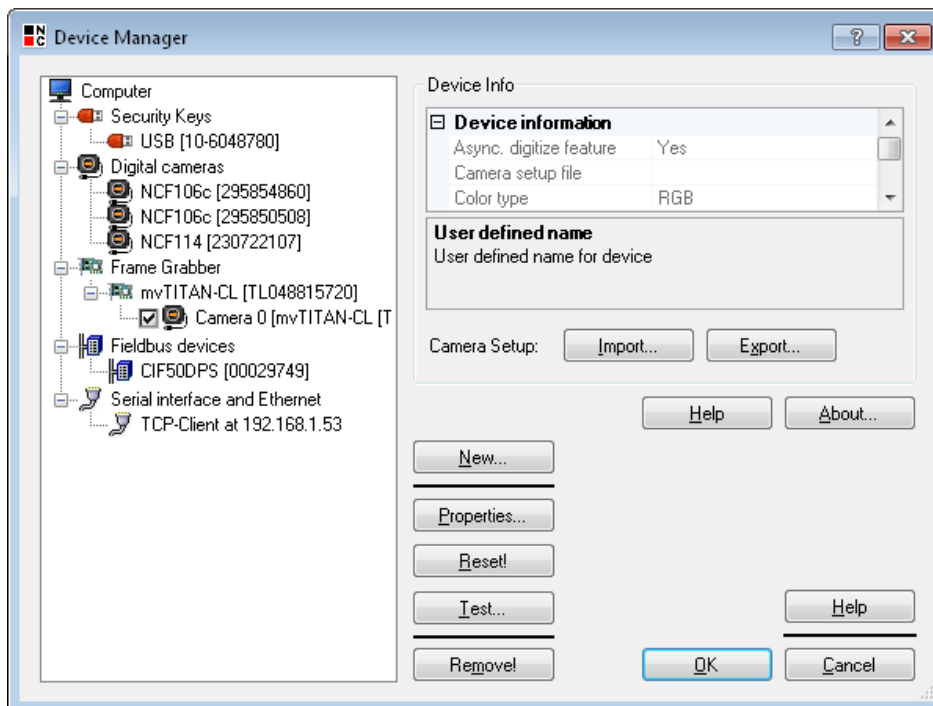
The dialog lists the devices configured, sorted by categories. The available categories are:

- Security keys
- Digital cameras
- Frame grabber boards
- Digital I/O boards
- Field bus boards
- Industrial Ethernet
- Serial interface and Ethernet

The NeuroCheck Hardware Wizard

If this is the first time you have opened the Device Manager, the list does not contain cameras or communication devices yet. Choose the button **New...** in the Device Manager dialog to open the NeuroCheck **Hardware Wizard**. It will guide you through the setup process of a new device.

The following image shows the NeuroCheck hardware wizard on the page where you select the driver for a digital camera:
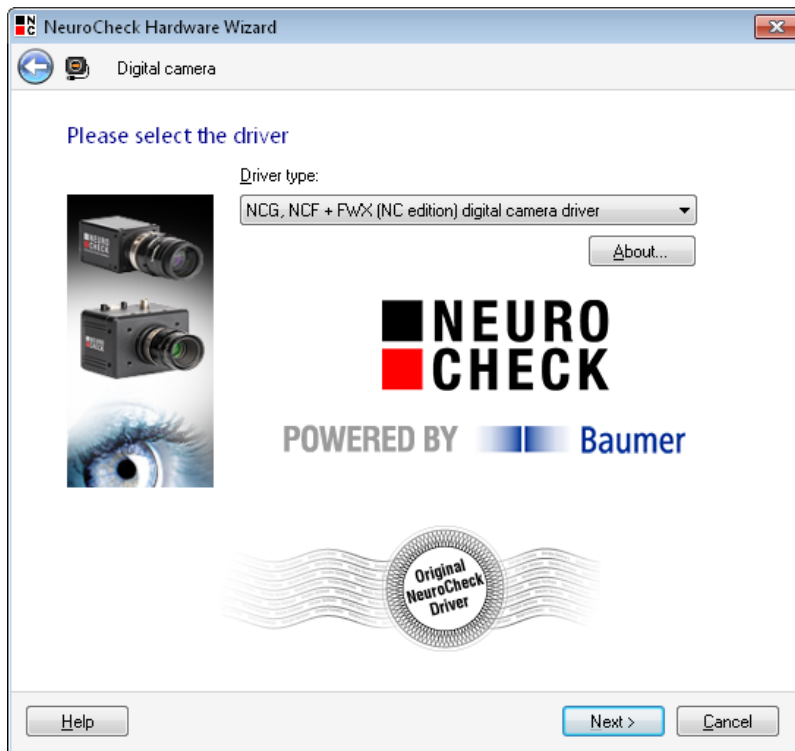
After successfully passing through the wizard, the device is registered within the NeuroCheck Device Manager, and you can use it in NeuroCheck. Choose the button **Properties** in the Device Manager to configure the new device.

> Please note that before including the device into the NeuroCheck device manager you need to install the vendor specific Windows device drivers for most device categories. The Windows device drivers are provided by the hardware manufacturer or are available for download. For details, please refer to the driver help file.

4. Creating a New Check Routine

This chapter gives you an introduction into configuring visual inspection programs with NeuroCheck. You can create a new check routine step by step while reading this chapter. You will find the complete check routine as the file `TUTORIAL_EN.CHR` in the NeuroCheck project directory in the sub folder `CHECK ROUTINES` ▸ `EXAMPLES`.

4.1 Inspection Task

Below you see an image of a blister pack with ten pills. The inspection task is to determine whether exactly ten pills are present in this packing unit.
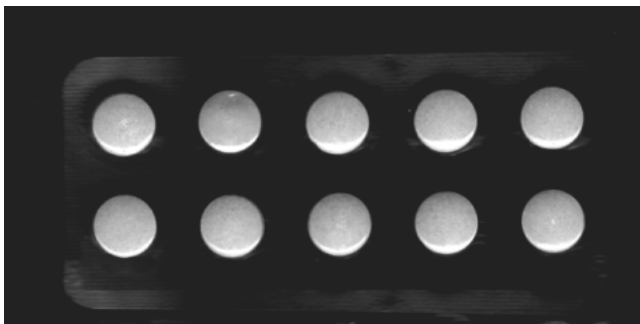

The complete solution of a visual inspection task is encapsulated in a NeuroCheck check routine. Such a check routine can consist of several individual checks, inspecting different aspects of a work piece. In this case only one criterion has to be checked, therefore the check routine will contain only one check.

4.2 Creating the Check Routine

From the NeuroCheck Intro screen as well as in Manual Mode you can create a new check routine by choosing **New** from the **Check Routine** menu or by clicking the depicted icon in the toolbar.

NeuroCheck then shows the Manual Mode screen with an empty check routine. It will automatically create a standard description for the check routine in HTML format.
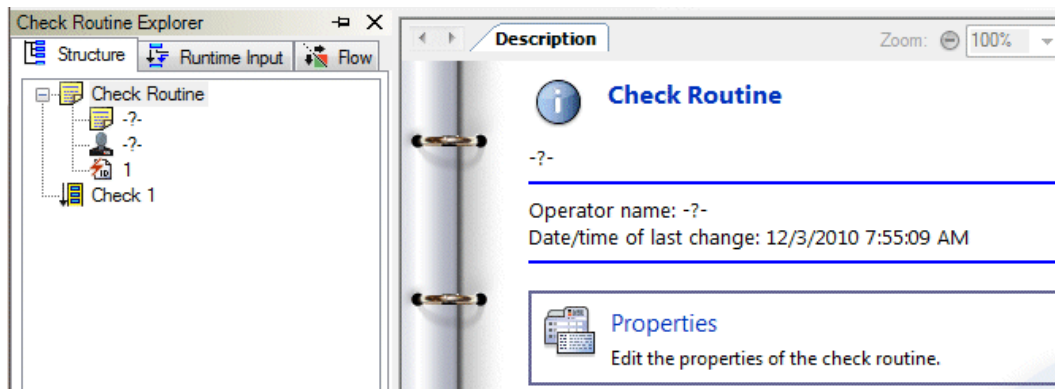
4.2.1 Check Routine Description
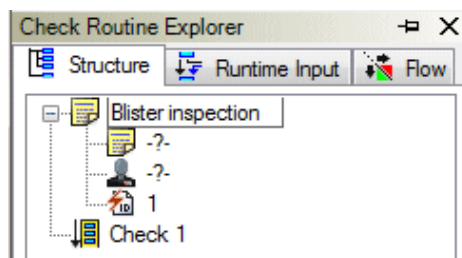
First you should enter a description for the check routine in order to properly identify it later. Click the first line of the check routine tree view, reading **Check routine**, once with the left mouse button to highlight it, then again to switch to edit mode. A cursor appears, allowing you to enter a new name for the check routine. Enter **Blister inspection** and confirm with the RETURN key.
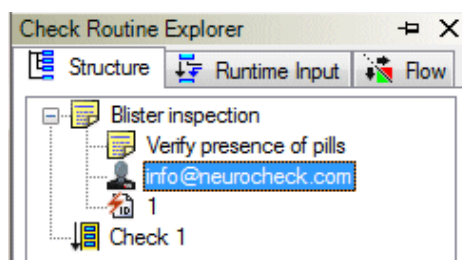
Proceed in the same way with the following lines to enter **Verify presence of pills** as the comment in the second line, your name as the operator in the third line. The lightning icon in the fourth line represents the identification number used to switch check routines in automatic mode and will not be used in this tutorial. Now the check routine tree view should look as shown in the figure. Note that these changes are immediately reflected in the HTML-page in the right window pane.

4.2.2 Saving the Check Routine

Before you start working on the inspection task, you should save what has been created so far. From the **Check Routine** menu choose **Save** or click the depicted icon. The familiar Windows file save dialog appears. Enter a name for the check routine, e.g. `Tutorial`. You do not need to enter a file extension, this is done by NeuroCheck. Confirm with **Save**. You will now see the file name appear in the title bar of the NeuroCheck window.

4.2.3 Creating and Editing Checks

As mentioned before, a check routine is made up of individual checks, performed independently of each other. A first check is automatically created together with the new check routine.

Additional checks can be created by choosing **New ▶ Check** from the **Edit** menu or by choosing **Append check** from the context menu opened by clicking an existing check in the tree view with the right mouse button.

The title of the check itself can be edited in the same way as that of the check routine. The title of a check has a special significance. Over time you will repeatedly encounter inspection problems very similar to one you already solved. NeuroCheck can import complete checks from other check routines so that existing solutions can be re-used. Entering a meaningful title helps identifying such "library checks" for importing. Enter **Counting pills** and confirm with the RETURN key.

4.3 Image Acquisition

Up to now the whole check routine consists of framework and management information only, it does not do anything useful yet. All the work in a check routine is done by so-called **check functions**. We will now add the first check function to our check routine in order to provide the check with an image to be inspected.

Usually this image will be captured from a camera and then transferred to NeuroCheck for processing. Capturing and transferring are separate processes which allows for greater flexibility in selecting and configuring image sources. We will skip the capturing here so that you can work through this example without the need for a camera or real test piece.

4.3.1 Transferring the Image

The first check function to be added to the check is therefore check function **Transfer image**. Choose **Add Check Function** from the **Edit ▶ New** menu or the context menu opened by clicking the title of the check with the right mouse button as in the following image.
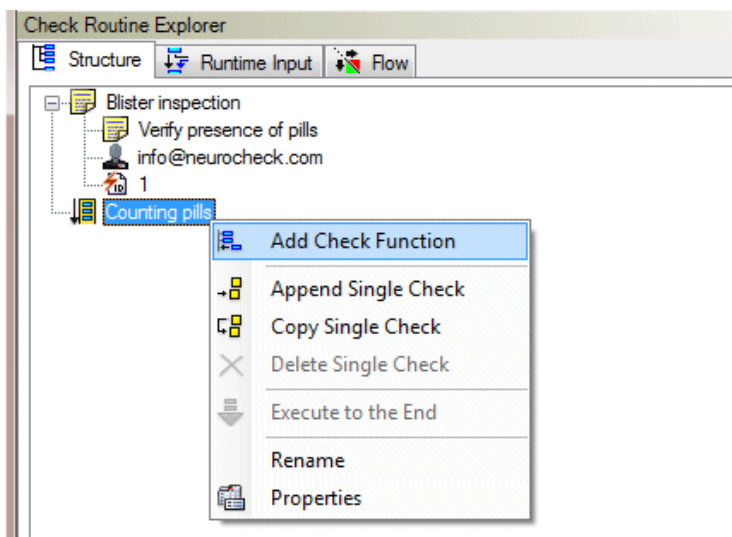
Alternatively you can click the depicted icon in the toolbar. The effect will always be the same: the dialog box for selecting a new check function is displayed.

The dialog box **Select Check Function** contains a separate page for every check function category in NeuroCheck. The pages are switched using the buttons on the left of the dialog box. You will find the check functions for image acquisition on the **Acquisition** page with the camera icon. To provide a better overview, the check functions on each page are again structured into sub-categories.
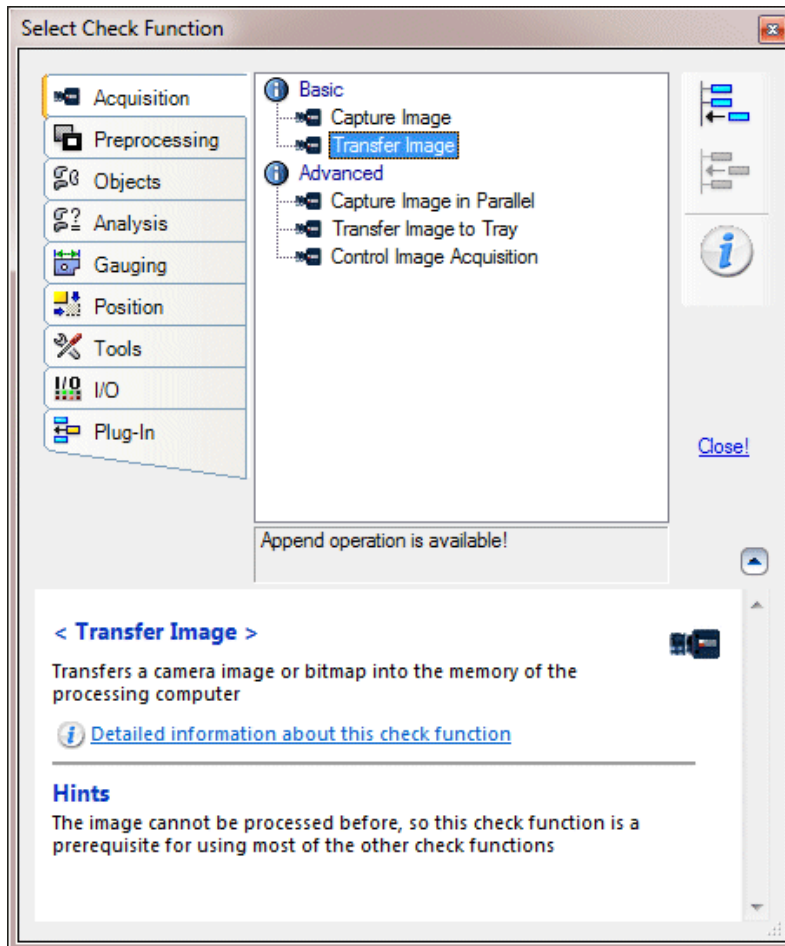
Select check function **Transfer image** from the sub-category **Basic**. To add this check function to your check, please click on the icon depicted. You may now close the **Select Check Function** dialog or keep it open to add further check functions later on.

Your check will now look like this:
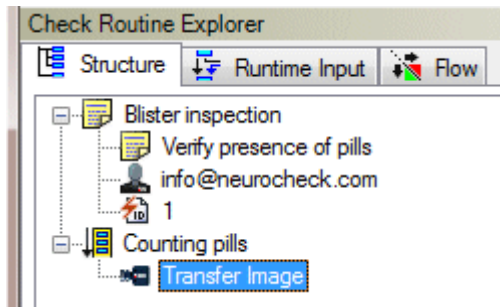
4.3.2 Setting Parameters

Now you have to tell NeuroCheck what image to use. This means you have to set parameters for check function **Transfer image**.

To open the parameter dialog of this check function you can use one of the following methods:

1. If the check function is selected as in the above image, you can choose **Parameters** from the **Check Function** menu or click the depicted icon in the toolbar or in the result view.

2. The second method is to click the name of the check function with the right mouse button and choose **Parameters** from the context menu.

3. The third method is a double click on the check function name in the check routine tree view.

4.3.3 Parameters for Image Transfer

For the check function **Transfer image**, the following dialog box will open, except that it does not display an image yet:
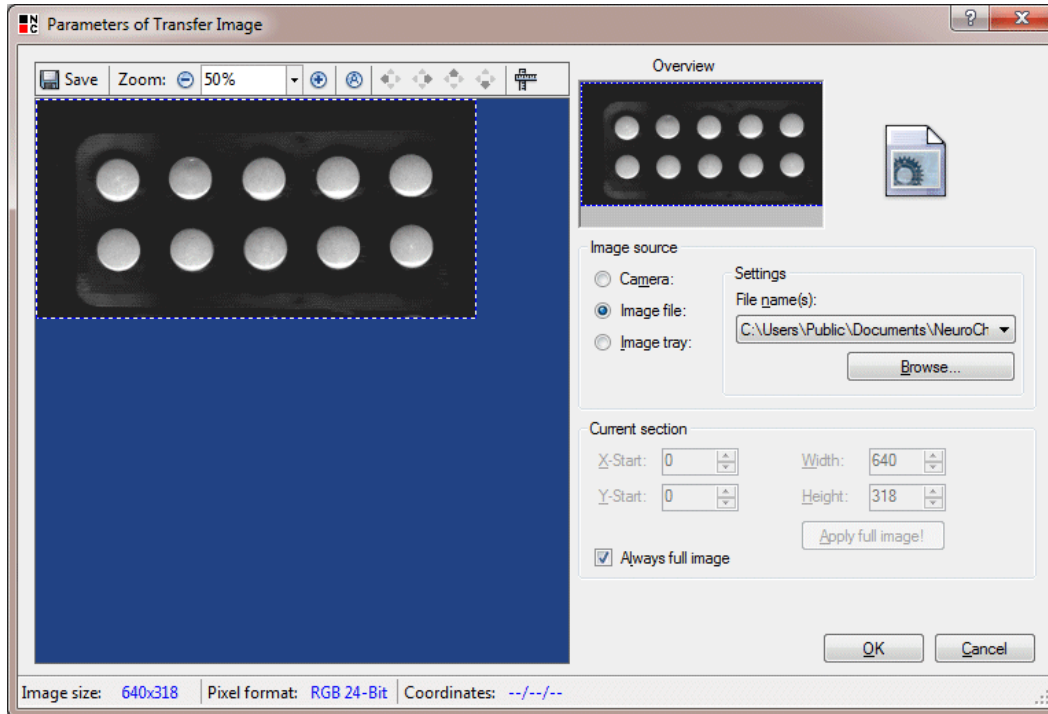
Please select the **Image file** option in the **Image source** group first. Then use the **Browse...** button to select the file TUTORIAL.BMP from the CHECK ROUTINES ▶ IMAGES directory within the preset project directory. Confirm your selection with **Open**.

Check function **Transfer image** offers the possibility to only transfer a section of the image. The default setting, though, is **Always full image**. Please keep this settings and leave the parameter dialog of the check function with **OK**.

4.3.4 Executing the Image Transfer

You can run the check routine up to this point by selecting check function **Transfer image** in the tree view with a mouse click and choosing **Execute** from the **Check Function** menu or clicking the depicted icon. You can also click the check function name in the check routine tree view with the right mouse button and choose **Execute** from the context menu.

NeuroCheck then executes the check routine up to this point and displays the result in the right window pane, i.e. the section loaded from the image. The NeuroCheck window now should look approximately as in the following image:
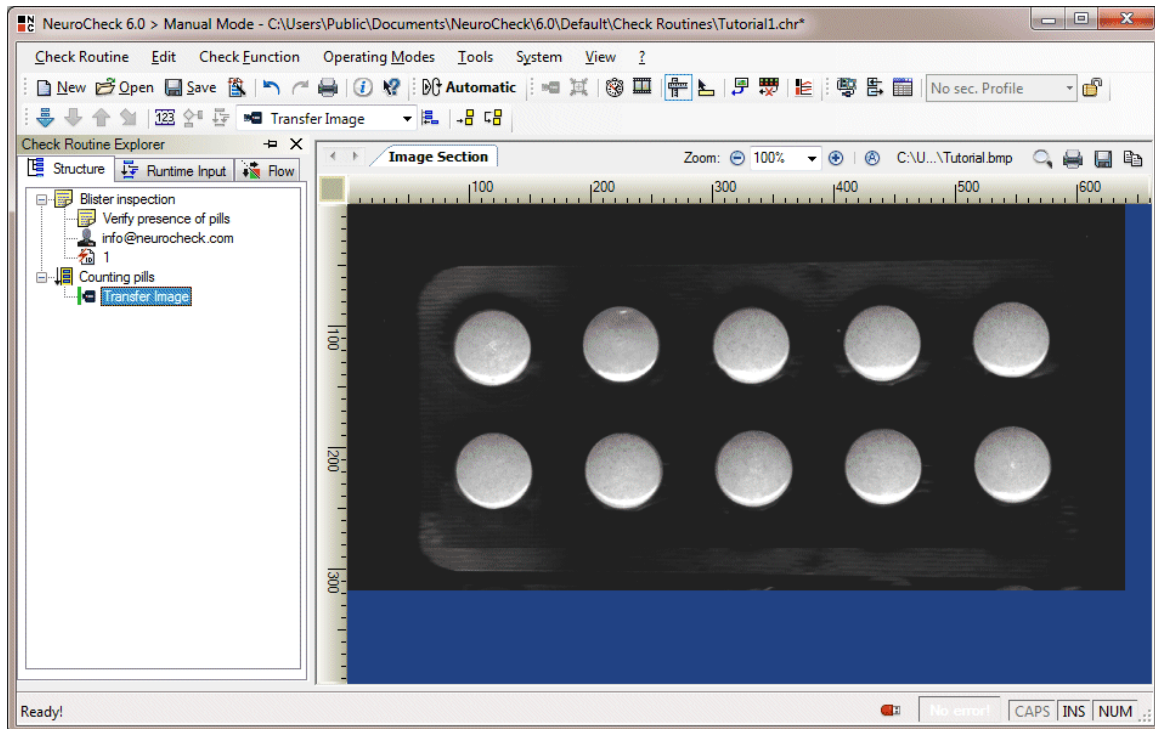
Now you should save the check routine again by choosing **Save** from the **Check Routine** menu or the depicted icon. The check routine is saved under the previously assigned file name. The menu command **Check Routine ▶ Save As…** allows you to save the check routine under a new file name.

4.4 Regions of Interest

The pills are objects within the image. All check functions dealing with objects belong to the check function category **Objects**, marked with the icon shown here. The check functions for object evaluation require a region of interest to work with. Therefore, we have to set a region of interest now. Proceed as before to open the **Select Check Function** dialog. This time, select the **Objects** page in the dialog.

4.4.1 Unavailable check functions

You will notice that a lot of check functions on this page are marked with the red icon shown here. These check functions cannot be appended or inserted into the check at that point. If you select such a check function, the red status field of the dialog box will show an explanation as to why the check function cannot be used at the moment. Here the reason is that all these check functions require at least one region of interest to be defined in the input data object.
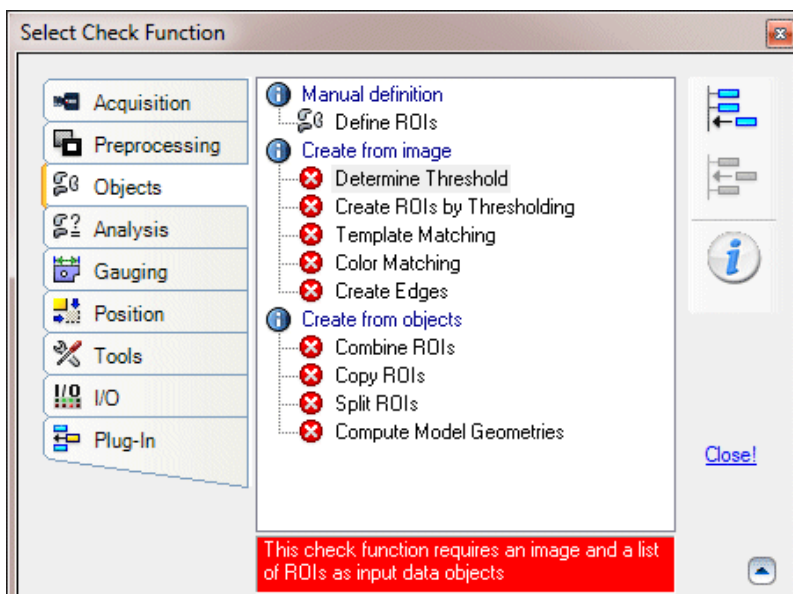

The only check function currently available from the **Objects** category is check function **Define ROIs** from the sub category **Manual definition**. It requires an image as input data object, and the preceding check function **Transfer Image** provides such an image. Append the check function **Define ROIs** it to your check routine.

4.4.2 Define Region of Interest

Check function **Define ROIs** is one of the most important check functions within NeuroCheck. You will need it often to define regions of interest for further analysis.

We will simply search the whole image for the pills. This means that the region of interest will comprise the entire image. Open the parameter dialog of check function **Define ROIs** and select the **Rectangle** mode in the center of the dialog.

In the graphics panel on the left, draw a rectangle by dragging the mouse with the left mouse button pressed. Then click the rectangle with the right mouse button and choose **Full image** from the context menu. The region of interest will then cover the entire image section read into memory. Leave the parameter dialog of the check function with **OK**.
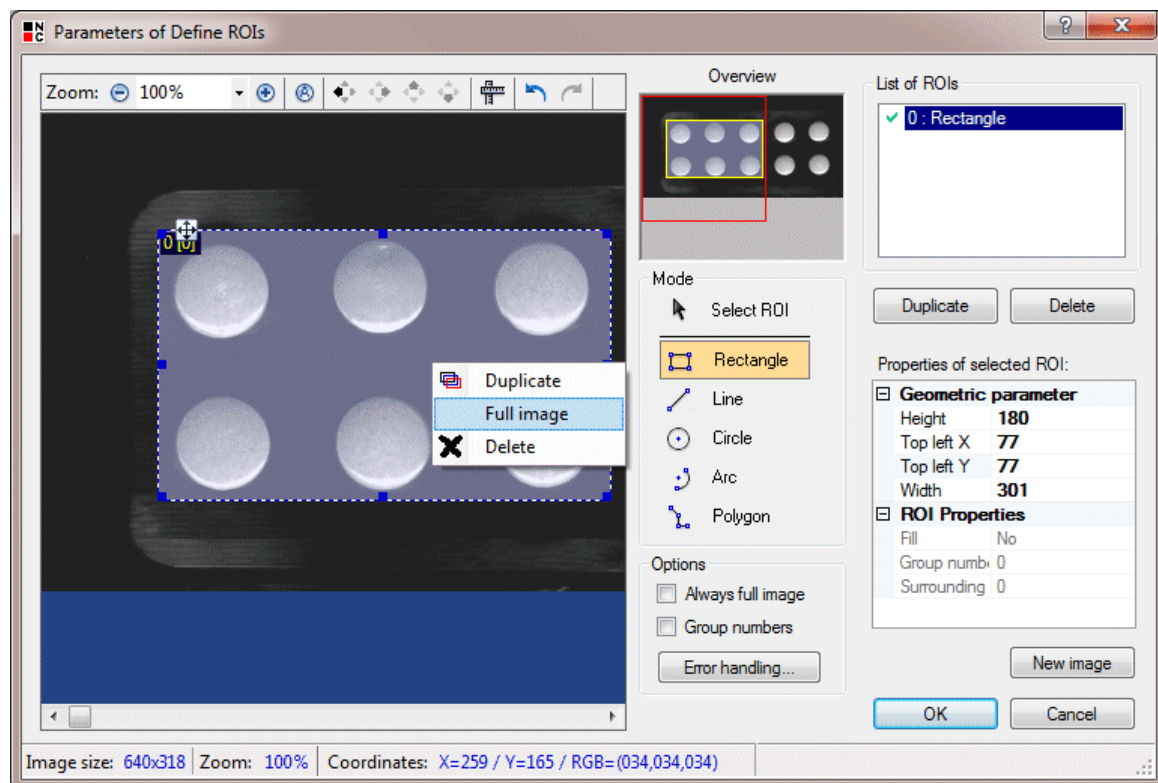
4.5 Thresholding

The pills contrast well with the background. Therefore, a simple thresholding operation will suffice to isolate the objects in the image. First a threshold has to be computed to separate light from dark image sections. This is the task of check function **Determine threshold**. Append this check function to the check. You will find it on the same page as check function **Define ROIs** , but in sub category **Create from image**.

Executing the check function removes all gray shades from the image, leaving only black and white areas.

Display Options

The right window pane of the NeuroCheck manual mode of operation is called **Result View**. You can divide it vertically into two display areas. To do so, move the mouse to the upper edge of the window pane **Result View**. Now, drag the grey frame line downward, holding down the left mouse button. You will see a histogram of the image in the upper pane, the thresholded black and white image in the lower display area.

But check function **Determine threshold** offers even more display options. There are several control elements on the top border of each pane, from which you can select the display option to be presented in the corresponding image pane and the zoom level. Click the **Input image** tab above the upper pane.

For both display areas, select an identical zoom factor so that both images can be seen completely within each display area, for instance, choose a zoom level of 50%. Now the NeuroCheck window should look like that shown in the following image, allowing you to compare the original gray level image to the thresholded **Binary image**.
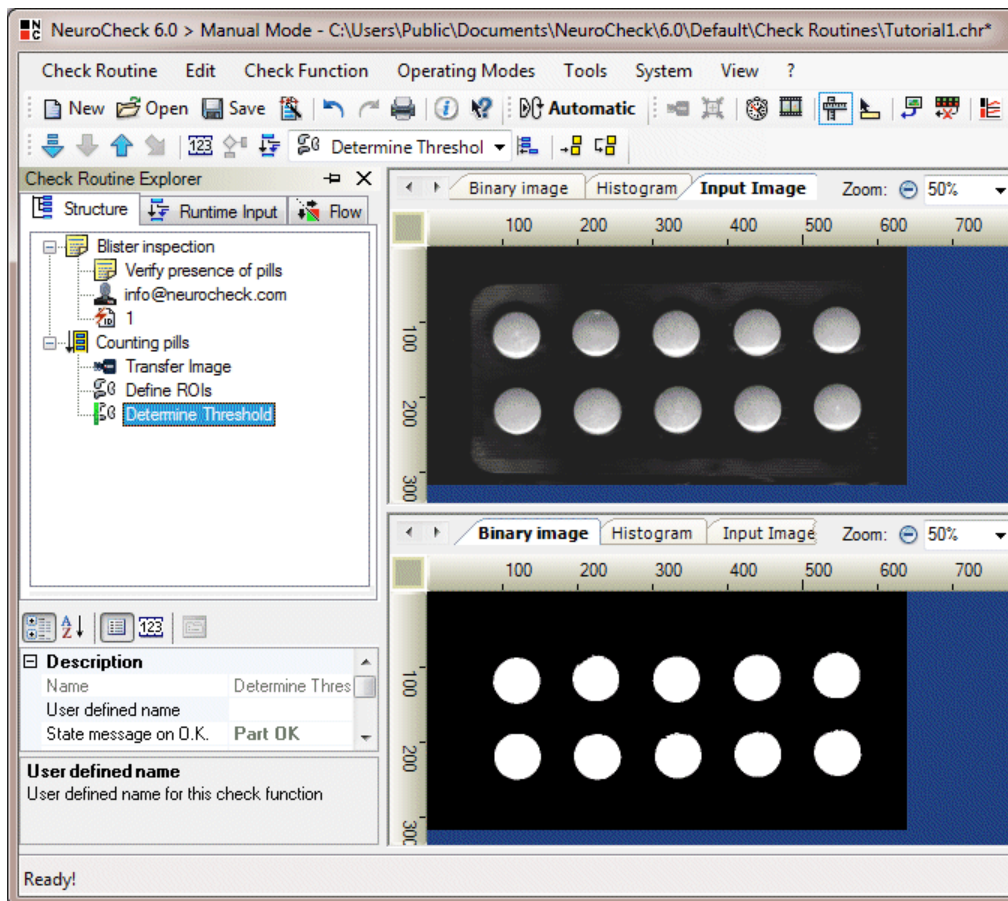
The background of the NeuroCheck result window pane can be configured. To do so, choose **Software Settings** from the **System** menu. In the **Software Settings** dialog, go to the page **General ▶ Colors and Styles** and select your preferred color for the gray level image background in the **Image background** category.

4.6 Searching for the Pills

The pills are clearly separated from the background in the thresholded image. We can now isolate them as objects from the image scene. Append check function **Create ROIs by Thresholding** to your check routine. Again, you will find this check function on the **Objects** page of the **Select Check Function** dialog.

In the parameter dialog of **Create ROIs by Thresholding** set the options as in the following image in order to find all bright objects. Switch the setting of **Object Color** to **Light** in the center of the dialog box.
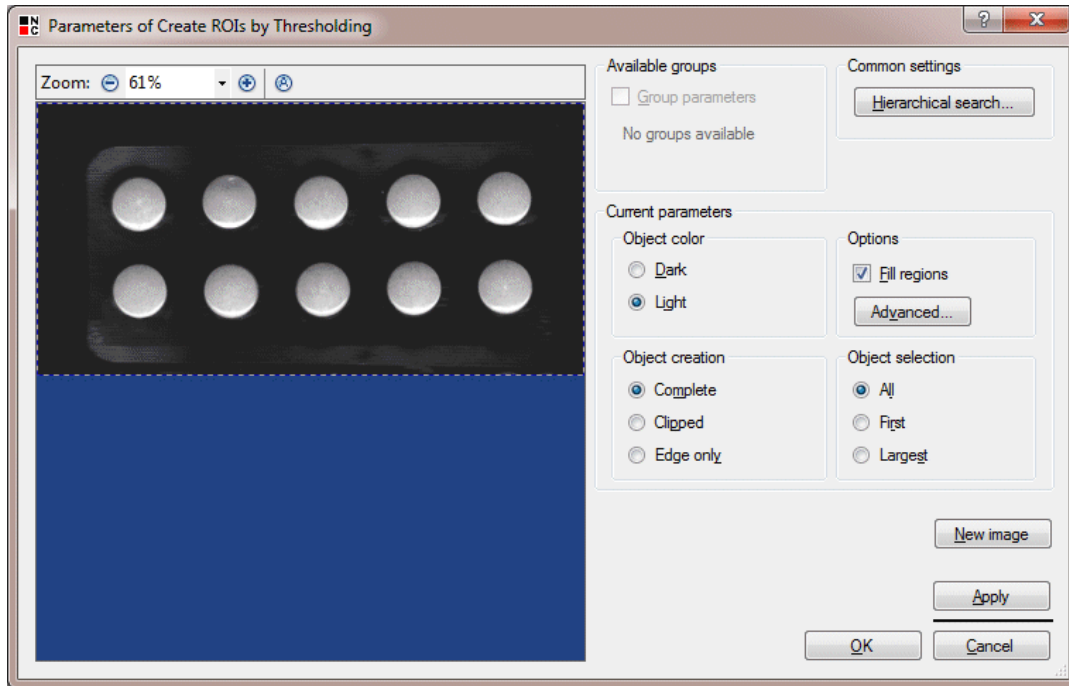
Running the check routine up to this point separates all ten pills as individual objects from the background. Now their number has to be checked to complete the solution of this inspection task.

4.7 Checking the Number of Pills

Append check function **Count ROIs** to the check routine. You will find this check function on the **Analysis** page of the **Select Check Function** dialog box. Since this check function can be used to verify the compliance of an existing object configuration with prescribed values, it has a target value dialog instead of a parameter dialog (though there are check functions having both).

Open the **target value** dialog by double-clicking the check function or by clicking the icon on the left or by choosing **Target Values** from the **Check Function** menu or the context menu.

Please check that the **Verify target values** option is activated (the check function can be used simply to count objects without deciding whether the number is correct or not). Enter "10" for the minimum as well as for the maximum value, because there have to be exactly ten pills present.
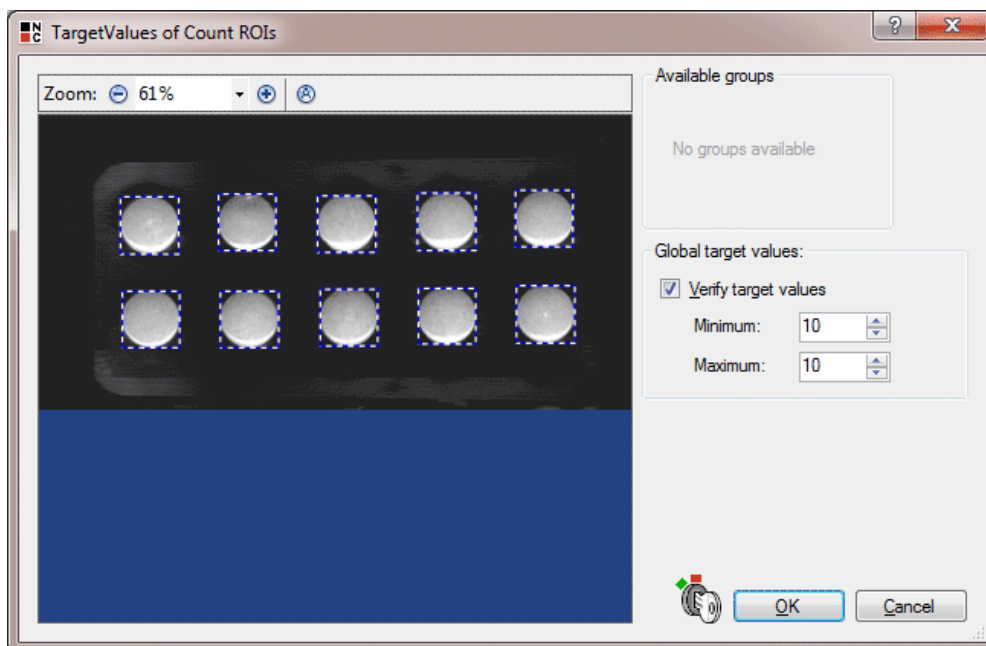
Close the target value dialog with **OK** and execute the check routine. NeuroCheck informs you that the work piece is OK since it contains the required number of objects. The screen shot below shows the default display appearing automatically, if the right window pane was horizontally divided as described in section "Thresholding".
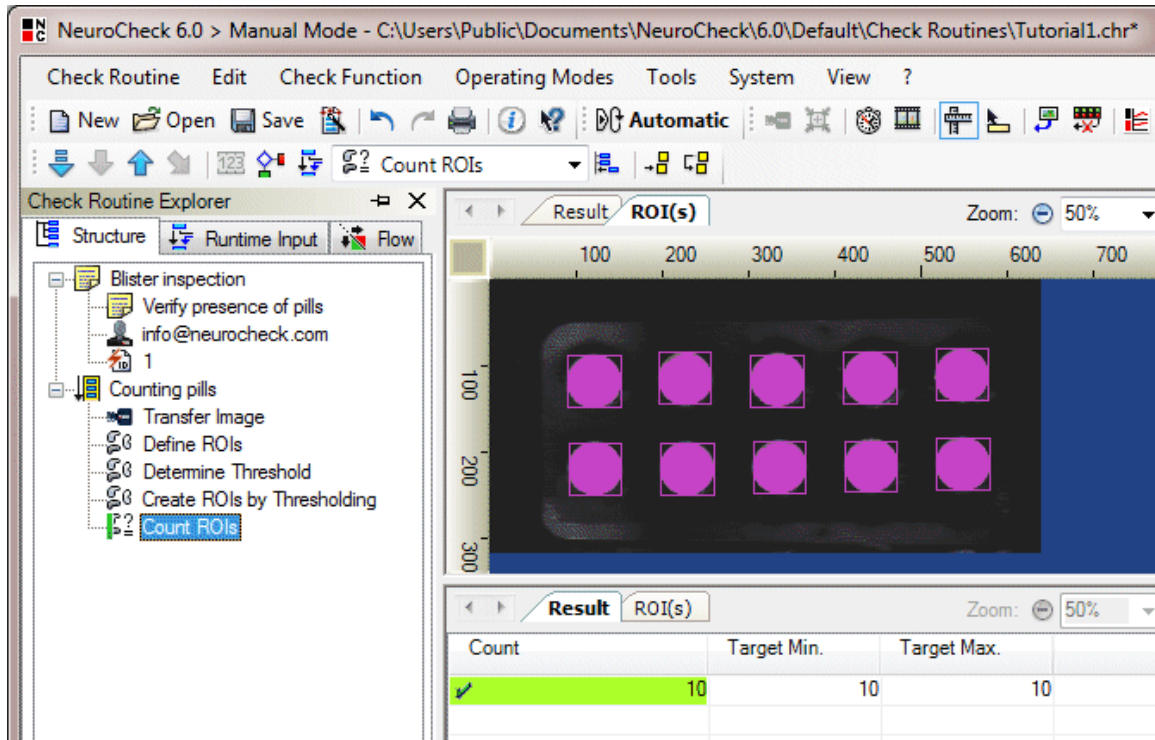
With this final step the inspection task has been solved. Again, you should save the check routine.

What did we achieve?

- You now have a first impression of working with check routines in NeuroCheck's manual mode.
- You have seen some of the most important NeuroCheck check functions.
- You have successfully implemented your first NeuroCheck visual inspection task.

4.8 Automatic Execution

Immediately after saving the completed check routine you can run it in automatic mode.

4.8.1 Automatic Mode Screen

To switch the operating mode from **Manual Mode** to **Automatic Mode** please choose **Automatic** from the **Operating Modes** menu or click the depicted icon in the tool bar.

NeuroCheck switches to Automatic Mode and displays two windows: The Control Panel window and the Process View window.

The Control Panel

You will see a label with the text "Control Panel" in the upper right corner in one of these windows. The Control Panel is the NeuroCheck main window in Automatic Mode, giving the operator the possibility to interact with the system. Furthermore, it displays important information about the system's state and what it is doing.
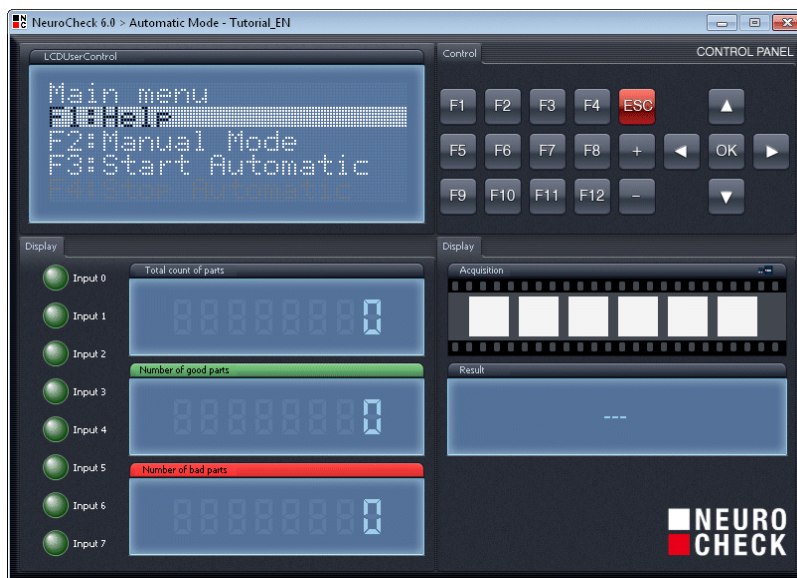
The Process View

The second window is hidden behind the Control Panel at first start. Bring it to the front by clicking on it with the mouse. You will see a label with the text "Process View" in it. This Process View contains a detailed visualization of the check routine results for the current test piece. In contrast to the Control Panel, the Process View display typically is specific for each check routine, because it depends on the check functions available in the check routine and their respective result displays.

The appearance of the NeuroCheck screen in automatic mode is highly configurable by using built-in graphical-interactive designer tools: The **Control Panel Designer** and the **Process View Designer**. They allow for instance to individually optimize a Process View for a specific check routine and vision system.

4.8.2 Triggering Check Routine execution

Starting Automatic Mode

Arrange the windows in a way that you can comfortably see both, and bring the Control Panel window to the front. NeuroCheck is in Automatic Mode, but it is not ready yet because it still is in the state "stopped". To start Automatic Mode with the automated signal polling, press either the **F3** key, the button with the designation **F3** or double-click on the text **F3: Start Automatic** in the **Control Panel Menu**.

In NeuroCheck's standard configuration, you will receive a warning message about image transfer from file. For a vision system in an automated environment, it would be fatal to evaluate images from a file instead of the real camera images. In this case it is OK to load the images from file. Please click on the **No** button because you do not want to cancel starting the Automatic Mode.

Executing the check routine

In NeuroCheck's standard configuration, an internal timer generates the start signal automatically once per second. The check routine and the checks it contains are executed automatically. The contents of both windows are updated regularly, and a counter displays the number of executions performed. Because the image is transferred from a file, the result is always the same: "Part OK".
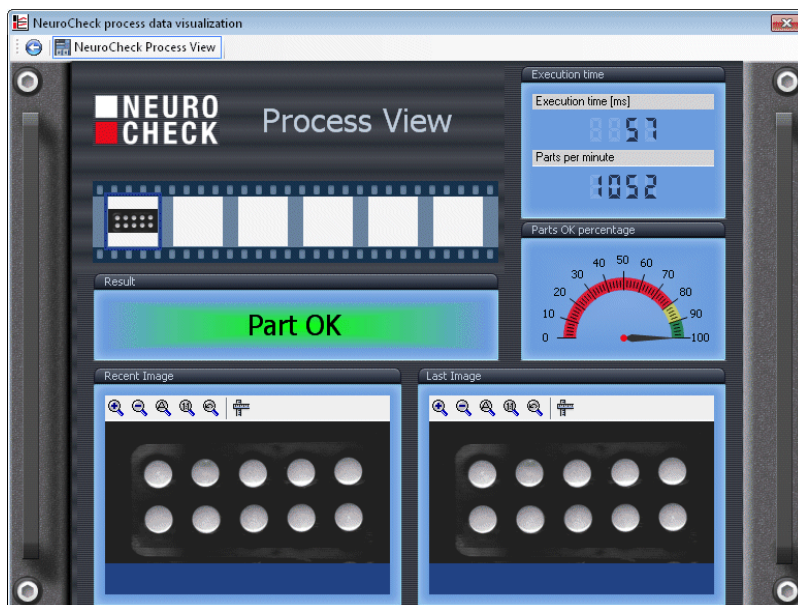
In a real-world production line inspection system, check routine execution in automatic mode will typically be started by an external signal from a PLC or master computer. The signal will for instance be transferred via digital inputs or Ethernet. General configuration options for external control and communication are set by choosing **Remote Control** from the **System** menu in Manual Mode.

Nevertheless, the simulated start signal trigger gives you an impression of how the automatic operation would look.

4.8.3 End Automatic Mode

Stopping Automatic Mode

To be able to switch from Automatic Mode to Manual Mode, the Automatic Mode needs to be stopped. To stop automatic execution please bring the Control Panel window to the front. Press either the **F4** key, the button with the designation **F4** or double-click on the text **F4: Stop Automatic** in the **Control Panel Menu**.

NeuroCheck will switch to state "Automatic stopped". Now it does not react upon the start signal any more.

Switching back to Manual Mode

Please note that the availability of most **Control Panel Menu** commands depends on the state of Automatic Mode (started or stopped). The command for switching to Manual Mode is now available again. To do so, please press either the **F2** key, the button with the designation **F2** or double-click on the text **F2: Manual Mode** in the **Control Panel Menu**.

> Use NeuroCheck's **Control Panel Menu Editor** to define the commands that will be available in Automatic Mode, and which functions keys these commands are assigned to.

The simple, direct switching between the development environment (Manual Mode) and runtime environment (Automatic Mode) is extremely useful while developing an inspection solution and makes it possible to adjust it quickly and in real-time to varying conditions.

4.9 From here

Now you have a first impression of how to work with NeuroCheck to solve visual inspection tasks.

Within the scale of this **Getting Started** manual it is not possible to describe the broad range of functionality of the NeuroCheck software. To get a deeper understanding of the structure and handling of the software and an overview of its capabilities, you should work through the **Training Course** manual or book a training course at your local NeuroCheck support office.