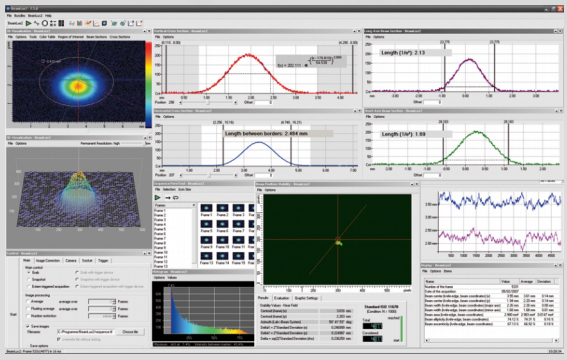
metrolux

ML1310

Beam Diagnostic System

- **Installation Guide**
- **User Guide**
- **Reference Manual**



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beamscan II

Please carefully read this manual prior to any usage of the product. Make sure to understand and follow any included notes and instructions to avoid injury.

Validity

This manual describes the following devices in their initial configuration:

Product no.: ML1310
Description: beamscan II

Manufacturer

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Safekeeping and Completeness

This manual must be accessible for authorized personnel.

Parts or Chapters of this manual may not be removed at any time. Missing pages or parts of this manual must be replaced immediately.

Contents of this manual were developed with great care. The manufacturer does not take any liability for damages that were caused due to error, inexactness or incompleteness of this manual.

Change management

This documentation is not subject to any kind of update service. Changes in this documentation can be carried out by Metrolux without any further announcement.

Table of Content

1 Introduction

The beamscan II software is designed for scanning and analyzing projected laser lines. Beside the analysis of scanned imaging data beamscan II can address stepper motor controllers and trigger generators. It can be controlled remotely via TCP/IP connection and the integrated Metrolux XML protocol (see also XML Reference Manual). The modular design of beamscan II makes it possible to control several analog or digital image sensors and integrate specific evaluation modules, depending on the individual needs.

1.1 How to Use This Manual

This manual gives a quick insight in handling the software program.

If the software package has not been delivered together with a measurement computer first read the chapter **2 Installation and Start-up.**

In chapter **3 First Steps** some step-by-step instructions of simple measurement operations are explained to get familiar with the modes of operation of beamscan II.

Chapter **4 Reference Manual** includes a detailed description of the control elements. The fundamental elements are referenced in section **4.2 Tool Elements**.

In chapter **5 Trouble Shooting** simple advice for user analysis and elimination of software malfunctions is provided. For advanced questions about beamscan II the Metrolux service team is available.

1.2 Safety Instructions

The following safety instruction must be followed in addition to your national laws and regulations on accident prevention.

Existing laws and regulations on accident prevention must be followed in any case.

1.2.1 Symbols

Danger!

This symbol highlights mechanical crushing hazards.

Danger!

This symbol highlights laser radiation related health risks.

Prohibition!

This symbol points out a prohibition in order to prevent damage to material, device or environment.

Disposal!

This symbol indicates notes concerning of parts and packing.

Note!

This symbol indicates important advice.

1.3 General Notes

Handling in the area of a laser must be performed by skilled personnel (licensed specialist). Before performing any activity personnel must be familiar with this manual and national laws and regulations on accident prevention.

- When working in the area of a laser always make sure to wear personal protective equipment (PPE) such as laser safety goggles and protective gloves.
- Make sure that the laser beam outlet has been shut before working in the beam area.
- Always avoid diffusing beams while adjusting any optical elements.

The product's full functionality is guaranteed only for designated usage. Designated usage is defined by this manual.

The Metrolux cameras can be operated at max. 50µJ/cm² or 50µW/cm² without additional attenuator (see also camera date sheet).

Make sure that the laser beam is sufficiently attenuated before illuminating the camera with the laser beam.

2 Installation and Start-up

2.1 System Requirements

The following table shows the minimum requirements of a computer for a practical use of the software:

Component	Minimum Requirement
Processor	Pentium 4 – 2.0 GHz (multiple core processors are recommended)
Memory	min. 512 MB (>1024 MB or more are recommended)
Mass Storage	ca. 50 MB for the software + additional capacity to store evaluation results
Graphic	graphics adapter with 24 bit/pixel – mode recommended for optimum performance **Remark**: For manageable operating a screen resolution of at least 1280 x 1024 pixels is recommended.
Camera-Interface	Firewire, USB, GigE or Framegrabber – depending on the used camera **Remark**: Cameras with FireWire connection delivered by Metrolux come with a FireWire controller card, so that the PC must have a free PCI Slot.
Periphery-Interfaces	• USB-Port for the Dongle • (optional) USB-Port for the Laser Synchron Device • (optional) RS232, USB-Port or Bluetooth for the motor controller • (optional) TCP/IP for the Remote-Control-Module
Operating System	Windows 2000 / Windows XP / Windows Vista / Windows 7 (actual service packs; 32 and 64bit) Linux in preparation

2.2 Copy Protection

The software is copy protected by a hardware key delivered as USB dongle. In the unlikely event that the hardware key becomes defective, Metrolux will exchange the defective key with a replacement key. However, it is the customers responsibility to protect the hardware key as any asset of comparable value. Metrolux is not responsible for lost or stolen keys.

2.3 Installing the Software

The beamscan II software shipment includes an USB dongle, which contains information about the purchased license. The software package can neither be installed nor started if this dongle is not connected to the PC.

While the software is starting it searches for cameras connected to the system. Therefore install and connect any cameras that shall be used with the software before starting the software.

To install the device drivers of the cameras and other devices included in the delivery please also follow the included corresponding device manuals.

2.3.1 Dongle Installation

First install the device drivers of the included USB dongle before connecting this dongle to your PC.

1. To install the drivers of the dongle start the setup program (corresponding to the used operating system) which is located on the Metrolux installation CD at **CD:\HardwareSetup\Dongle\CbSetup.**
2. Follow the instructions of the installation dialog.
3. After this setup has finished, connect the USB dongle marked with a four digit number to your PC. A red LED at the lower side of the dongle will indicate its operating mode.

2.3.2 beamscan II Installation

After successfully installing the dongle and connecting it to the system, install the beamscan II software package as well.

1. To install the beamscan II software package start the beamscan II installer located at the root directory of the Metrolux installation CD.
2. Follow the instructions of the installation dialog.
3. Optionally a Viewer Installer (beamscan II without camera control) as well as a Viewer dongle (marked with a V) can be present. This may then be installed in the same way e.g. on a separate PC. The simultaneous operation of two or more dongles on one PC is impossible!

To obtain an assured long-term stability of measurements by using newer operating systems since Windows Vista together with beamscan II, it is strongly recommended to select the classical desktop theme (Control Panel – Personalization/Change the theme – Windows Classic).

2.3.3 beamscan II Networking

The beamscan II software can use several different network connections depending on its license conditions. All advanced licenses have the possibility to be remotely controlled via a TCP/IP socket connection to transfer XML commands. In addition if a camera with Ethernet interface is connected to beamscan II not only TCP/IP sockets but also UDP connections are needed.

If a firewall is active in the operating system and your software needs network connection make sure to set the correct rules.

- The XML socket connection needs a free TCP transfer on the local network
- The camera interface needs a TCP connection as well as an UDP connection on the ports 12220, 12221 ... (depending on the number of cameras per network interface)

The following exemplary description shows how to configure the Windows 7 internal firewall so that remote control and camera interface are operating as they should. Individual security settings can not be discussed here in detail. Metrolux does not assume any liability for incorrect security settings of the underlying operating system or the connected network.

After a correct installation and at the first start-up of the beamscan II software Windows 7 shows the dialog seen in Figure 2.1.

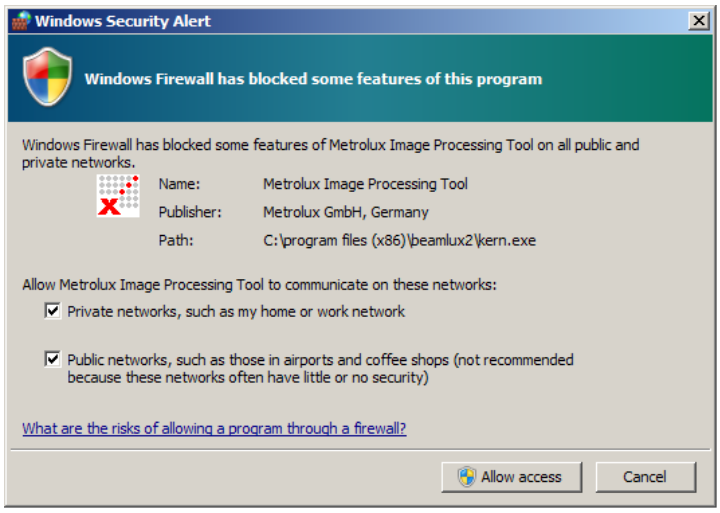


Figure 2.1: Windows Security Alert

For allowing an XML remote controlling select the first option to enable the local networks communication. Ethernet cameras are normally connected directly to a systems' network interface and so are identified as an unknown (or public) network. To get access to such cameras enable the public networks communication as well.

For trouble shooting it is recommended to temporarily switch off the used firewall and then perhaps restart the complete system to see if any connecting errors are gone.

To check the actual Windows 7 firewall settings or even if the first dialog was missed find the firewalls' advanced security settings dialog and search at the inbound rules for the **Metrolux Image Processing Tool** as

shown in Figure 2.2. If these rules are set to block any communication call the properties dialog to each of the rules and correct it as shown below.

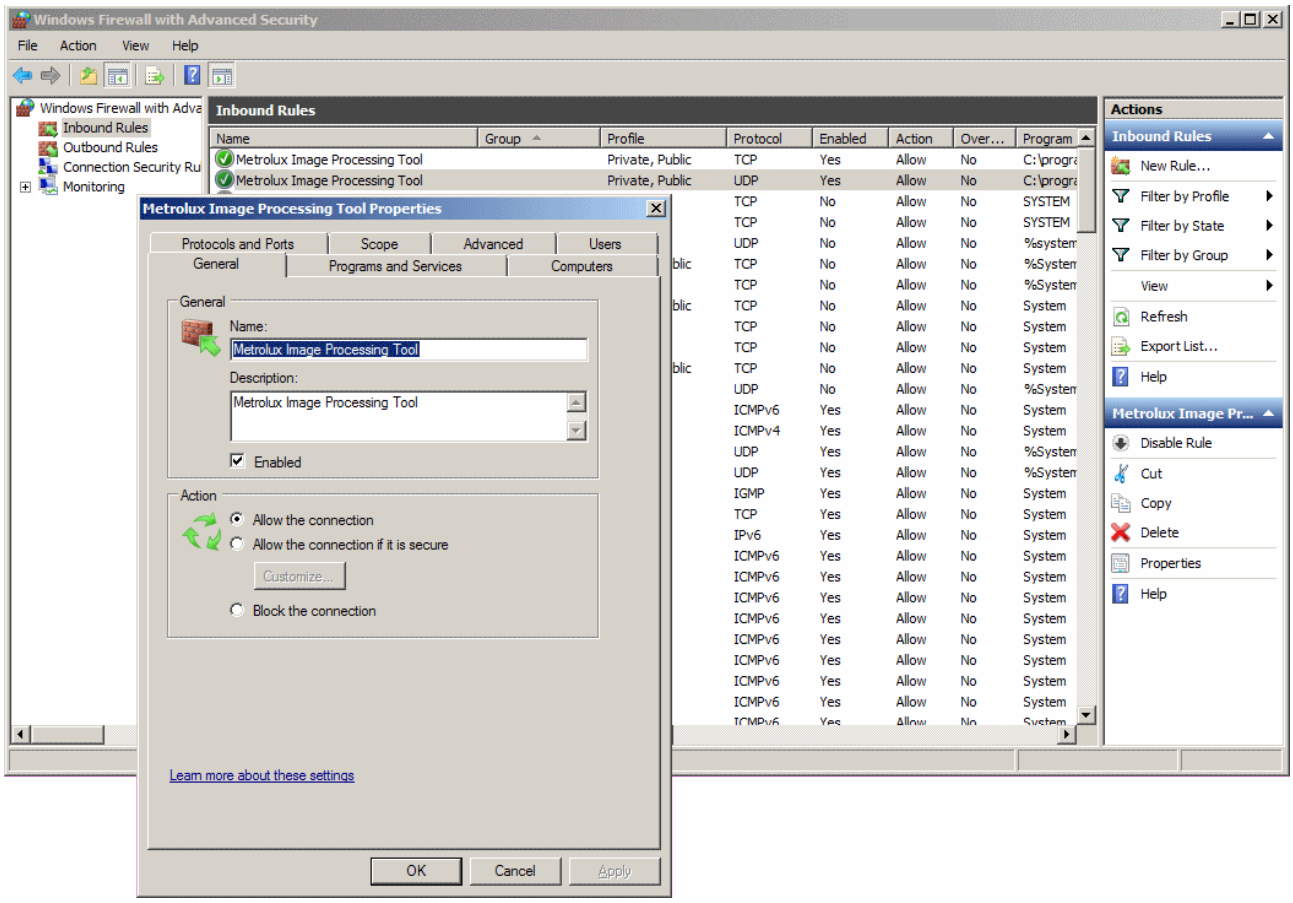


Figure 2.2: Advanced Security Dialog of the Windows 7 Firewall

2.3.4 Windows Vista / 7 On-Screen Display

- Completely disables ClearType and removes Segoe UI from the Windows interface.
- Supports Windows Vista and Windows 7

Since Windows Vista the default user interface (UI) font Segoe UI is optimized for ClearType technique which looks rather bad on older or cheaper monitors. Even if ClearTyp is completely disabled to avoid colorful characters where they should be black the Segoe UI font itself still looks not really acceptable.

Unfortunately there is no option to change the font on certain parts of the user interface by the Windows setting dialogs.

To improve this condition a friendly person (named Eric G.) worked out a tweak called **Windows Aero (Tahoma Font)** which can be downloaded for free in several internet forums(*). (A detailed read-me can be found there as well.)

Windows Aero (Tahoma Font) replaces all instances of Segoe UI with Tahoma, the default UI font in Windows 2000 and Windows XP. This tweak is available as final installer and as archive containing all the files required to manually implement **Windows Aero (Tahoma Font)** on the local operating system. The manual installation is presented for those who wish to use **Windows Aero (Tahoma Font)** in addition to the original copy of Windows Aero. It is addressed to advanced users only. The installer, however, replaces the original aero.msstyles file and is easy to use.

1. To install the **Windows Aero (Tahoma Font)** tweak start the installer located on the Metrolux installation CD at **CD:\Tools\Desktop\Windows Aero (Tahoma Font).exe**.
2. Follow the instructions of the installation dialog.

- The installer can be run again to add/remove components. However, please use the Uninstaller to remove all components.
- The installer must temporarily switch your Windows theme in order to install **Windows Aero (Tahoma Font)**. Sometimes, due to timing issues, the installer fails to automatically switch you back to your originally selected theme after restarting. If this happens, simply manually switch themes.
- The "Disable ClearType" component only affects the administrator account whose credentials are used to run the installer. ClearType must be manually disabled/enabled on all other accounts.

(*)http://www.sevenforums.com/customization/77125-windows-aero-tahoma-font.html

3 First Steps

The following sections give a short description how to perform a measurement. Detailed descriptions of the program elements are found in chapter 4 - Reference Manual.

There are two different acquisition modes of the beamscan II software: simple frame acquisition and scanning procedure. These two modes are toggled **only** by activating the **Scan** tab of the **Control** tool.

Do not press the **Start** button as long as the **Scan** tab is activated and you are not prepared for a scanning procedure.

3.1 How to Set up Beam Profiling

Follow these steps to adjust the camera settings:

1. Open the **2D-Visualization** tool from the beamscan II menu of the main window or press  in the tool bar.
2. Open the **Control** tool from the beamscan II menu or press  in the tool bar.
3. Choose the **Control** tool's **Camera** tab.
4. Choose as **Active camera** the type of camera you have installed on your system. A detailed description of the camera settings can be found in section 4.2.1.3.
5. Set the camera magnification factor (1.0 without camera lens).
6. Make sure that the Scan tab has not been activated and press the **Control** tool's **Start** button or press  in the tool bar.

The actual frame numbers are shown in the main window's status bar on the bottom.

7. Illuminate the camera with the laser beam to see the spot in the **2D View**.

- Do not illuminate the camera's sensor with higher energy than the damage threshold of the camera device.
- Make sure that the beam is sufficiently attenuated before activating the laser.

8. Align the laser beam to the center of the camera sensor.
9. Activate the **Cross Section Tool** in the **Tools** menu of the **2D-Visualization** tool.
10. If the plots are not already displayed in the **2D-Visualization** window activate this feature in the **Cross Section Tool** menu with the item **Show Plot in 2D.**
11. Activate **Center of Gravity** in the **Cross Section Tool** menu to get the sections positioned to the spot's center.
12. When measuring a focused laser beam focus the laser to the camera plane. The smallest width of the profile in the section curves shows the best focus.
13. Adjust the camera's exposure time (lowest slider on the **Camera** tab) or choose **Auto-Exposure**.

- Choose a time setting so that the spot's maximum intensity is at about 80% of the camera's saturation.
- Add N/D filters in the beam path if necessary.

3.2 How to Trigger with the Laser Synchron Device (LSD)

If the measured laser is a pulsed laser a synchronous triggering of laser and camlux camera can be generated by a trigger device. Metrolux provides such trigger devices: the Laser Synchron Device (LSD) ML1610 or ML1630. An LSD can be controlled by the beamscan II software. The **Control** tool provides user controls to connect the LSD and to set its triggering parameters (see section 4.2.1.5).

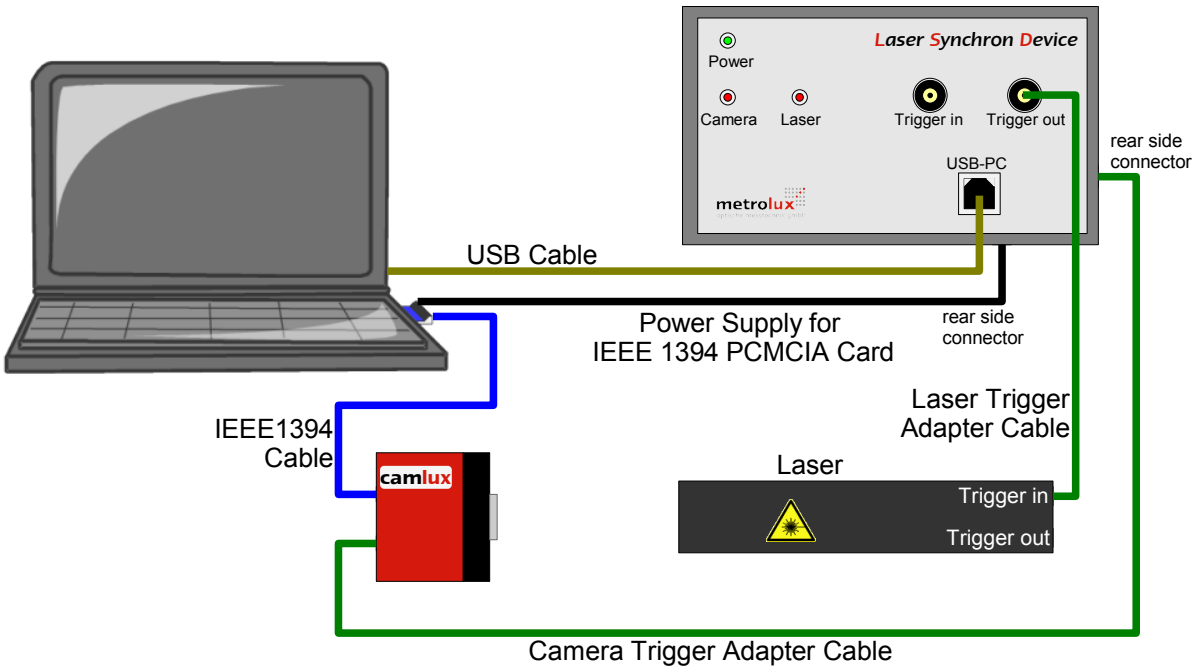


Figure 3.1: Triggering Setup with an LSD

In Figure 3.1 the measurement setup for triggering camera and laser with an LSD is shown.

An additional option of the LSD is to insert a time-delay between the incoming trigger pulses of a laser and the outgoing trigger pulse to the camera.

In Figure 3.2 the setup for the delayed triggering of the camera is shown. The laser sends the trigger pulse to the LSD which sends the pulse delayed to the camera.

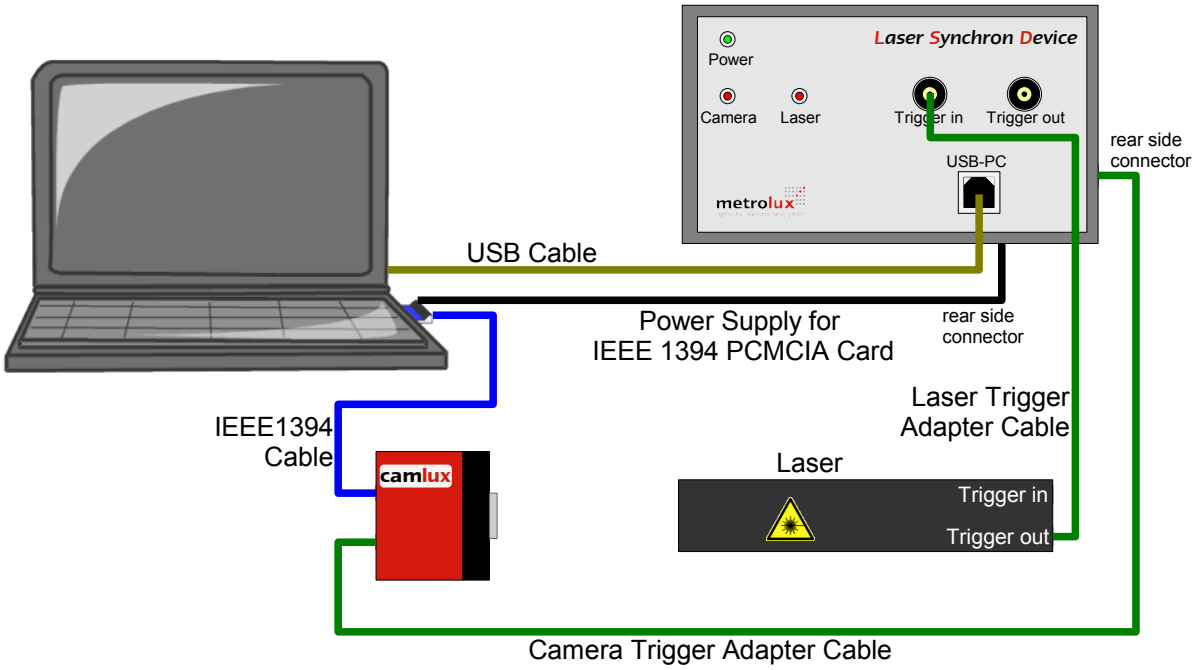


Figure 3.2: Triggering Setup Time-Delayed

Follow these steps to adjust the settings for external triggering:

1. Open the **Control** tool from the beamscan II menu of the main window or press  in the tool bar.
2. Choose the **Control** tool's **Scan** tab.
3. Click the **Configure** button in the **Trigger** frame.
4. If the trigger device is not yet connected enter the password and then enter the COM port to which the USB interface of the LSD is connected (see Windows Device Manager). Then press the **Connect** button to start the communication to the LSD.
5. On the **Trigger Device Options** dialog set the required parameters for the delay between the pulses for camera and laser as well as the pulse width.

Do not press the **Start** button at this time. As long as the **Scan** tab is active the **Start** button will start the complete scanning procedure.

6. Choose the **Control** tool's **Main** tab.
7. In the **Main control** frame select **Continuous (with LSD)** for continuously triggered frame grabbing or **Snapshot** for triggered single shots.
8. Set the **LSD frequency** to the desired trigger frequency.
9. To acquire Images press the **Start** button while the **Main** tab is active.

3.3 How to Set up the Background Correction

Follow these steps to correct any background signals not belongling to the laser beam:

1. Choose the **Control** tool's **Image Correction** tab.
2. Press the **Control** tool's **Stop** button or press  in the tool bar if the image acquisition had been started before.
3. Cover the laser beam (near the laser).
4. On the **Image Correction** tab in the **Background Subtraction – Settings** frame set a number of frames to be averaged and press the **Acquire** button.
5. Check the **Subtract background** checkbox.
6. Press the **Control** tool's **Start** button or press  in the tool bar.
7. Now the image should show a continuous black area. It can be helpful to check the **truncate negative values** checkbox as well to eliminate effects of negative values.
8. Uncover the laser beam. The image of the laser spot now should have a homogeneously background with zero counts.

3.4 How to Set up the Results Display

Follow these steps to configure the display of the evaluated results:

1. In the **Tools** menu of the **2D-Visualization** tool activate the **Region of interest**.
2. Resize and move the ROI-frame so that it encloses the laser spot and is about three times larger than the spot size in both directions or choose **Auto resize** from the **Region of interest** menu.
3. Open the **Display** tool from the beamscan II menu or press  in the tool bar.
4. Open the **Configure Items** dialog by selecting **Configure** from the **Items** menu.

5. Select the items to observe. To select for example the beam sizes do the following steps:
   1. In the item tree expand the **2D ROI**
      – **Beam dimensions**
      – **Beam coordinates**
      – **Moving knife-edge** (or Moving slit, or Second moment).
   2. Select **Width (major axis)** and **Width (minor axis)**.
   3. Choose (for each item separately) **scientific** and **Precision** = 3 in the **Format** frame on the right side.
   4. Enable the **Pass/Fail** option in the frame beneath and enter your own limits for each item.
   5. Close the **Configure Items** dialog.
   6. Open the **Configure Font** dialog from the **Items** menu and choose individual font attributes if needed and close it when ready.
6. Optionally you may open other tools like the Progression View or the **Section** tools and configure and position them as well.
7. Save the currently created beamscan II configuration by selecting **File – Save Configuration** from the main menu. The beamlux2.ini file is loaded at start-up. If a different file name is used it has to be reloaded manually.

4 Reference Manual

This chapter is designed as a reference for the control elements included in the beamscan II software. To this end the description of components and dialogs of the used operating system have been omitted. It is assumed that the user is familiar with the controls of the operating system.

The beamscan II software can be shipped in variable configurations depending on the correlated measurement setup. Considering this flexibility at first the basic elements are explained. Additional sections follow which describe the optional components. Some of the extensions may also be referenced in supplement documents which are only enclosed if relevant.

The following syntax is used for denotation of the different elements:

User Control:	active user control element
Menu Element:	active item of a menu list
Indicator:	passive element to display information
Group Label:	identifier of a group of elements or of menu items

4.1 Main Window

Upon start-up of the beamscan II working environment the console window appears with the log of the loaded modules. The top of the list shows the libraries of the available camera interfaces. A single camera interface module is able to serve several cameras of the same type. Among others also imaginary example cameras are loaded, which consist of a software module only and which synthetically generate images. This is for simulating any measurements for testing.

The console shows the number of detected cameras at the end of the camera block. If this number is smaller than the number of loaded camera interface modules, then possibly not all provided cameras are connected to the PC.

At the end of the start-up process the loading of the configuration file is reported. After this the program is ready for user interaction.

The most important elements of the main window are the menus, the tool bar and the status bar (see Figure 4.1).

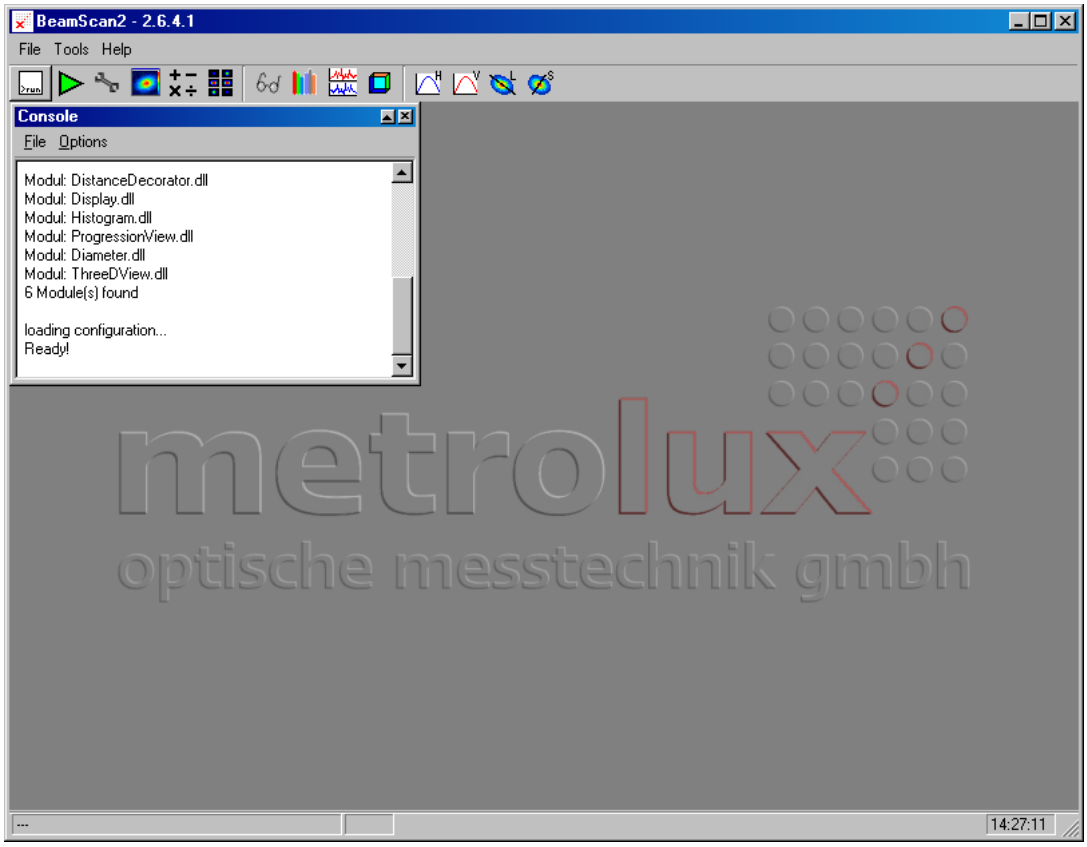


Figure 4.1: Main Window

File	
Console	opens the Console window
Script Interpreter	calls the script interpreter (see also Script Reference Manual)
Open Working Directory	opens the Windows Explorer at the current working directory
General Settings	dialog for global settings like the path of the working directory, fonts or time formats
Save Configuration	saves the current configuration to file including window positions and settings
Load Configuration	loads a previously saved configuration
Reload Configuration	reloads the configuration as it was at the start-up of the program
Reset Configuration	resets the configuration to the state of the installation, excluding the camera settings. These settings stay unchanged.
Screen Shot	saves the window content as a file in the format "bmp", "jpg" or "png"
Close	closes the program

Tools	
Control	controls all available measurement parameters (see section 4.2.1)
2D-Visualization	displays acquired or loaded frames (see section 4.2.2)
Arithmetic2D	combines or manipulates frames (see section 4.2.3)
Sequence View	composes or displays recorded frame sequences (see section 4.2.4)
Display	lists measurement results (see section 4.2.5)
Histogram	shows the intensity histogram (see section 4.2.6)
Beam Position Stability	measures the course of the beam position (see section 4.2.7)
Progression View	shows the progression of measurement results (see section 4.2.8)
3D-Visualization	displays the frame in 3D (see section 4.2.9)
Horizontal Cross Section	evaluates horizontal cross sections (see section 4.2.10)
Vertical Cross Section	evaluates vertical cross sections (see section 4.2.10)
Long Axis Section	evaluates long axis sections or at free orientation (see section 4.2.10)
Short Axis Section	evaluates sections perpendicular to the long axis (see sec. 4.2.10)

Help	
Info	general program information, like version and manufacturer address

The number of continuously grabbed frames is displayed in the status bar of the main window (Figure 4.2). The two numbers denote the consecutive number of acquired frames and (in parenthesis) the number of evaluated frames as well as the current time delay between two frames in milliseconds.

Figure 4.2: Status Bar

4.1.1 Console Window

The **Console** window contains important information about start-up and for trouble shooting. This window opens at start-up in the main window (see Figure 4.3). The top of the list shows all modules which are loaded depending on the installed license followed by the number of detected cameras which can be used to acquire frames. After the start-up is finished the **Console** can be configured to show further information and to create log files if requested. These logs can be found in a separate sub folder of the current working directory.

File	
Clear	Clears the window's content.
Close	Closes the window.

Options	
Show Info Message (blue) **Show Error Message (red)** **Show Debug Message (gray)** **Show XML Message (green)** **Show COM-port Message (magenta)**	These filters can be selected to show messages The selected filters are also valid for the logging into the log file (when activated).
Write Message to Log File	Enables or disables the writing of a log file into a sub folder called \.*logfiles* of the current working directory. A file name containing the current date as taken from the operating system is generated automatically.
Console Font	The font of the text displayed in the console window can be changed to any font installed in the operating system.

4.2 Tool Elements

The elements described in this section represent the operating equipment for the scanning procedures and analysis of laser lines.

4.2.1 Control Tool

The **Control** tool controls the processing of the image acquisition and the measurement procedure respectively. It also is required to configure the connected hardware components like cameras or actuating elements.

4.2.1.1 Control – Main Tab

On the **Main** tab all parameters can be set which directly control the process of the image acquisition.

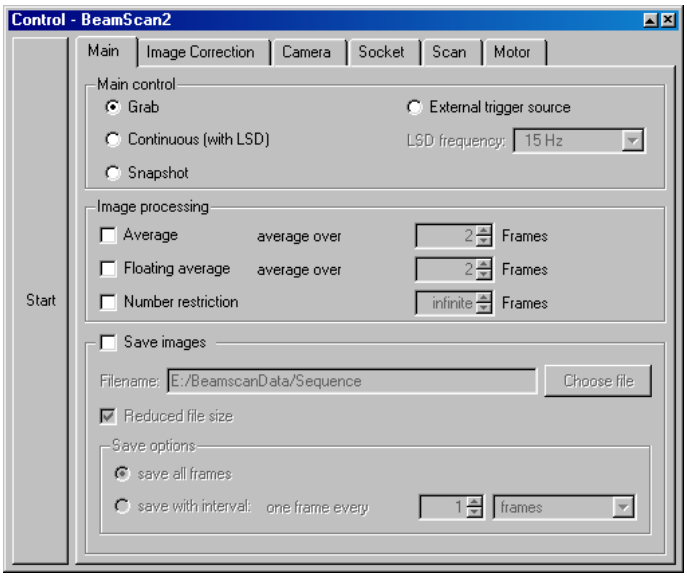


Figure 4.3: Control – Main

Start/Stop	starts and stops the image acquisition according to the parameters which are set on the **Main** tab.

The **Start/Stop** button of the **Control** tool and the  tool button either relate to the settings of the **Main** and the **Image Correction** tabs or, if the **Scan** tab is active, those settings of the **Scan** tab (see also section 4.2.1.5).

The scan tab mode of the Start/Stop function also activates the positioning unit.

Note that with starting the camera acquisition also the laser could be started depending on the settings made about trigger source.

So take the necessary precautions of operating the laser before starting the camera.

Note that in the case of activated scan tab also the positioning unit is started with starting the camera.

So take the necessary precautions of operating the positioning unit before starting the camera.

Main control	
Grab	continuous grabbing of frames, as many frames as possible are evaluated
External trigger source	continuous grabbing, the camera has to be started by an external trigger source (e.g. the laser)
Continuous (with LSD)	only if the LSD(*) is connected: continuously grabbing of frames triggered by the LSD
LSD Frequency	displays the frequency of the LSD(*) (set at the Scan tab) to trigger with
Snapshot	grabbing a single frame, the start button has to be pressed for each single frame and a trigger pulse must be initiated.

(*) LSD = Laser Synchron Device, Metrolux product ML1630 (digital)

The time between grabbing of frames and the number of grabbed frames is shown in the status bar of the main window (see Figure 4.2)

Image Processing	
Average	averaging frames: The grabbed images are continuously averaged and the result is always processed step by step. If the specified number of frames is reached, the sequence ends and the camera is stopped.
Floating average	continuous averaging of frames: The grabbed images are continuously averaged and the result is always processed step by step. If the specified number of frames is reached, the oldest frame is discarded while the last grabbed frame is added.
Numerical restriction	The acquisition stops after the preset number of frames has been grabbed.

Save Images	Activating the Acquisition of Sequences of Frames	
Filename	file name to save a sequence of frames. If the file already exists the file name gets a suffix which is a number in brackets, thus *name.tif* becomes *name(1).tif*. The number is increased as long as the file already exists. Files with more than 2 GB are automatically split and get the suffix "*_Part001*" with consecutive numbering.	
Reduced file size	To reduce the amount of disk space of the saved data particular for long sequences the data can be saved as pure integer values.	
Save Options	**save all Frames** **save with interval**	Frames are continuously embedded into the sequence or they are embedded only in steps of the defined interval (number or time).

When recording a sequence of frames the activated background corrections are applied before saving the data. Therefore no corrections are applied when reloading such a sequence.

4.2.1.2 Control – Image Correction Tab

The camera's raw data can show constant effects like a significant amount of background noise or an inhomogeneous sensitivity of the image sensor, which will distort the evaluation of the image signals.

These effects can be detected before the intrinsic measurements and then be eliminated from the imaging data during acquisition. The corrected imaging data are evaluated.

With the elements of the **Image Correction** tab it is possible to create or load correction matrices and dark images. The type of correction can be also chosen.

Ensure that the correct camera parameters for **Camera-ROI**, **Binning** and **Flip image** on the **Camera** tab are set ***before*** the correction data are created or loaded (see section 4.2.1.3).

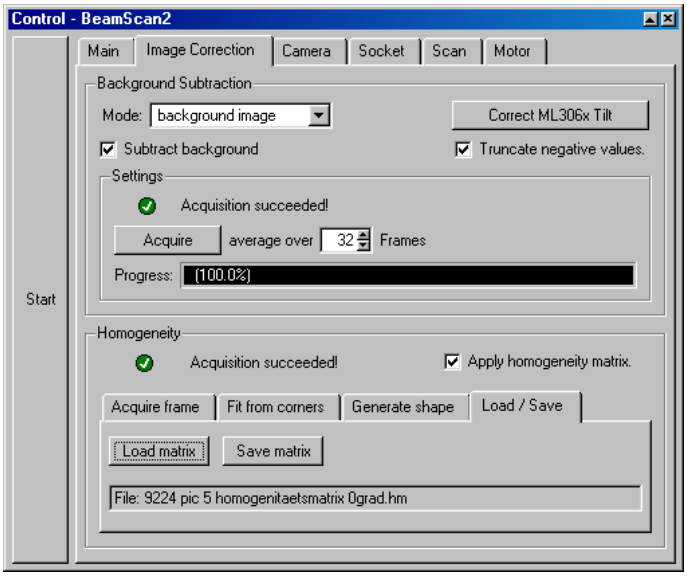


Figure 4.4: Control – Image Correction

Background Subtraction		
Mode	The following modes of correcting the dark image are available: **background image** grabbing a dark image with a blacked out camera **corners of the image** calculation of a constant dark value by averaging the corners of the current image **lines (anti smearing)** dynamic calculation of a dark image by averaging the columns at the upper and lower edges of the current image **constant / percentage** subtracting a constant absolute or relative level	
Correct ML3063 Tilt	This button calls a dialog for calibrating the tilt compensation of the Metrolux ML3063 Substrate measurement head. It is only active for cameras showing the ML3063 signature (see section 4.2.1.2.1 for details).	
Subtract background	A stored dark image or a dynamically calculated dark image is subtracted from the camera's raw data prior evaluation.	
Truncate negative values	Negative values caused by noise can be truncated to 0.	
Settings	Depending on the chosen mode this control element has different items.	
	background image	grabbing and averaging a defined number of frames with blacked out camera
	corners of the image	defining the size of the **span** of the considered triangular areas in the corners of the image. Optionally the areas can be displayed in the **2D View** by checking **show overlay.**
	lines (anti smearing)	defining the **span** as the number of considered lines at the upper and lower edge of the image. Optionally the areas can be displayed in the **2D View** by checking **show overlay.**
	constant / percentage	specification of the absolute or relative background signal

Sensitivity inhomogeneities of the camera sensor are normally corrected in the camera itself (thus before transferring the image data). But the measurement conditions, such as the optical ray path to the camera aperture, can induce additional variations of the intensity that then appear as inhomogeneities or vignetting in the image. These inhomogeneities can be reduced by the methods explained below. A homogeneity matrix is created and is multiplied with each new frame to correct the inhomogeneities if this function has been activated.

Homogeneity	
Apply homogeneity matrix	becomes active if a matrix is available. Then it can be decided if this matrix is multiplied with the image data or not.
Aquire	To acquire a homogeneity matrix image first the camera sensor has to be illuminated homogeneously. Ideally the intensity of the illumination should approximate that of the image signal that is to be measured later. To create the homogeneity matrix the acquired image is normalized such that the multiplication of the matrix and the original image results in a constant signal of the image's average intensity.

Homogeneity	
	For the image acquisition multiple images can be averaged.
Fit from Corners	The homogeneity matrix is calculated as linear plane. Therefore the slopes in horizontal and in vertical direction are calculated by a least square fit of the pixels lying inside the triangles which are spanned at the corners.
Generate	A section of a sphere or saddle surface is created. The curvature is specified as relative value of the difference between the center and the horizontal (vertical) edge of the image area.
Load / Save	Previously created correction matrices can be saved and reloaded at a later time.

4.2.1.2.1 Calibrating the Tilt Compensation

The optical system of the ML3063 detector leads to an apparent tilt of the intensity distribution. This apparent tilt can be compensated by multiplying the camera frame and a normalized correction plane. The parameters of this correction plane are obtained with the help of the dialog shown in Figure 4.5. A short "How to" with some important hints is shown in the upper text field.

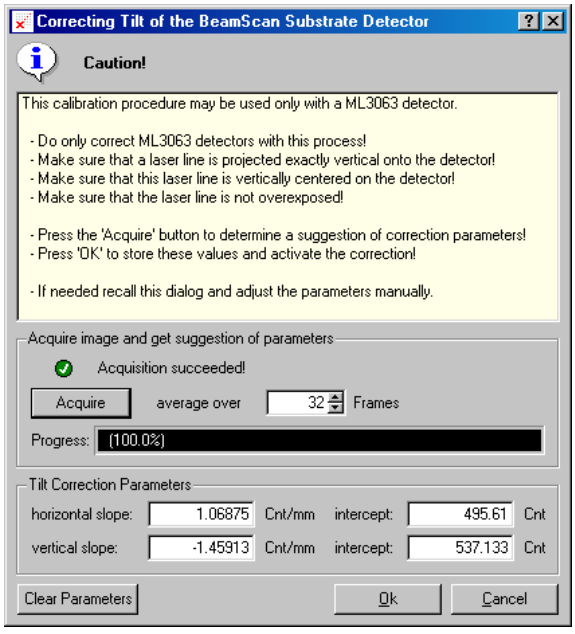


Figure 4.5: Calibration of Tilt Compensation

As soon as this dialog is called a running frame acquisition is stopped immediately.

Aquire image and get suggestion of parameters	
Aquire	Start an image acquisition averaging the given number of images. The resulting image is automatically searched for a laser line in the center. If a line is found the intensity of this line is fitted by horizontal and vertical straight lines through the center of gravity.
averaged over	number of averaged images
Progress	progression bar of the image acquisition

Tilt Correction Parameters	
horizontal slope	horizontal slope of the straight line fitted in the center of the laser line
intersection	horizontal intersection of the straight line fitted in the center of the laser line
vertical slope	vertical slope of the straight line fitted in the center of the laser line
intersection	vertical intersection of the straight line fitted in the center of the laser line

After acquiring an image the resulting line parameters of the fit are shown in the edit fields as first suggestion of a correction plane. The intersection of the correction plane is always the sum of the horizontal and vertical intersection values. If these parameters do not give a satisfying correction result the values can be changed manually. With the **Line Fit** function of the **Cross Section** tools (see section 4.2.10.1) the correction can be estimated.

Clear Parameters	set the parameters to neutral values so that no correction is done
OK	exit the dialog and apply the currently shown parameters
Cancel	cancel the dialog without applying the currently shown parameters

If new parameters have been applied they are considered not before the next acquired image.

4.2.1.3 Control – Camera Tab

On this tab a camera can be selected as active camera and its parameters can be set.

During the start-up phase of the software the console window lists all the installed camera interfaces followed by a line reporting the number of the cameras actually detected on the system (including the sample cameras).

The combo box lists the camera type notations of those cameras which are connected to the system and which have been identified by beamscan II. The number of these items corresponds to the number of cameras as it is reported in the Console window.

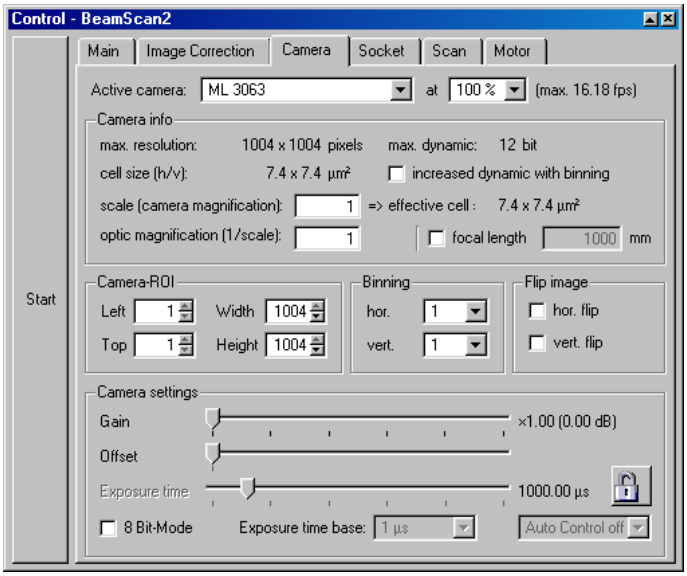


Figure 4.6: Control – Camera

Active Camera	This list contains all cameras which were found at start-up and can be selected as active camera. Simultaneously this label serves as button to call a dialog which allows to change the camera's name shown in the combo box. This permits to differentiate between cameras of the same type.
at	sets the maximum image refresh rate in four steps

If the active camera is changed during image acquisition an active acquisition sequence is automatically. stopped.

- At start-up in the console window all installed camera interfaces are logged. Afterward the number of cameras are connected to the system is logged.
- The functions explained below depend on the active camera type.

Camera Info	
max. resolution	number of pixels per row (horizontal) and per column (vertical)
max dynamic	maximal dynamic range at the selected binning
cell size (h/v)	horizontal and vertical dimension of a pixel
increase dynamic with binning	defines whether the intensity signal is normalized to the maximum bit depth (inactive) at the selected binning or if the full dynamic range is used.
scale	When using an additional objective with a magnification $v \neq 1$ the image plane is scaled. Also the effective pixel size depending on this magnification is displayed.
optics magnification	= 1 / **scale**
focal length	considering a far field lens in front of the camera with specified focal length, allows displaying of the camera coordinates in mrad.

Camera ROI	
left	left border of the Region Of Interest (ROI) directly defined in the camera's processor unit
width	width of the ROI
top	upper border of the ROI
height	height of the ROI

Binning	
hor.	combining this number of pixels in horizontal direction
vert.	combining this number pixels in vertical direction

- When using a camera ROI or binning greater than 1 the image data size is decreased before transferring the data. A smaller data size increases the maximum possible frame refresh rate.
- A binning grater than 1 moreover decreases the noise and thus increases the sensitivity of the camera sensor.

Flip image	
hor. flip	horizontal mirroring of the image
vert. flip	vertical mirroring of the image

Ensure that the correct camera parameters for **Camera ROI**, **Binning** and **Flip image** are set ***before*** the correction data are created or loaded on the **Image Correction** tab (see section 4.2.1.2).

Camera settings	
Gain	Gain of the camera's A/D converter. A gain greater than 1 increases the sensitivity but also increases the noise.(*)
Offset	Constant raising of the background level(*) (not available with all camera models).
Exposure Time	Exposure time (electronic shutter time of the camera). If the exposure time is set to a fixed value of 1 millisecond in beamscan II an additional button to unlock the disabled slider is placed on the right hand side.
8 Bit - Mode	For cameras having a higher dynamic range than 8 bit the range can be limited to 8 bit. This increases the frame refresh rate.
Exposure timebase	Logarithmic graded time base for the exposure time slider. With this adjustment exposure times between 1µs and 20min are possible. (The item 1µs – 1s is an additional option for exact selection of microsecond steps over the range of this interval.) This element is active only if the exposure time is enabled.
Auto Control	Automatic control the exposure time or the gain factor according to the last frame: **Auto Control off** auto control is inactive **Auto Exposure** auto exposure time **Auto Exp. ROI** auto exposure time correlating to the rectangle of the Region Of Interest (ROI, see section 4.2.2.1) **Auto Gain** auto gain factor **Auto Gain ROI** auto gain factor with respect to the ROI This element is active only if the exposure time is enabled.

(*) The sliders also can be varied in small steps by clicking left or right near the knob onto the slider control element.

- Gain and offset should be set in a way that the background signal of the blacked out camera is between 0 and 10 counts (for 8 bit cameras).
- Similarly any overexposure is to be avoided (intensity is truncated and set to the maximal possible intensity level of the camera).

4.2.1.4 Control – Socket Tab (optional)

The Metrolux software provides an access via a TCP/IP socket. At this tab the socket connection can be configured to act as a server or as a client.

For this socket connection an XML interface protocol is available which offers options such as data transfer of evaluation results or complete remote control of measurement processes via LAN network. The XML interface protocol description and the detailed description of the socket dialog may be found in the separate **XML-Interface** manual.

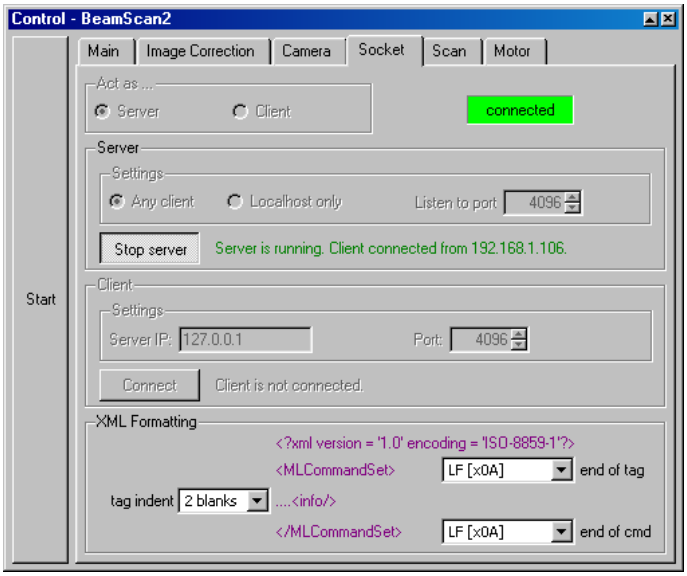


Figure 4.7: Control – Socket

4.2.1.5 Control – Scan Tab

The **Scan** tab contains all parameters which are necessary to control a scanning procedure to acquire a scanned frame of a laser line.

Start Scan / Stop Scan	starts and stops the image scan acquisition according to the parameters set on the **Scan** tab.

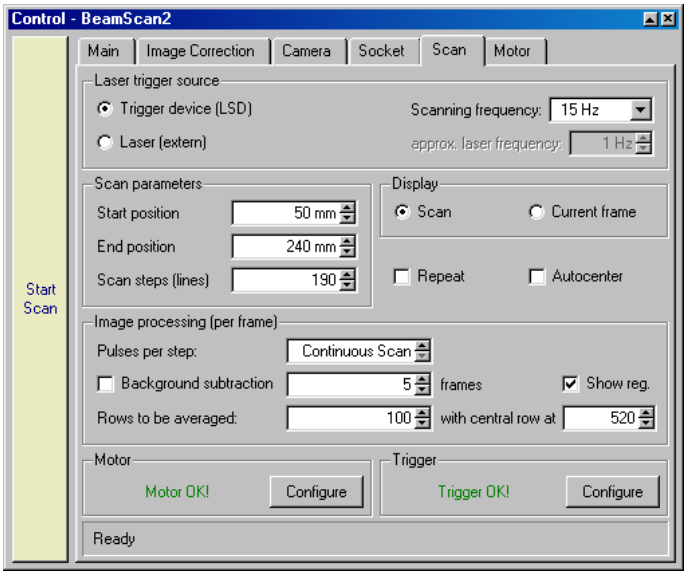


Figure 4.8: Control – Scan

The **Start/Stop** button of the **Control** tool and the  tool button either relate to the settings of the **Main** and the **Image Correction** tabs or, if the **Scan** tab is active, those settings of the **Scan** tab (see also sections 4.2.1.1 and 4.2.1.2).

To make clear which mode is currently active the button changes its background color to light yellow if the scanning mode is live.

Note that the scanning mode of the Start/Stop function also activates the positioning unit.

Note that with starting the camera acquisition also the laser could be started depending on the settings made about trigger source.

So take the necessary precautions of operating the laser before starting the camera.

Note that in the case of activated scan tab also the positioning unit is started with starting the camera.

So take the necessary precautions of operating the positioning unit before starting the camera.

Laser trigger source	
Trigger device (LSD) Laser (extern)	selecting the trigger source between the external option (could be a trigger generator or the laser) and the LSD(*) which is controlled by beamscan II
Scanning frequency	define the trigger frequency of the LSD(*)
approx. laser frequency	enter the approximated frequency of the external trigger source. This is required to synchronize the image acquisition with the prescribed frequency of the external trigger source.

(*) LSD = Laser Synchron Device, Metrolux product ML1630 (digital)

The user elements of the **Laser trigger source** frame are synchronized with the corresponding options of the **Main** tab so that these settings change as well.

Scan parameters	
Start position	start position of the scan in millimeters
End position	end position of the scan in millimeters
Scan steps (lines)	number of measurements between the limit positions, which is also the number of rows of the scan image

Display	
Scan Current frame	The frame which is displayed in the **2D View** window during the scanning procedure can be changed between the resulting scanned image as it grows and the currently acquired local frame.

Repeat	If active the procedure restarts scanning in the opposite direction when a limit position is reached. This is repeated until the scanning procedure is stopped.
Autocenter	The center of gravity of the single line images are horizontally centered in the frame before they are considered as row in the scan.

Image processing (per frame)	
Pulses per step	number of pulses to exposure a single scan step frame
Background subtraction	Specifies whether the frame background shall be corrected for the scan or not. If it is enabled a background image is acquired before the scan starts triggering the laser.
frames	number of frames to be averaged for a background image
Show reg.	Activates to display the region of averaged rows for a single scan line (scan region). A green rectangular is then shown in the 2D View whenever the individual camera frames are displayed but not in the resulting scan image.
Rows to be averaged	number of horizontal lines of the frame to be averaged for the resulting scan line at a single step, height of the scan region
with central row at	pixel position of the central row of the scan region

If the scan procedure runs with external triggering and a background image shall be obtained before scanning make sure that the external trigger source does not start triggering before the background image acquisition has been finished.

Motor	
status message	displays the current connection state to the motor controller device
Configure	calls a dialog to set the motor parameters (see section 4.2.1.5.1)

Trigger	
status message	displays the current connection state to the trigger device
Configure	calls a dialog to set the trigger parameters (see section 4.2.1.5.2)

4.2.1.5.1 Motor Controller Dialog

To operate stepper motor components (e.g. a positioning unit) by using a motor controller like the Metrolux Controllux ML8010, ML8011 or ML8020 a corresponding interface is provided.

The interface can be configured with the **Motor Controller Dialog** (see Figure 4.9). The motor device is operated automatically in the scan mode (see section) or manually at the **Motor** tab (see section 4.2.1.6).

This dialog is password protected.

If one or more motor controllers are connected to the system, their interface parameters are determined at the start-up of beamscan II from the Windows device manager and are provided for selection in the interface combo box.

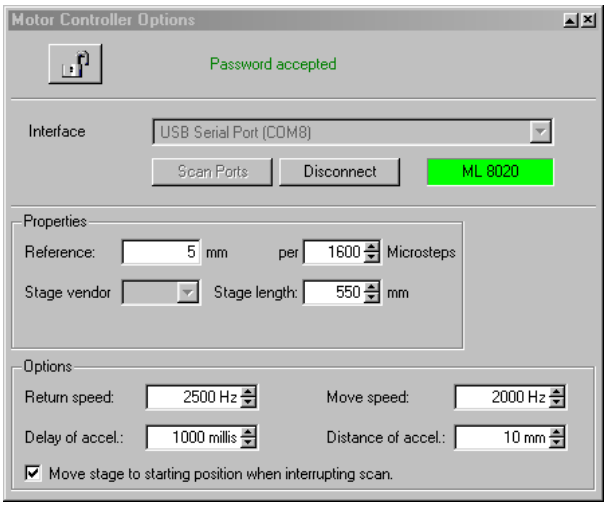


Figure 4.9: Motor Controller Options

If a device already had been connected before, this connection is resumed at the restart of beamscan II.

Interface	combo box with selection list of all available "COM-Connection" entries as shown in the Windows device manager.
Scan Ports	rereading the "COM-Connection" list e.g. after connection of a new device to the system while beamscan II is running.
Connect / Disconnect	connecting / disconnecting a device
ML 8020	displays the device name of a connected device in a green text label or the hint **not connected** in a yellow label.

- While reading the interface parameters beamscan II will test whether the connected device is a known motor controller or not. If a fitting device is detected, its interface entry is suggested at the top of the list.
- If a device is already connected, its interface entry does no longer appear in the selection list.
- If no fitting interface is available, the entry **No Port...** is displayed.

Properties	
Reference	setting the reference for length scale as **millimeters per microsteps**
Stage vendor	selecting the positioning unit's vendor to set the correct motor current
Stage length	complete traverse length

At the very first connection of a motor controller or if the device type has been changed, the reference parameters are read from the controller, are displayed and marked yellow and the connection is closed.
This is to let the user first check the new settings before they are applied with the next connection.

Motor #	Choosing the motor channel for properties and control, if the controller supports more than one channel, otherwise this element is invisible.

A change of reference parameters will not be considered before a reconnection of the controller, whereas a change of the speed setting will be taken into account directly.

Before activating any moving parts make sure that no person is in immediate vicinity of the moving parts:

Options	
Return speed	setting a higher speed to drive back to start position
Move speed	setting the move speed used to scan in step and repeat mode
Delay of acceleration	delay of the positioning unit's acceleration phase before the scanning procedure starts at constant velocity (see Appendix B Acceleration Delay)
Distance of acceleration	distance which the unit moves during the acceleration phase before the scanning procedure starts at constant velocity (see Appendix B Acceleration Delay)
Move stage to...	moves the positioning unit to the start position if the scan is stopped by the user

4.2.1.5.2 Trigger Configuration Dialog

A trigger device is used to synchronize and trigger the camera and light source, e.g. to define a delay time between trigger signals of different devices. This can be provided by the Metrolux Laser Synchron Device (LSD) ML1610 (analog cameras) or ML1630 (cameras with separate trigger input).

Installation and setup of an LSD is described in the manual of this device.

This dialog is password protected.

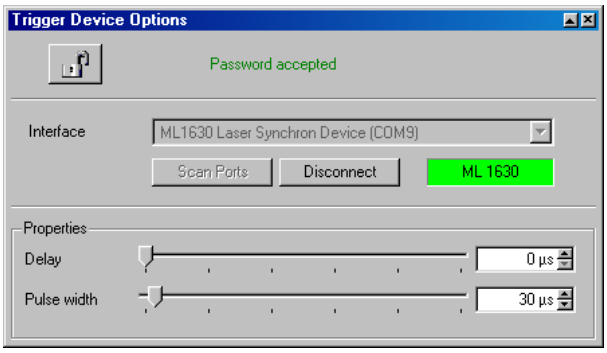


Figure 4.10: Trigger Device Options

If one or more LSDs are connected to the system, their interface parameters are determined at the start-up of beamscan II from the Windows device manager and are provided for selection in the interface combo box.

Any device connection that had been established in previous sessions will be resumed upon restart of beamscan II.

This dialog contains the pulse properties which should be changed by authorized persons only, while changing the trigger frequency can be done at the **Scan** tab (see section 4.2.1.5)

Interface	combo box with selection list of all available "COM-Connection" entries as shown in the Windows device manager.
Scan Ports	rereading the "COM-Connection" list e.g. after connection a new device to the system while beamscan II is running.
Connect / Disconnect	connecting / disconnecting a device
ML1630	displays the device name of a connected device in a green text label or the hint **not connected** in a yellow label.

- While reading the interface parameters beamscan II will test whether the connected device is an LSD or not. If a fitting device is detected, its interface entry is suggested at the top of the list.
- If a device is already connected, its interface entry does no longer appear in the selection list.
- If no fitting interface is available, the entry **No Port...** is displayed.

For software version 2.5.8.0 and newer it is possible to change the trigger parameters during a running image acquisition. Therefore the sequence breaks shortly to transfer the new settings.

Properties	
Delay	time delay between trigger pulses of laser and camera
PulseWidth	signal width of the generated trigger pulse

4.2.1.6 Control – Motor Tab

The standard operation of the positioning unit of scanning laser lines is controlled by the elements of the **Scan** tab. Beside this scanning operation it is possible to move the unit manually to any possible position with the help of the additional user controls of the **Motor** tab.

Before activating any moving parts make sure that no person is at close range of the moving parts:

If the motor control unit is not yet connected the **Motor Controller Dialog** as it is described in section 4.2.1.5.1 can be also called by pressing the **Configure** button of the **Motor** tab.

Interface	displays the used COM port address
Configure	calls the Motor Configuration Dialog which is described in section 4.2.1.5.1

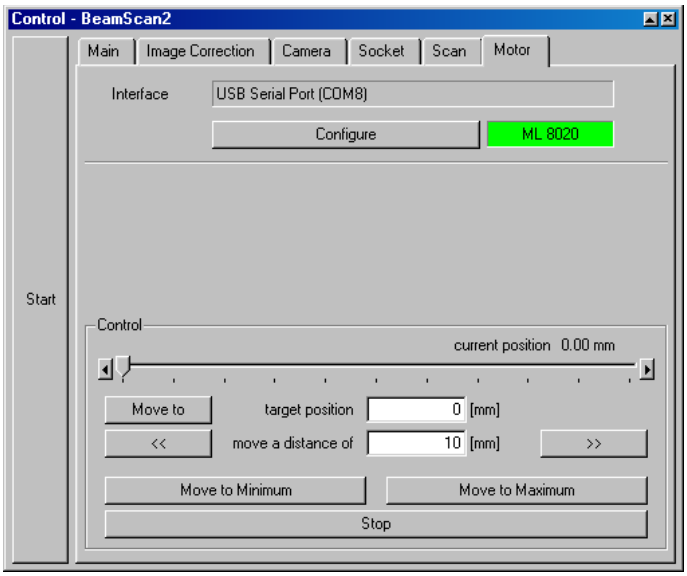


Figure 4.11: Control – Motor

Control	
current position	displays the current position dynamically
Position Slider	Manual setting of the motor's position within the movement range. After the slider has been changed the new position is approached and the slider is dynamically updated.
Move to	Moves to the entered target position. If the value is too large or too small the maximum or the minimum position is approached. The current position is displayed dynamically.
target position	sets the desired target position
<<	moves towards the minimum position by the entered step width
move a distance of	selection of step width which the unit is moved by clicking the arrow buttons of the corresponding direction
>>	moves towards the maximum position by the entered step width
Move to Minimum	moves to minimum position
Move to Maximum	moves to maximum position
Stop	stops the motor movement immediately

4.2.2 2D – Visualization

The **2D-Visualization** (or abbreviated **2D-View)** window performs the task of displaying the currently acquired image or a loaded image:

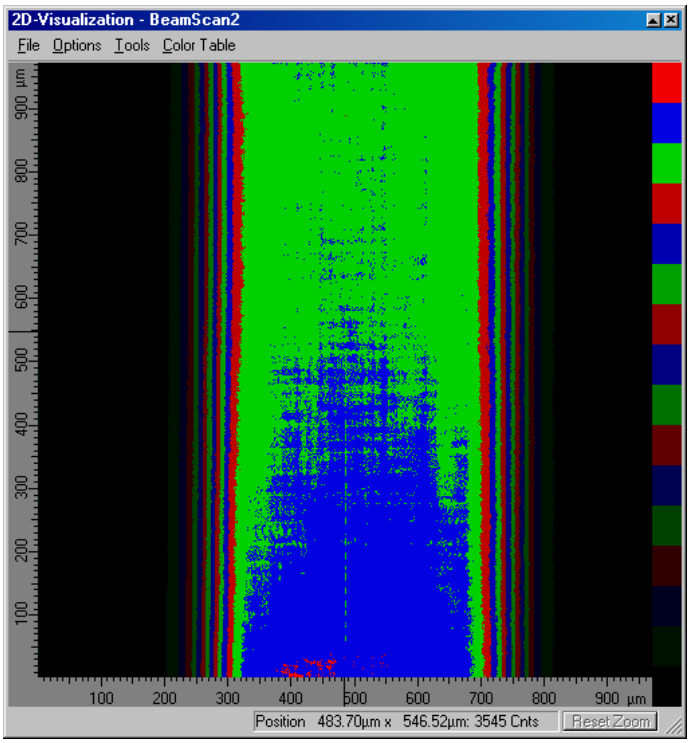


Figure 4.12: 2D - Visualization

In the scales on the left and bottom sides of the window the current mouse position in the frame is shown with markers. At the same time the marked mouse coordinates and the image intensity at the marked position are shown in the status bar at the bottom right side. The color scale which is used to display the different image intensities is shown at the right side of the window.

Inside the frame area a zoom region can be defined by pressing the right mouse button and moving the mouse. By releasing the button the marked region is displayed filling the frame area. The zoom region can be moved by pressing and holding the left mouse button. While the zoom is active a button for resetting the zoom is enabled on the bottom right. Further zoom regions can be defined inside the current zoom region. The zoom can be also reset by a menu item of the ***Options*** menu.

File	
Open Tiff Image	loads an image file of the type "tif", which contains additional Metrolux specific data
Save Image as	saves the displayed image data using the format "tif" (with additional Metrolux specific data) or as bitmap in the image format "bmp", "jpg" or "png" If any background or intensity corrections are active the corrected data are saved. If one of the bitmap formats ("bmp", "jpg" or "png") is chosen an additional dialog appears containing options to save the bitmap with rulers or selected color range as well.
Save Zoom Area as	saves the displayed image data as bitmap in the image format "bmp", "jpg" or "png" considering the actually set zoom region If any background or intensity corrections are active the corrected data are saved. An additional dialog appears containing options to save the bitmap with rulers or selected color range as well.
Save as CSV	saves the frame data as Comma Separated Values (CSV). A small dialog provides the option to change the separator or binning of pixels.
Export as CSV to Clipboard	copies the CSV data to the clipboard
Print	prints the displayed image
Close	closes the 2D-View window

Options	
Keep Aspect Ratio	keeps the aspect ratio when changing the size of the window
Square Pixels	shows square pixels independent on their real shape
Show / Hide File Info	shows or hides a window containing image information to an currently loaded image file
Original Size	displays exactly one image pixel per screen pixel for square pixels, for rectangular pixels in horizontal direction only
Minimum Size	displays the **2D-View** window with its smallest possible size
Physical Values **Pixel Values**	units of the scales in millimeters or in pixel numbers
Reset Zoom	resets all zoom activities
Step Back (Zoom)	resets a single zoom step

The following table lists the tools which can be activated to be displayed in the **2D-View** as well. For each activated tool an additional Menu is created. This tools show graphical elements within the frame (see Figure 4.13).

Tools	
Region of Interest	Region of Interest, ROI. If a ROI has been defined, only the area inside the ROI is used for image analysis (see below).
Diameter	Graphical display of the beam axes, the shape and size of the evaluated beam profile ellipse in the **2D View**. The method of the calculation can be defined in the **Diameter** Menu (see below).
Distance	measurement of the distance between two selected points in the image
Cross Section Tool	horizontal and vertical cross section through the image. The progression of the section can be shown at the left and the bottom sides of the image area (see below) as well as in separate tool windows.
Beam Section Tool	two sections perpendicular to each other whose orientation angle can be set manually. It can also be oriented on the two half-axes of the beam profile ellipse. The progression can be shown in separate tool windows only.

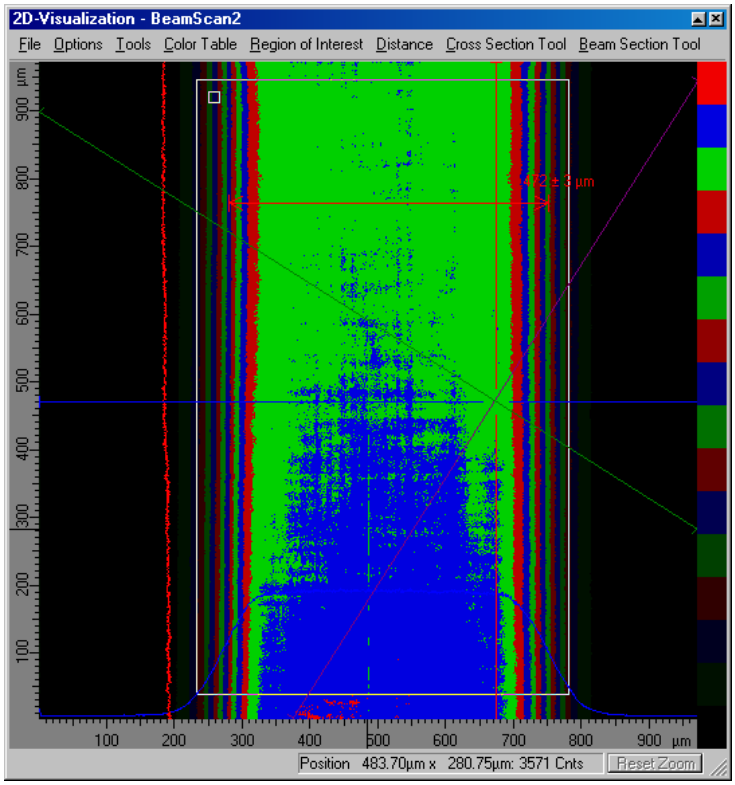


Figure 4.13: 2D-View with activated tools

Color Table		
Cool **Gold** **Hot** **Fire** **Prisma** **Smart**	several assignments of color palettes to the image intensities	
RGB	**RGB2** **RGB4** **RGB8** **RGB16**	the colors red, green and blue as alternating assignment per 2, 4, 8 or 16 intensity values of the image. The brightness of the colors varies with the image intensity values over the full range.
	RGB2 light **...** **RGB16 light**	see above, but the color brightness varies only between maximum and half maximum.
Linear	**Linear White** **Linear Red** **Linear Green** **Linear Blue**	typical gray scale image, further single color intensity variation in red, green or blue
Show Scale	shows a scale at the color bar with the choosen color palette. The scale shows counts. Also the intensity value at the current mouse position is shown in the status bar.	
Set Range	activates a tool bar to limit the color scaling. Intesities outside the given range are displayed in the corresponding margin colors as the scale colors are distributed lineary to the limited range.	

4.2.2.1 Tool Menus In 2D-View

Region of Interest	
Rectangle **Square** **Ellipse** **Circle**	defines the geometrical shape of the Region Of Interest
Manual	size and position of the ROI can be set manually using the mouse(*)
Centroid	ROI position automatically follows the signal's centroid, the size is set manually
Auto Resize	ROI position automatically follows the centroid, the size follows the spot's intensity geometry in the image
Show Size	displays the ROI area size in the upper left corner at the ROI position marker
Reset	Resets the ROI to default values: • **Manual**: the selected geometrical shape of the ROI is centered in the frame and adjusted to the aspect ratio of the frame. • **Centroid**: the selected geometrical shape of the ROI is only adjusted to the aspect ratio of the frame. • **Auto Resize**: no effect.
Quit	turns off the tool

(*) To change the position the mouse pointer has to be moved into the position marker (small rectangle, ROI frame color) in the upper right corner of the ROI. Then it can be shifted by pressing the left mouse button and moving the mouse.

The methods used in the **Diameter** tool are designed for the beam profiling of a laser spot. The used methods to evaluate the beam widths are equivalent to the measurement methods as they are described in the ISO/TR 11146-3 (2004) norm.

Diameter	
Second Moment	evaluates the beam diameter using the calculation of the second moments in the beam system (along the long and the short axis of the beam profile ellipse); 4σ-method
Knife-edge (Beam)	evaluates the beam diameter by positioning a (virtual) knife edge in a way that 84% and 16% of the beam intensity are detected (beam system)
Slit (Beam)	evaluates the beam diameter by positioning a (virtual) slit in a way that 13,5% of the maximum beam intensity are detected (beam system)
Second Moment (Lab)	evaluates the beam diameter using the calculation of the second moments in the lab system (camera coordinates)
Knife-edge (Lab)	evaluates the beam diameter by positioning a (virtual) knife edge in a way that 84% and 16% of the beam intensity are detected (lab system)
Slit (Lab)	evaluates the beam diameter by positioning a (virtual) slit in a way that 13,5% of the maximum beam intensity are detected (lab system)
Quit	turns off the tool

Distance	
Reset	resets the positions of the measurement line to default values in the upper left corner of the image
Quit	turns off the tool

Cross Section Tool	
Horizontal Cross Section... **Vertical Cross Section...**	calls separate windows to display and evaluate the cross sections (see also section 4.2.10)
Manual **Center of Gravity** **Maximum**	set the position manually The position automatically follows the signal's center of gravity. The position automatically follows the signal maximum.
Show Plot in 2D	displays the curve in the **2D-View** window
Reset	resets the positions to the center of the image
Quit	turns off the tool

Beam Section Tool	
Long Axis Section... **Short Axis Section...**	calls separate windows to display and evaluate the beam sections (see also section 4.2.10)
Manual **Follow Beam**	set the position and rotation angle manually The position automatically follows the center and the orientation of the long and short half-axes of the beam profile ellipse as it is evaluated in the **Diameter** tool.
Reset	resets the positions to the center of the image and along the camara coordinate axes
Quit	turns off the tool

4.2.3 Arithmetic2D Tool

This tool allows the execution of simple calculations with total frames as terms.

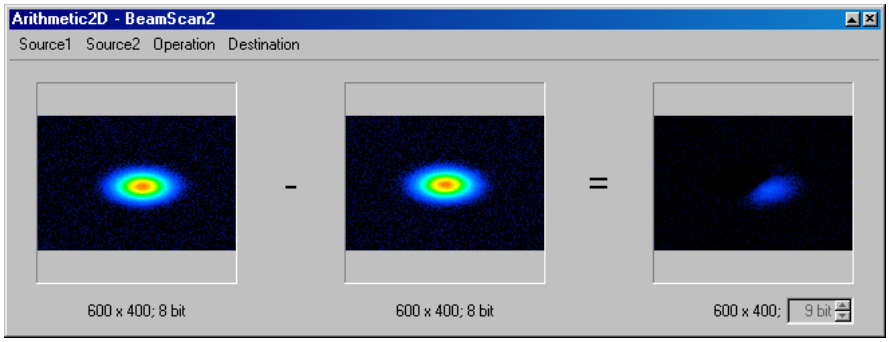


Figure 4.14: Arithmetric2D

Source1 / Source2	
Displayed Image	transfers the image which is currently shown in the **2D-View** as operand
Load Image	loads an image file as operand
Numeric Value	specification of a constant value as operand
Load Homogeneity Matrix	(only ***Source2*** – Menu) loads a homogeneity matrix from file as operand

Operator	
+ – x ÷	possible operators

Destination	
Show in 2D-View	transfers the result into the **2D-View**
Save Image	saves the result as image file
Set as Source 1 / 2	transfers the result as operand for further operations
Edit Bit Depth	activates an edit box in the lower right corner to predefine the bit depth of the result

4.2.4 SequenceView Tool

The **SequenceView** tool offers the possibility to process and administrate sequences of images. Using the settings of the **Save Images** elements on the Main tab of the **Control** tool (see section 4.2.1.1) it is possible to directly acquire image sequences. It is also possible to compose sequences out of different single image files.

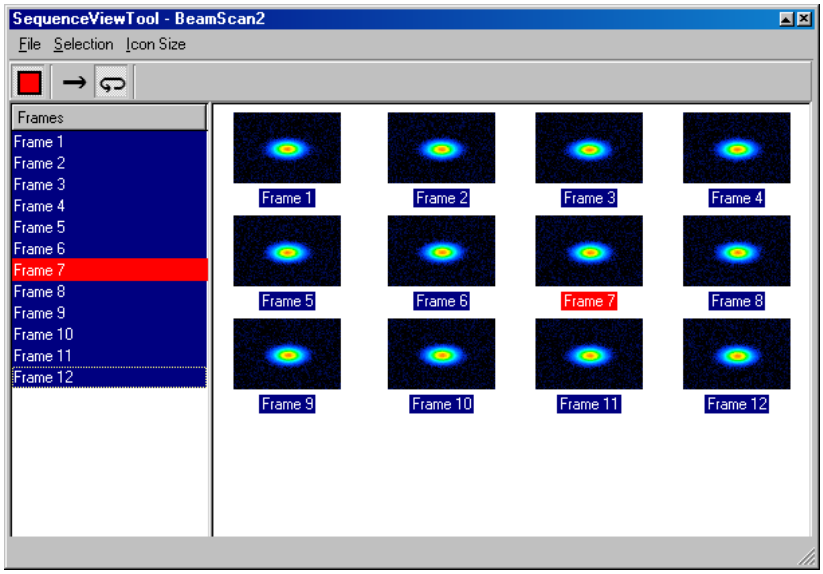


Figure 4.15: SequenceView

The images which shall be processed first have to be selected in the left area of the tool. The traversing of the sequence can be started and stopped with the Start/Stop-Button at the tool bar. The loaded sequence can be processed once or continuously. In doing so a complete analysis of the single images is done.

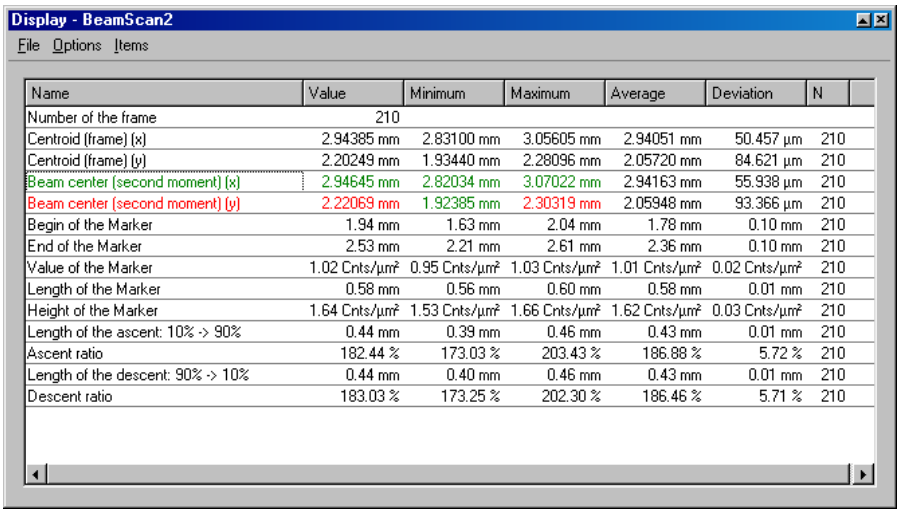
File	
Open Sequence	loads a sequence from file
Add to Sequence	loads a single image or a sequence of images and appends it to the current sequence.
Save Sequence	saves the current sequence into a file
Clear Sequence	clears the currently loaded sequence
Close	closes the tool

Selection	
Select all	selects all loaded images of the current sequence
Invert Selection	inverts the selection
Save Selected Items	saves the selected images as sequence file
Delete Selected Items	deletes the selected images from the current sequence

Icon Size	
Small Icons **Medium Icons** **Large Icons**	icon size for the displayed preview in the **SequenceView** tool

4.2.5 Display

The **Display** window visualizes a summary of the current measurement data and their statistics. Therefore it can be designed individually (see also section 4.2.5.1). So e. g. "good / bad" criteria can be defined, which let the values appear in different colors. The displayed table can be saved as text file.



Name	Value	Minimum	Maximum	Average	Deviation	N
Number of the frame	210					
Centroid (frame) (x)	2.94385 mm	2.83100 mm	3.05605 mm	2.94051 mm	50.457 µm	210
Centroid (frame) (y)	2.20249 mm	1.93440 mm	2.28096 mm	2.05720 mm	84.621 µm	210
Beam center (second moment) (x)	2.94645 mm	2.82034 mm	3.07022 mm	2.94163 mm	55.938 µm	210
Beam center (second moment) (y)	2.22069 mm	1.92385 mm	2.30319 mm	2.05948 mm	93.366 µm	210
Begin of the Marker	1.94 mm	1.63 mm	2.04 mm	1.78 mm	0.10 mm	210
End of the Marker	2.53 mm	2.21 mm	2.61 mm	2.36 mm	0.10 mm	210
Value of the Marker	1.02 Cnts/µm²	0.95 Cnts/µm²	1.03 Cnts/µm²	1.01 Cnts/µm²	0.02 Cnts/µm²	210
Length of the Marker	0.58 mm	0.56 mm	0.60 mm	0.58 mm	0.01 mm	210
Height of the Marker	1.64 Cnts/µm²	1.53 Cnts/µm²	1.66 Cnts/µm²	1.62 Cnts/µm²	0.03 Cnts/µm²	210
Length of the ascent: 10% -> 90%	0.44 mm	0.39 mm	0.46 mm	0.43 mm	0.01 mm	210
Ascent ratio	182.44 %	173.03 %	203.43 %	186.88 %	5.72 %	210
Length of the descent: 90% -> 10%	0.44 mm	0.40 mm	0.46 mm	0.43 mm	0.01 mm	210
Descent ratio	183.03 %	173.25 %	202.30 %	186.46 %	5.71 %	210

Figure 4.16: Display

File	
Save	Saves the currently displayed table as text file.
Close	Closes the tool.

Options	
Minimum	activates the corresponding table columns
Maximum	**Deviation** is the average standard deviation to the average
Average	**Number** gives the number of evaluated images, which are included in the statistical values
Deviation	
Number	

Items	
Configure	Calls a tool window to alter the table view (see section 4.2.5.1).
Configure Font	Changing the **Display** table's font and its attributes. If the distance between screen and user is large (e. g. during a measurement) it may be helpful to use a very large font in the display.
Reset on Start	Specifies if the existing measurement values are deleted with a restart of the image acquisition or not.
Reset	Resets all statistical evaluations of the **Display** table.

When right clicking to a single line of the **Display** table a reset button appears for resetting the statistics of a single line.

4.2.5.1 Display – Configure Items

In this window the **Display** table can be configured. It is called via the **Display** – Menu ***Items – Configure***.

At the left area all available measurement variables are listed in a tree view. With activating the particular checkbox the values are included in the **Display**'s table.

A short description of the available measurement values can be found in Appendix A- Measurement Items.

On the right hand side of the window individual display attributes can be set for the measurement values. For this the appropriate item has to be selected on the left hand side.

To obtain any evaluation results of the **Sections** branch the corresponding section tools have to be activated.

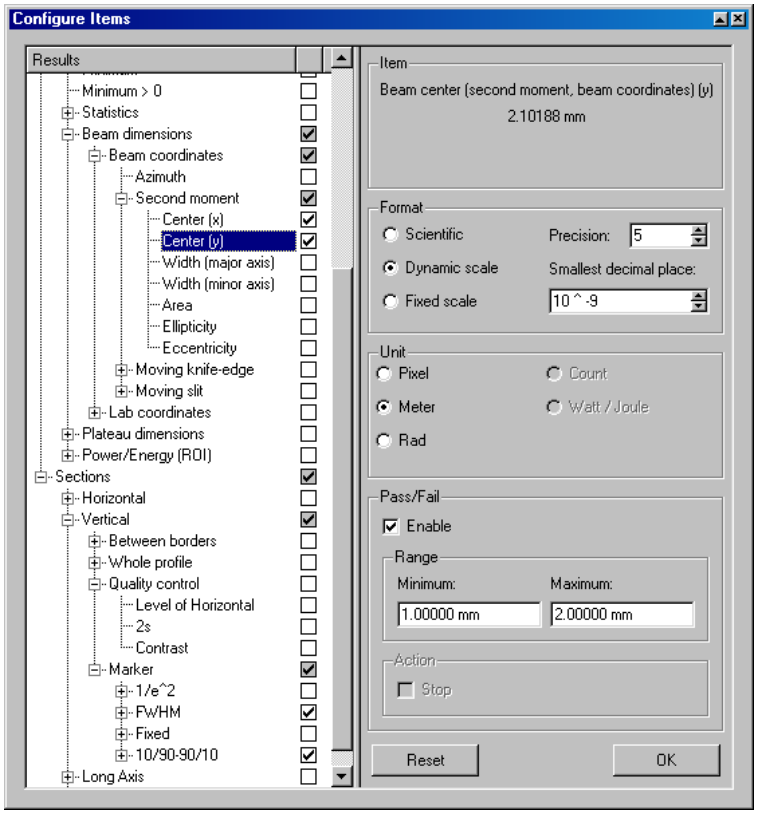


Figure 4.17: Display - Configure Items

Display Attributes		
Item	Long term of the measurement value's description.	
Format	**Scientific**	scientific number format with decimal power
	Dynamic scale	floating point value with dynamic value range
	Fixed scale	floating point value with fixed value range
	Precision	(only with **Scientific** and **Dynamic scale**) number of decimal places
	Smallest decimal place	(only with **Scientific**) limitation of the displayed precision
Unit	**Pixel** **Meter** **Rad** **Count** **Watt/Joule**	Choosing the unit of the measurement value, if more than one unit is available for this item. To activate the unit Rad as the angle in the detector plane the camera needs to have a far field lens (see also 4.2.1.3 Control – Camera Tab).
Pass/Fail	**Enable**	Activates the range interpretation for this item.
	Range	Range definition for the "good" criterion.
	Action	Performing action if the value leaves the "good" range (implemented only for some items).
Reset	Resets the statistical values as well as the pass/fail signaling in the **Display** table for the selected measurement item.	
OK	Closes the configuration window.	

4.2.6 Histogram

In this window the frequency distribution of the intensity values of the current image is displayed

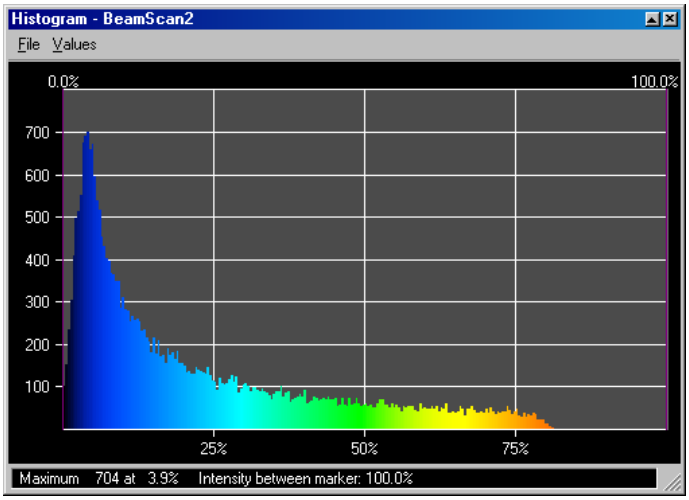


Figure 4.18: Histogram

File	
Save Image as	saves the displayed histogram as file in the format "bmp", "jpg" or "png"
Save as CSV	saves the values as Comma Separated Values (CSV)
Copy CSV to Clipboard	copies the values as CSV to the clipboard
Close	closes the window

Values	
... as percentage **... as counts**	selecting the scale of the abscissa

4.2.7 Beam Position Stability

The **Beam Position Stability** tool or **Pointing Stability** tool visualizes the progression of the beam's centroid coordinates. These position values are also stored and statistically evaluated. The stability values for the near field and the far field can be obtained . The statistical conditions can be chosen in a way that the EN ISO 11670:1999 requirements are fulfilled.

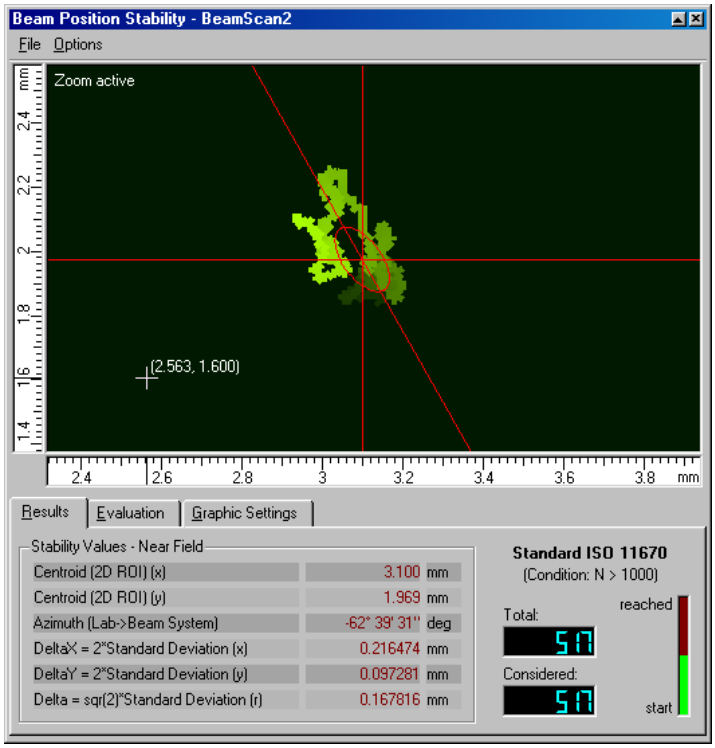


Figure 4.19: Beam Position Stability

The tool window consists of a graphical display of the measured values and a data area with three tabs containing the evaluation results and some configuration settings (see Figure 4.19).

From each camera frame the center of gravity is determined and its position is shown in the graph with a single symbol. The chronology of the beam centroids of several images can be followed by the fading color of the symbols. Similar to a fluoroscopic the oldest symbols have the most faded color. For best orientation the graphical area has a horizontal and a vertical scale that corresponds to the scales of the **2D View**.

Inside the graphics area a zoom region can be defined by pressing the right mouse button and dragging. If the button is released the (hatched) zoom region is displayed filling the graphic area. A zoomed graphic is marked with the displayed text "Zoom active" in the upper left corner. The ***Options*** menu contains an item to reset the zoom.

Whenever the mouse pointer stays in the graphic area it is shown as cross-hairs and its position is marked in the scales. When pressing the left mouse button the current position is displayed at the cross-hairs.

Marker lines show the current evaluation results in the graphic area (red lines in Figure 4.19). In this way the current average of all beam centroids is marked by the cross-hairs position. The ellipse around the average position represents the value of the standard deviations in both directions corresponding to the average centroid. An additional marker line through the cross-hairs shows the calculated azimuth.

During the running acquisition the marker lines are not displayed in the graph before the defined number of measurements to be considered is reached.

File	
Save Image as	saves the graph as file in the format "bmp", "jpg" or "png"
Save Results	saves the evaluation results as text file (see also section 4.2.7.1)
Copy Results to Clipboard	copies the evaluation results to the clipboard
Save Beam Positions as CSV	saves the beam centroids in chronological order as Comma Separated Values (CSV) to a text file
Copy CSV to Clipboard	copies the beam centroids to the clipboard in chronological order
Print	in preparation
Close	closes the tool

Options	
Keep Aspect Ratio	keeps the aspect ratio of the detector area when resizing the window
Square Pixels	shows square pixels independent on their real shape
Original Size	displays exactly one image pixel per screen pixel for square pixels; for rectangular camera pixels in horizontal direction while the vertical direction is interpolated
Reset Zoom	resets all zoom activities
Physical Values **Pixel Values**	units of the scales in millimeters or in number of pixels
Clear Evaluation	clears the statistical evaluation values at any time

4.2.7.1 Beam Position Stability – Results Tab

On this tab the evaluation results of the beam position stability are displayed. The evaluation always starts and stops with the image acquisition. In addition it is possible to reset the evaluation in the **Options** Menu at any time during acquisition.

Stability Values	
Centroid (frame/2D ROI) (x,y)	average coordinates of the evaluated beam centroids subject to the region which is selected on the **Evaluation** tab and inside which the centroids are obtained
Azimuth (Lab->Beam System)	azimuth between camera coordinate system and the direction of maximal deflection of the asymmetric beam axes allocation in the far field (see ISO 11670).
DeltaXY = 2*Standard Deviation (x,y)	horizontal (x) and vertical (y) beam position stability
Delta = sqr(2)*Standard Deviation (r)	beam position stability at rotational symmetry ($\Delta_x/\Delta_y \leqslant 1.15$)

As long as the evaluation condition required in the ISO 11670 (2003) of at least 1000 measurements of the beam position is not fulfilled, the results are displayed in red color. Otherwise they are displayed in black color.

The vertical status bar at the right side of the tab shows the progress of the ISO condition.

Total	number of all centroid values in the current measurement sample
Considered	number of values considered in the statistically evaluation (depending on the settings of the **Evaluation Mode** (see section 4.2.7.2).

4.2.7.2 Beam Position Stability – Evaluation Tab

On this tab the evaluation conditions can be defined. The **Evaluation Mode** influences the number of averaged centroid values, whereas the **Region** determines how the single centroids are calculated in the image .

Evaluation Mode	
Short-term eval. (1 s)	considering all values within the last second of the measurement (short-term stability)
Mid-term eval. (1 min)	considering all values within the last minute of the measurement (medium time span)
Long-term eval (1 h)	considering all values within the last hour of the measurement (long-term stability)
Self-defined time	considering all values within a user-defined period (activates **Time** edit control)
All determined values	considering all values of the measurement
Last 1000 values (ISO)	considering the last 1000 values of the measurement
Self-defined number	considering user-defined number of values (activates **Number** edit control)

Region	
Frame **ROI**	The beam centroids are either determined across the entire detector area or across the Region of Interest (ROI) as defined in the **2D-View** window.

Azimuth Format	
Radians **Deg min sec**	displayed format of the angle

Observation Plane	
Near Field **Far Field**	If a lens is mounted to the camera to observe the far field of a laser beam this can be considered here. Then the values of the beam position stability are printed as angles instead of length coordinates.
Focal Length [mm]	focal length of the lens used for far field imaging

4.2.7.3 Beam Position Stability – Graphic Settings Tab

On this tab the graphical display of the measurement values can be changed.

Symbol Shape	
Circle **Cross** **Square** **Lines**	shape of the symbols presenting the measurement values With the option **Lines** the measured values are joined with lines and no symbol is painted.

Symbol Size	
Small **Medium** **Large**	size of a single symbol or thickness of the line

Number of shown samples	number of simultaneously shown values; up to 1000
Sample Color	color of the sample symbols
Background Color	color of the background
Marking Line Color	color of the marking lines
Show Lines	defines whether the marking lines are shown or not

4.2.8 Progression View

With the **Progression View** the temporal change of measured values can be observed. Measured values having the same characteristic are summarized in one and the same chart. On the left side basic statistical details of the measurement variable are displayed. The description of a measurement variable is printed with the same color as the corresponding curve on the right side.

With long-term measurements sometime the limit of available working memory is reached. In this case the **Progression View** empties its content to refill it. To avoid data loss the use of the Auto Save (see 4.2.8.2Auto Save Comma Separated Values) is strongly recommended.

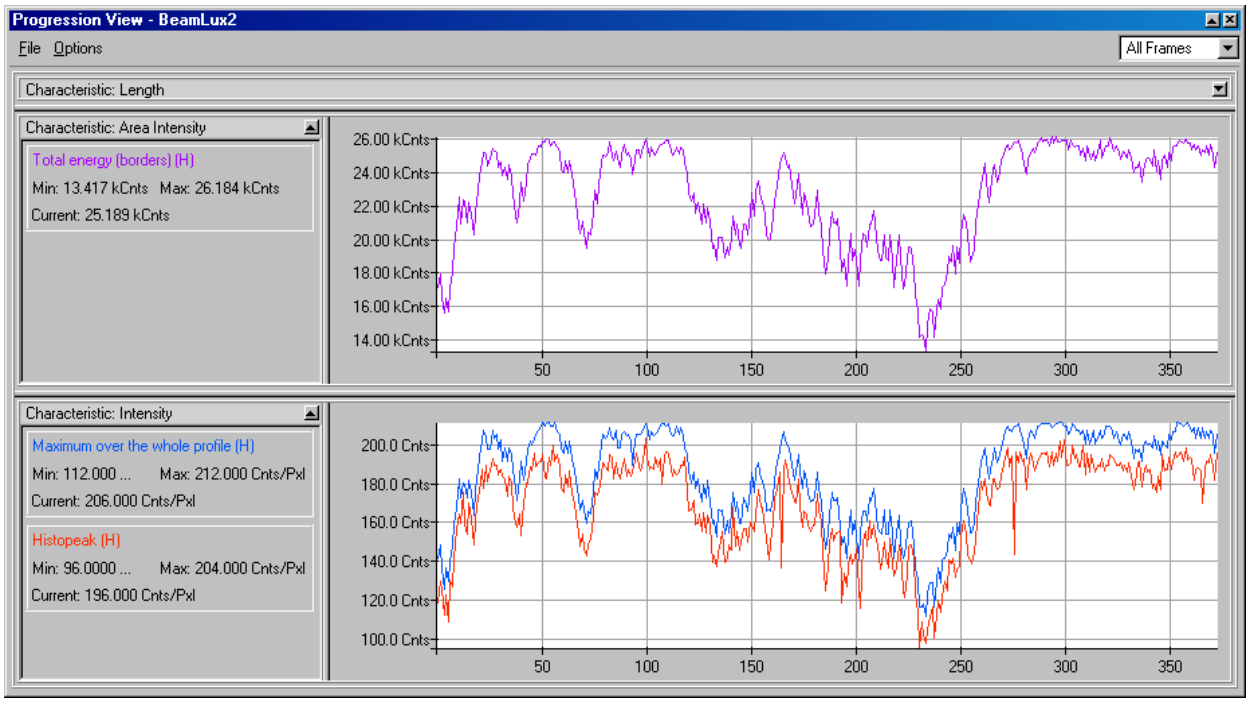


Figure 4.20: Progression View

Frames	a combobox at the upper right corner of the window for choosing the length of the curve which is visible in the graphic area. Depending on the selection the visible section of the abscissa is scaled to the number of frames or to a time scale. The invisible parts of the curve can be reached by a scroll bar.

- With long-term measurements the use of the Auto Save (see 4.2.8.2Auto Save Comma Separated Values) is strongly recommended.
- The incoming data volume can be reduced by triggering the camera with a suitable low trigger frequency.
- Metrolux tests this tool for a long-term stability of at least 24 hours.

If the window is closed the measurement period is interrupted. Then the evaluation within this tool will be paused.

The measurement label control (see Figure 4.21) contains a bar in which the measurement characteristic is displayed and which allows it to minimize this chart temporarily.

The colored description of a measurement value includes a (mouse-over) tool tip with a detailed description

By clicking the right mouse button inside a measurement value label control leads to a pull down menu containing additional options.

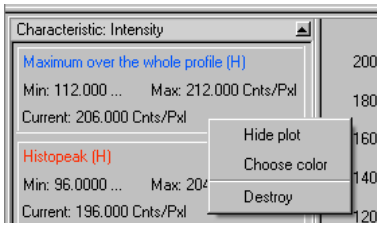


Figure 4.21: Pull Down Menu

Hide Plot	the corresponding curve is not displayed in the graph as long as this option is active
Choose color	selecting the color of the curve
Destroy	equivalent to the deselection of the measurement variable in the item list (see section 4.2.8.3)

File	
Clear	deletes the graph and clears the stored values
Save Image as	saves the graph as file in the format "bmp", "jpg" or "png"
Save Data as CSV	saves the values as Comma Separated Values (CSV)
Auto Save Data as CSV	calls the dialog to automatically save the CSV (see section 4.2.8.2)
Copy CSV to Clipboard	copies the values to the clipboard
Close	closes the tool

Options	
Reset Zoom of all Charts	resets the zoom sections of all graphs
Minimize all Charts	minimizes all charts simultaneously
Select Items	calls the sub window for selecting the measurement variables to be displayed (see section 4.2.8.3)
Unselect all Items	clears the selection of the item list
Time Line	toggles the display between frame numbers and acquisition time

4.2.8.1 Graphics Zoom

A zoom region within the graphic area can be defined by pressing the right mouse button and moving the mouse (see Figure 4.22, left side). When the button is released the hatched area is extended to the whole graphical area. The zoom region can be shifted along the curve as long as the left mouse button is held.

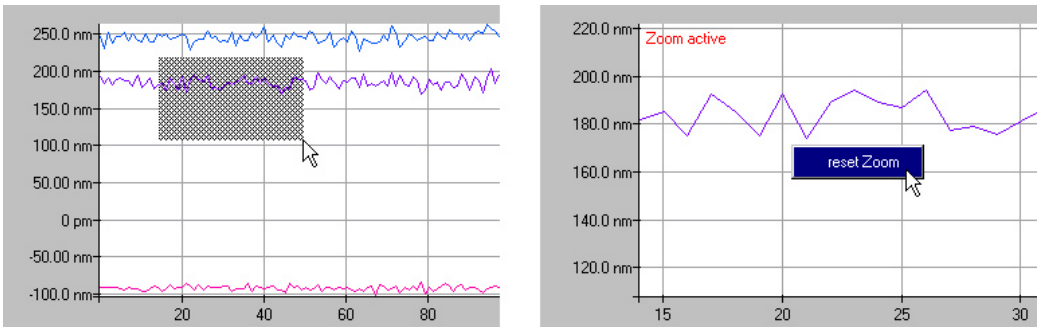


Figure 4.22: Zoom

An active zoom is indicated in the upper left corner of the graphic area. A click of the right mouse button into an active zoom area will bring up a one line pull down menu for resetting the zoom appears (see Figure 4.22, right side).

4.2.8.2 Auto Save Comma Separated Values

The data recorded during a measurement can be automatically saved at preset intervals. The settings corresponding to this auto saving can be determined in the window which is shown in Figure 4.23. This window can be called by the menu ***File*** – **Auto Save Data as CSV**.

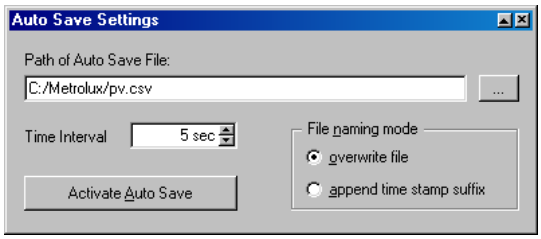


Figure 4.23: Auto Save Dialog

It is possible to use the entered file name as name base (see **File naming mode**), so that with a restart of a measurement (clearing the data) a new file is created and the file of the previous measurement is preserved. This does not apply if the current measurement is continued.

To avoid extremely large files the file size is limited to ca. 130 MB. When this size is reached a new file is created which has a suffix with consecutive numbering, e.g. *pv**0001**.cvs*. In this case the data header only appears in the first file.

Auto Save Settings		
Path of Auto Save File	file path and name or base name for saving the CSV	
Time Interval	time delay for the automated saving in the range of 1 second to 10 hours	
File Naming Mode	**overwrite file** **append time stamp suffix**	The given file name is either overwritten with each new measurement or the current date and time are appended.
(De)Activate Auto Save	Activate/Deactivate automatically saving.	

The smaller the set time delay is, the less data lines have to be appended to the CSV file and so the temporary interruption of the measurement caused by the saving procedure will interfere less.

4.2.8.3 Progression View Items

This sub window is used to configure the **Progression View** graphs. It is called via its ***Options – Items*** menu.

All available items of measurement variables are listed in a tree view. By activating the corresponding checkbox the items are displayed as graph in the **Progression View**. Those items having the same unit and the same range are plotted in the same graphic area.

Short descriptions of the available measurement variables can be found as overview in Appendix A - Measurement Items.

The sequence of the items in the graph initially depends on the order in which they were selected. After saving and reloading the configuration (e.g. with a restart) the sequence of the items is prescribed by the program and therefore will always be in the same order.

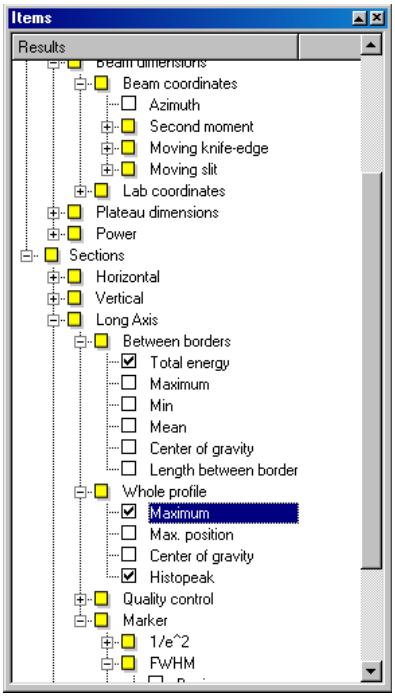


Figure 4.24: Progression View Items

4.2.9 3D Visualization

With the **3D Visualization** window it is possible to view the intensity profile of a frame in 3D. Different perspectives can be observed.

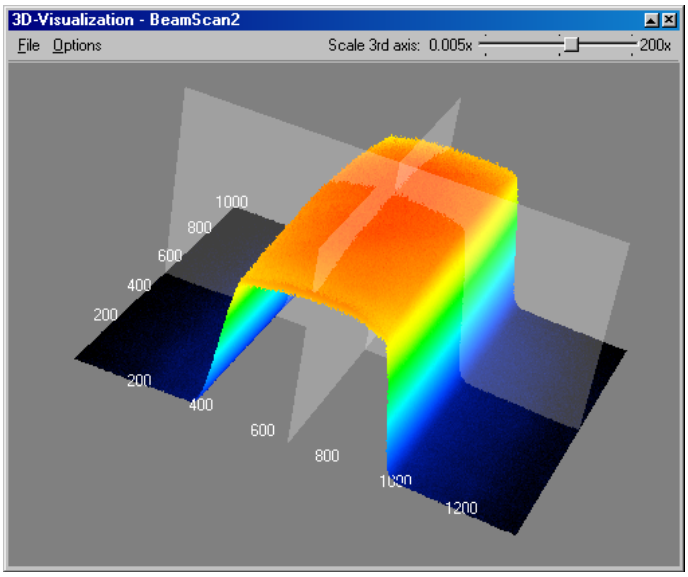


Figure 4.25: 3D Visualization

The perspective can be changed arbitrarily by using the mouse. The following movements can be executed:

Movement	Display Change
press and hold left mouse button	horizontal movement of the mouse pointer turns around the vertical frame axis, vertical movement turns around the horizontal axis
press and hold right mouse button	horizontal movement of the mouse pointer turns around the axis perpendicular to the frame area
turn mouse wheel	zooming the coordinate system
hold mouse wheel / central mouse button	shifting the view with the mouse pointer

File	
Save Image as	saves the image as file in the format "bmp", "jpg" or "png"
Close	closes the tool

Options	
Reset View	resets the rotation angle, position, perspective and the zoom factor to default values.
Set Background Color	changing the background color
Set Movement/Grid Resolution	Changing the displayed resolution during movement of the profile view. Using a low resolution makes the movement fluent. The static view is always shown with the maximal resolution.
Show Perspectively	selects a perspective view of the 3D data
Show Cross Axis	shows the current position of the horizontal and vertical cross sections
Show Grid	Shows the 3D surface as grid or continuous surface. At a large number of pixels the grid is not visible any more and appears continuously.
Rotate	The 3D surface continuously rotates around the vertical image axis
Set Rotation Speed	The rotation speed can be varied in three steps.

Scale 3rd axis	slider to scale the z-axis by a factor factor from 0.005 to 200

The color scale used to display the 3D surface is identical to the scale chosen in the **2D View** window.

4.2.10 Section Tools

The **Section** tools show and evaluate cross sections through the image. For that the intensity curve is plotted along the location. There are four different possibilities to position a section and show it in a separate tool window:

horizontal and vertical cross section (**Cross Section Tools**)

freely orientated and positioned section and its perpendicular (**Beam Section Tools**)

The sections can be activated in the **Tool**-menu of the **2D-View** window. Then the intensity profiles of the sections are shown as lines (Figure 4.26). Their positions can be changed by mouse operations. In addition the curves of the horizontal and the vertical cross section can be displayed.

The handling of the section's menus is explained in detail in section 4.2.2.1 in detail. If the option "manual" is selected in these menus, the position can be changed manually with the mouse pointer. The **Cross Sections** can be shifted in the graphic. The **Beam Sections** can be turned and their intersection can be shifted. With the other positioning options available in the menu the positions are determined automatically.

The positions of the horizontal and the vertical section can also be displayed in the **3D-view** (Figure 4.25).

In addition to this the horizontal and vertical sections can be positioned to any exact pixel position in the image by sliders in their tool windows (Figure 4.27).

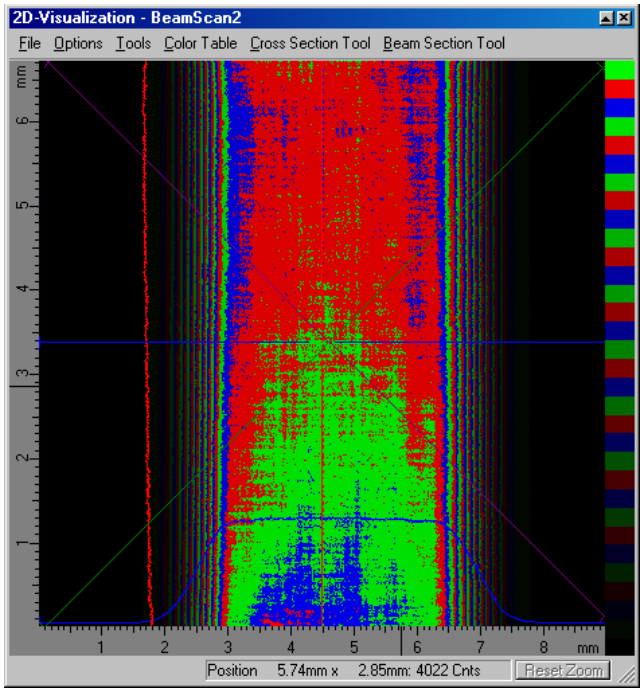


Figure 4.26: Displaying the Sections in the 2D-View

If the sections are moved with the mouse pointer in the **2D-View**, the precision of the position depends on the size of the **2D-View** window.

The windows for displaying the sections and their evaluation results can be activated from the **2D-View** menu or with the corresponding tool buttons (Figure 4.27 and Figure 4.28).

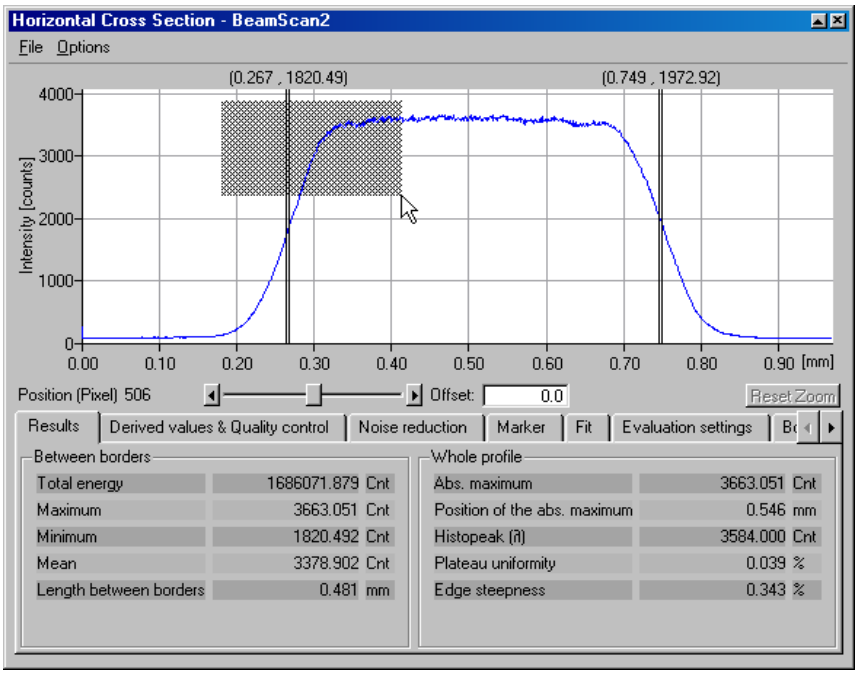


Figure 4.27: Horizontal Cross Section

Position (Pixel)	(only in the **Cross Section** tool) show the pixel position of the current cross section as well as a pixel wise shift with the slider
Offset	intensity in counts, which is subtracted from each pixel value (equal to a constant background subtraction, the profile is shifted downwards)
Reset Zoom	If zooming is active it can be reset with this button.

Inside the graphics area a zoom region can be defined by pressing the right mouse button and moving the mouse (see Figure 4.27). By releasing the button the shaded region is displayed filling the graphics area. The zoom region can be moved along the curve by pressing and holding the left mouse button. While the zoom is active the words "Zoom active" are displayed in the upper left corner of the graphics area. Further zoom regions can be defined inside the current zoom region. The zoom can be reset by a menu item of the ***Options*** menu or by a button on the right beneath the graphics area.

Border lines can be set in the graphics area manually or automatically. These border lines are shown as double lines in the graph. The curve coordinates of the so marked positions are displayed in brackets above the border lines (see Figure 4.27). The criteria for setting the borders automatically are described in detail in section 4.2.10.1.

The border lines should not be mistaken for the marker lines. The marker lines mark special positions and are painted as dashed lines in the graph (see also Figure 4.28). The criteria of placing the marker lines are explained in section 4.2.10.1.

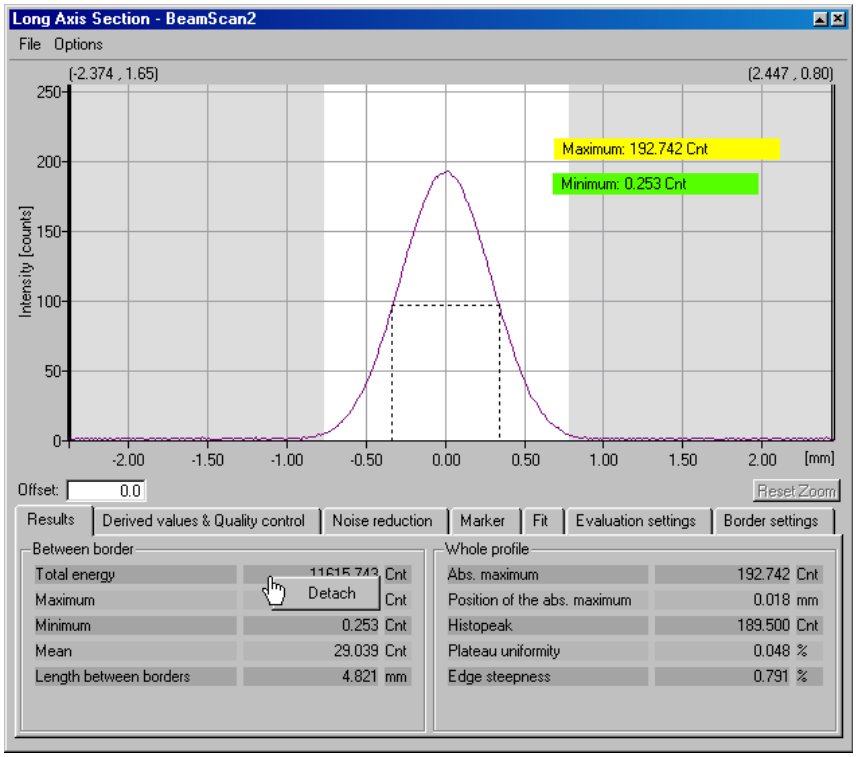


Figure 4.28: Beam Section

File	
Save Image as	saves the graph as file in the format "bmp", "jpg" or "png"
Save Analysis Data	saves the evaluation results as text file
Copy Analysis Data to Clipboard	copies the evaluation results to the clipboard
Save Section as CSV	saves the intensity values along the section as Comma Separated Values (CSV)
Copy Section to Clipboard	copies the intensity values along the section as CSV to the clip-board
Print	prints the window as it is currently displayed
Close	Closes the window. The settings in the **2D-View** are not influenced.

Options	
Reset Zoom	resets all zoom activities
Step Back (Zoom)	resets a single zoom step
Show Data	shows or hides the data area (as described in section 4.2.10.1)
Configure	configuration dialog to design the graphic area

4.2.10.1 Data Area of the Section Evaluation

The section tools include a data section which offers evaluation methods and result listings. These methods are developed for curve analysis of the sections and are specially designed for the analysis of laser beams. The evaluation methods follow the measurement rules of the ISO 13694:2000 norm.

The themes which are described in the following sections are placed on seven different tabs of the tool's data section.

Results		
Between borders	**Total energy**	total energy under the curve of the section between the borders
	Maximum	maximum intensity along the section between the borders
	Minimum	minimum intensity along the section between the borders
	Mean	average intensity of the section between the borders
	Length between borders	distance between the borders
Whole profile	**Abs. Maximum**	maximal intensity along the section (inside the ROI if it is active, see below)
	Position of the abs. maximum	position of the maximum intensity along the section
	Histopeak (λ)	maximum in the histogram = intensity value occurring most often
	Plateau uniformity	ratio between full width at half maximum of the intensity histogram's maximum and the maximum intensity
	Edge steepness	normed difference of the effective radiation area at the intensities of 10% and 90% of the maximum intensity, scale factor is the 10% area

The measurement values listed in this table are evaluated according to the ISO 13694:2000 norm.

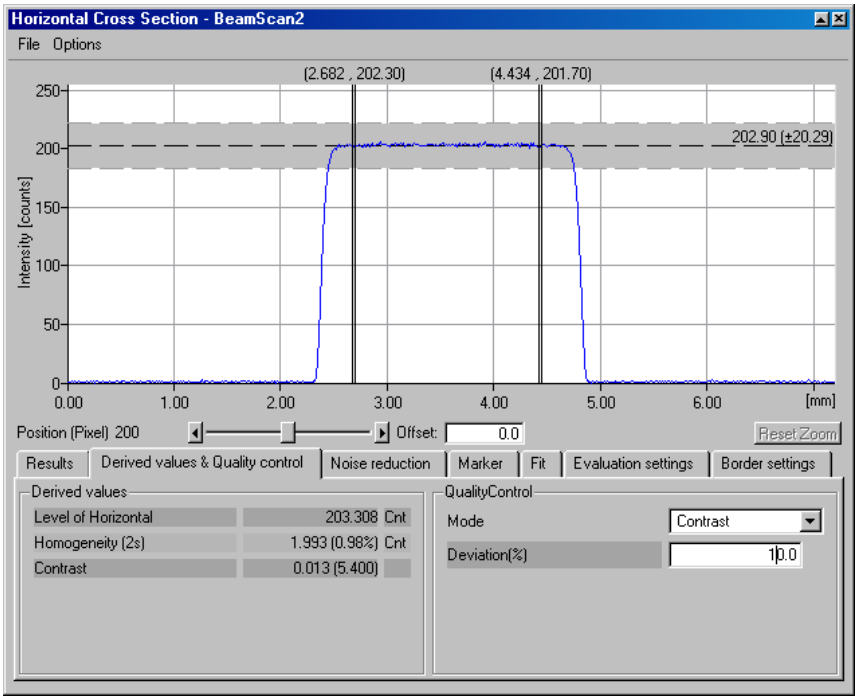


Figure 4.29: Quality Control of the Sections

Derived values & Quality control		
Derived values	**Level of Horizontal**	average intensity of the curve between the borders
	Homogeneity (2s)	double standard deviation to the average intensity in counts (and relative to the average value in %)
	Contrast	contrast from $\frac{(I_{max}-I_{min})}{(I_{max}+I_{min})}$ and ($I_{max}-I_{min}$) in brackets
Quality Control	**Mode**	displaying results as shaded areas in the graphic area (Figure 4.29). The following options are available: • None (display disabled) • Contrast (= $(I_{max}+I_{min})/2$) • Homogeneity (= average / Level of Horizontal) • Homogeneity (2D) (= average of the **2D View**)
	Deviation (%)	width of the gray area in proportion to the displayed value

Noise reduction		
Mean (lines) (only in the Horizontal and Vertical Cross Section)	**Type**	types of filters for noise reduction perpendicular to the section. The following modes are available: • None (noise reduction disabled) • Rectangular • Binomial • Savitzky-Golay (Savitzky et al. (1964)) • Triangle
	Kernel width	number of averaged lines above and beneath the section
	Order	(Savitzky-Golay only) the order of the used polynomial
Convolution	**Type**	types of filters for noise reduction perpendicular to the section. The following modes are available: • None (noise reduction disabled) • Rectangular • Binomial • Savitzky-Golay (Savitzky et al. (1964)) • Triangle
	Kernel width	width of the filter mask
	Order	(Savitzky-Golay only) the order of the used polynomial

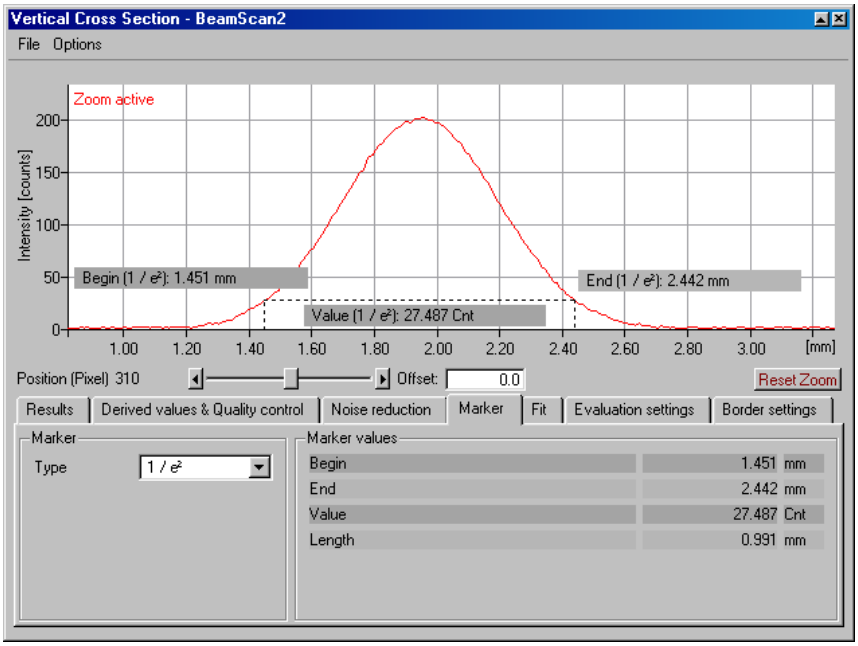


Figure 4.30: Markers in the Sections

Some of the measurement results can be directly visualized by markers in the graph (for examples refer to Figure 4.30).

Marker		
Marker	**Type**	marker types to mark special positions in the section. The following types are available: • None (disables the markers) • Centroid (the signal's centroid, Center of Gravity = COG) • Maximum (the signal's maximum, Max) • Fixed (see also **Evaluation settings**) • $1/e^2$ (signal value of $1/e^2 \simeq 13{,}53\,\%$) • FWHM (full width at half maximum) • 1090 / 9010 (signal's difference at 10% and 90% of the maximum)
	Percentage	(only with type Fixed) percentage declaration for the signal level of the marked region (reference value see **Evaluation settings)**
Marker values	**Value**	(for COG or Max) intensity value at the marker's position
	Position	(for COG or Max) marker's position
	Start	(for Fixed, 1/e² or FWHD) start position of the marked region
	End	(for Fixed, 1/e² or FWHD) end position of the marked region
	Value	(for Fixed, 1/e² or FWHD) signal value of the marked region
	Length	(for Fixed, 1/e² or FWHD) width of the marked region
	Marker height	(for 1090 / 9010) 80% of the maximum intensity
	Length (ascent)	(for 1090 / 9010) width of the left slope triangle in mm
	Ascent	(for 1090 / 9010) slope as $\frac{90\,\%-10\,\%}{L_{ascent}}$
	Length (descent)	(for 1090 / 9010) width of the right slope triangle in mm
	Descent	(for 1090 / 9010) slope as $\frac{90\,\%-10\,\%}{L_{descent}}$

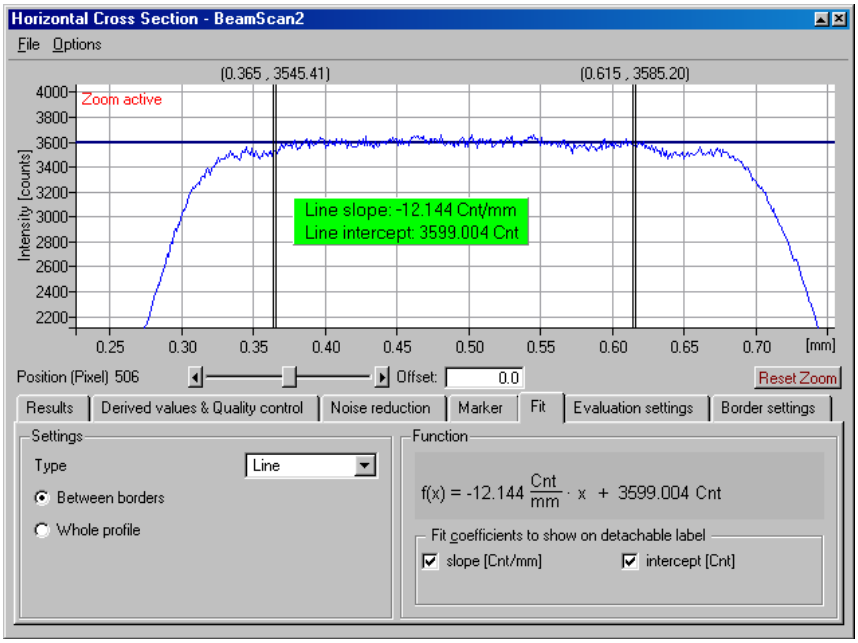


Figure 4.31: Fitting Curve in the Sections

Fit		
Settings	**Type**	type of function to fit the shape of the section. The following types are available : • None (deactivates the fit) • Line (best fit straight line) • Gauss (fitting a Gauss curve, Exp. 2) • Super Gauss (fitting a Gauss curve having the exponent as free parameter)
	Between borders Whole profile / Restrict to ROI	Selecting the segment which is considered for the fit. If **Whole profile** or **Restrict to ROI** is shown, depends on the corresponding setting at the **Evaluation Settings** tab.
Function	shows the resulting fit function as formula	
	Fit coefficients to show on detachable label	Selection of the coefficients which shall be shown on the detached label (see 4.2.10.2).

If calculation of a fitted curve is activated, the calculated curve is automatically plotted in the graphics area of the section.

The option **Whole profile** becomes **Restrict to ROI** in case of selecting **Restrict to ROI** in **Evaluation settings**.

Evaluation Settings		
Setting	**Reference**	The following types are available as reference for the marker type **Fixed**: • Absolute maximum • Customized maximum (see below) • User defined • Histopeak
	Reference value	Displays the current reference value. In mode **User defined** it is possible to specify this value.
	Whole profile **Restrict on ROI**	selection of the analyzed region (ROI, Region of Interest see also section 4.2.2)
Customized maximum (only visible if this item is selected in the Setting above)	**Number of maxima**	number of the highest pixel values used to calculate a *temporary average maximum*, value range 1-100, integer
	Lower threshold (%)	Threshold value in % of the *temporary average maximum*, value range 1-100, floating point

The calculation methods for the reference value of the different modes is described in detail below.

- If the **Restrict to ROI** is chosen in **Evaluation settings** as region of evaluation, this influences all result values displayed on the different tabs.
- In the graphics area the regions of the section outside the ROI are marked with a gray background (see Figure 4.28).
- All other settings on this tab correlate exclusively to the definition of a reference for the display of the marker type **Fixed**.

Calculation of the reference value for **Percentage of reference**:

1. In the case of the **Absolute Maximum** the section's absolute maximum S_{max} is decreased by the defined percentage rate p_{ref} and this new value is used as reference value $R_{a,max}$ to position the borders. This means:

   adapted reference maximum: $R_{a,max} = \frac{S_{max} \; p_{ref}}{100}$

2. With the **Customized Maximum** the reference maximum is obtained by two parameters, which can be set by the user: the number of considered maximal values along the section (**Number of maxima** N_{max}) and the lower threshold for this value set (**Lower threshold** T_{lower}). This means:

   average of all considered maximum values: $\overline{S} = \sum_{i=1}^{N_{max}} S_i$,

   Customized Maximum : $S_{c,max} = \sum_{j=1}^{N_{max}} S_j \quad \text{for all } S_j \text{ with } \frac{T_{lower}}{100}\overline{S} \leqslant S_j \leqslant \overline{S}$

   adapted reference maximum : $R_{c,max} = \frac{S_{c,max} \; p_{ref}}{100}$

3. At the **User Defined** specification the maximum value $S_{u,max}$ is defined. So this means:

   adapted reference maximum : $R_{u,max} = \frac{S_{u,max} \; p_{ref}}{100}$

Border Settings		
Setting	**Border**	positioning the borders (for detailed description see below): • By hand (no automatism) • According to ROI • Percentage of reference
	Reference	(only with **Percentage of reference**) the following reference types are available • Absolute maximum • Customized maximum • User defined
	Reference value (Cnt)	(only with **Percentage of reference**) displays the current reference. With **User defined** this value can be set.
	Percentage	(only with **Percentage of reference**) percentage rate to the reference value.
	Accept section end	(only with **Percentage of reference**) If the option **Restrict on ROI** is active in **Evaluation settings** and no fitting value is found on the right side, then the right ROI border is accepted. Otherwise an error message is shown in the upper left corner of the graphics area.
Customized maximum (only visible if this item is selected in the Setting above)	**Number of maxima**	number of the highest pixel values used to calculate a *temporary average maximum*, value range 1-100, integer
	Lower threshold (%)	Threshold value in % of the *temporary average maximum*, value range 1-100, floating point

The borders either can be positioned manually or conditions for automatically positioning the borders may be defined. For automatic positioning two methods are available:

1. The borders are positioned by the ROI (**According to ROI**, Region of Interest see also section 4.2.2) and are moved to the intersections of the ROI border with the section.
2. The border positions are determined relative to a reference value (**Percentage of reference**), which is calculated by the criteria above. The reference value is always searched from the outside to the middle of the section curve and the border is set to the position of the first occurrence of this value. The positions are calculated in a sub pixel range by linear interpolation between the nearest two pixel positions.

4.2.10.2 Detaching Separate Data Labels

The labels in the data section showing the evaluation results can be detached and freely positioned at any place of the section's window area. When moving the mouse pointer along a detachable label in the data section the mouse icon changes into a hand symbol (Figure 4.28).

The the pull down menu entry **Detach** can be obtained by clicking the right mouse button. This creates a copy of the label which can be moved to any place on the section window (Figure 4.32).

By clicking the right mouse button at a detached label a pull down menu for configuring the element's layout appears (Figure 4.32).

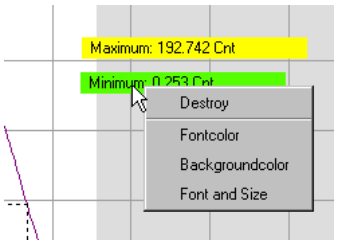


Figure 4.32: Detached Value Label

Destroy	deletes the clicked label
Fontcolor	opens a dialog to change the font color
Backgroundcolor	opens a dialog to change the label's background color
Font and Size	opens a dialog to change the font attributes

- All detached elements are included in the image when saving the section window as bitmap.
- The positions and layouts of the detached elements are considered in the saved configuration file and are restored at the program's start-up.

4.3 Extensions

4.3.1 Line Evaluation Display Tool (optional)

The **Line Evaluation Display Tool** evaluates the straightness error, the variation of the line extent as well as the intensity curve of an analyzed laser line. For the evaluation of the straightness first of all the centers of gravity of the sections perpendicular to the line are calculated. Then the extent of the minimum region which includes the entire line is evaluated. This is done by the method of Dhanish and Mathew, (2007). The evaluated data of the COGs, line extents and line intensities along the laser line are graphically shown and can be obtained as CSV values for further analysis.

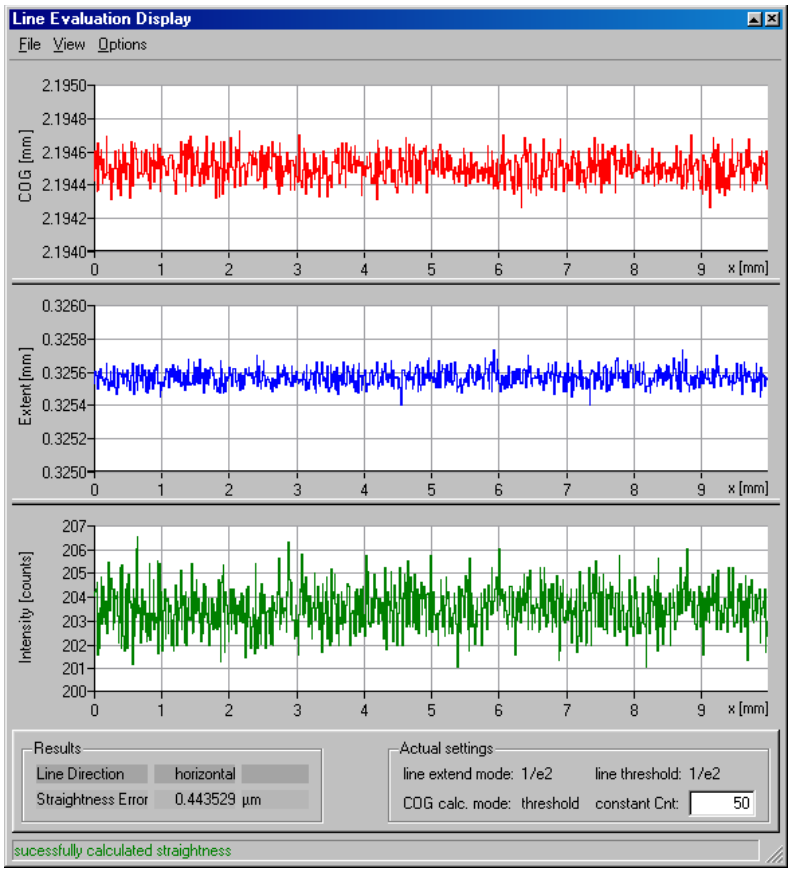


Figure 4.33: Line Evaluation Display

The status bar at the bottom of the tool's window informs about the tool state. If an error occurred during the calculation of the straightness error an error number is also shown. Descriptions to these numbers are listed in 4.1.

Inside the graphics areas a zoom region can be defined by pressing the right mouse button and moving the mouse. By releasing the button the dashed region is displayed filling the graphics area. The zoom region can be moved along the curve by pressing and holding the left mouse button. While the zoom is active the words "Zoom active" are displayed in the upper left corner of the graphics area. Further zoom regions can be defined inside the current zoom region. The zoom can be reset by menu items of the ***View*** menu.

At the separator bars between the graphic areas the height of these areas can be varied.

The scanned laser line should be positioned parallel as exact as possible to the scan direction because the evaluation is oriented on the rows and columns of the detector. If the line is positioned sloped to the movement this angle is not considered in the calculation.

File	
Save COG Values as CSV	saves the centers of gravity of the sections perpendicular to the laser line used to evaluate the straightness error as Comma Separated Values (CSV)
Copy CSV to Clipboard	copies the COGs as CSV to the clipboard
Save Extent Values as CSV	saves the extents perpendicular to the laser line as Comma Separated Values (CSV)
Copy CSV to Clipboard	copies the extents as CSV to the clipboard
Save Intensity Values as CSV	saves the intensity values at the COGs perpendicular to the laser line as Comma Separated Values (CSV)
Copy CSV to Clipboard	copies the intensities as CSV to the clipboard
Close	closes the window

View	
Small Font **Medium Font** **Large Font**	selects the font size to display the measurement values in three steps
Show Centers of Gravity	shows the graphic presentation of the centers of gravity determined of the sections perpendicular to the scanned line
Step Back (Zoom of COG)	resets a single zoom step of the COG graphic
Reset Zoom of COG Graph	resets all zoom activities of the COG graphic
Show Line Extents	shows the graphic presentation of the line extents determined along the scanned line
Step Back (Zoom of Extents)	resets a single zoom step of the line extent graphic

View	
Reset Zoom of Extents Graph	resets all zoom activities of the line extents COG graphic
Show Central Line Intensity	shows the graphic presentation of the line intensities determined along the scanned line
Step Back (Zoom of Intensity)	resets a single zoom step of the line intensity graphic
Reset Zoom of Intensity Graph	resets all zoom activities of the line line intensity graphic
Reset all Zooms	resets all zoom activities of all graphics

Options	
COG along entire row/column **COG Inside Extent of 1/e²** **COG Inside Extent of FWHM** **COG above constant threshold**	Sets the mode of calculating the centers of gravity of the perpendicular sections. A relative or an absolute threshold can be defined below which the signals are not considered any more. The constant threshold can be set in the data section of the tool window.
Line Extent at 1/e² **Line Extent at FWHM**	Sets the mode to evaluate the line extents. The threshold is calculated relatively to the local maximum of the respective section.
Line Threshold at 1/e² **Line Threshold at FWHM**	Sets the mode to detect the line ends. The threshold is calculated relative to the absolute maximum of the complete scan. The line can be broken at several places.
Configure	configuration dialog to customize the graph area

Results	
Line Direction	selected scan direction – always vertical in beamscan II
Straightness Error	Straightness Error as width of the minimal area around the line, evaluated by the method of Dhanish and Mathew

Actual settings	
Line extent mode	displays the mode selected in the **View** menu to evaluate the line extents
Line threshold	displays the mode selected in the **View** menu to detect the line ends
COG calc. mode	displays the mode selected in the **View** menu to evaluate COGs of the perpendicular sections
Constant Cnt	setting a constant threshold value to evaluate the COG by the **COG above constant threshold** menu item.

Error Number	Description
990	calculation aborted already in a previous process
991	unexpected error while calculating centers of gravity along the line
992	one of the center of gravity along the line could not be determined
993	too less values along the detected line
994	line's slope could not be calculated
995	tool failed to allocate temporary memory or calculate error region, iteration failed
996	precision of the iteration has been reduced to find result
997	frame could not be processed
998	line's extreme points of the line extension could not be found
999	line's slope could not be found

Table 4.1: Error Descriptions of Straightness Error Evaluation

5 Trouble Shooting

The following table may help to analyze and eliminate malfunctions of the beamscan II software. If the listed suggestions do not help to eliminate a malfunction please contact the Metrolux Support Team.

For malfunctions of a camera connected to beamscan II software please also refer to the corresponding camera manual.

Malfunction	Procedure
The camlux camera does not appear in the camera list box of the **Control** tool.	possible reasons: • The camera is not connected to the system: Please check the connection of the camera's data cable. Please also check the message of the number of found cameras at start-up in the console window of the beamscan II program. • The camera is not identified correctly by your operating system: Please consult the camera's manual for further error search. Reinstall the camera if necessary. • The camera is already used by another **Control** tool or another software. Check if further Metrolux software bundles are active.
A reproducible malfunction appears at the execution of measurements.	The chosen settings do not harmonize together: • Reset the last taken settings and analyze the behavior. If this does not help: • Save the current configuration to a backup file (main menu *File – Save configuration*). • Close the program. • Delete the configuration file (a file with extension INI, located in the beamscan II - working directory for version 2.5.5 or older or in the user directory in the beamscan II folder). • Restart the program. Default settings are generated again. • Analyze the behavior while reconstructing the measurement settings step by step.
The camera shows ghost images.	If ghost images appear limit the maximal possible frame rate (see section 4.2.1.3). One reason could be a too low data transfer rate of the used 1394 controller or the connection of too many cameras to the same IEEE1394 port.

Malfunction	Procedure
The application fails unexpected.	Running the software under Windows 7 in some rare situations can cause memory access errors. Run the application in Windows XM mode then (see properties of the beamscan II desktop icon).

Appendix A Measurement Items

Notation	Description
Number	acquisition number (only in the Display tool)
Date	acquisition date (only in the Display tool)
Time	acquisition time (only in the Display tool)
Width	width of the frame (only in the Display tool)
Height	height of the frame (only in the Display tool)
Sum	sum of counts of all pixels
Centroid (x, y)	coordinates of the center of gravity of the intensity distribution

Table A-1: List of the general measurement values

Main Group	Sub Group	Notation	Description
2D ROI (Region of Interest)		ROI Width	width of the current ROI
		ROI Height	height of the current ROI
		Maximum	maximum signal inside the current ROI
		Minimum	minimum signal inside the current ROI
		Minimum > 0	minimum signal inside the current ROI, negative values are not considered
	Statistics	Area	area of the ROI
		Sum	integral intensity inside the ROI
		Mean	average intensity inside the ROI
		Deviation	standard deviation to the average
		Centroid (x, y)	center of gravity inside the ROI
		Edge Steepness	average of slopes within the areas with $I < 0.1 \cdot I_{max}$ and $I > 0.9 \cdot I_{max}$
		Homogeneity	ratio of the average intensity to the maximum intensity

Main Group	Sub Group	Notation	Description
		Threshold	power density [or energy density] threshold, calculation of the measurement categories according to the definition in ISO 13694:2000 norm
	Beam dimensions (Beam coordinates) (Lab coordinates)	Azimuth	azimuth between the long axis of the beam profile ellipse and the horizontal camera axis.
		Second moment	geometrical profile size, determined according to the second moment method
		Moving knife-edge	geometrical profile size, determined according to the knife edge method, where a (virtual) edge is positioned such that 84% and 16% of the beam intensity is detected
		Moving slit	geometrical profile size, determined by the positioning of a (virtual) slit, so that 13,5% of the maximal beam intensity is detected
	Plateau dimensions	Plateau intensity	maximum in the upper third of the histogram of the ROI
		Plat. multimodal?	Is there only one ore more maxima in the upper third of the histogram of the intensities of the section?
		Plat. uniformity	ratio between the full width at half maximum of the plateau's intensity in the histogram and the maximum intensity of the ROI
		Relative Plat. unif.	ratio between the full width at half maximum of the plateau's intensity in the histogram to the plateau's intensity
		Plat. edge steepness	normed difference of the effective radiation areas at the intensities of 10% and 90% of the maximum intensity, scale factor is the 10% area
		Plat. relative thresh.	ratio between the threshold and the plateau's intensity
		Plat. evenness fact.	ratio of the average of all intensities which are >= than the threshold to the plateau's intensity
	Power/Energy	Power	power measured within the ROI
		Power density	power density measured within the ROI
		Energy	energy measured within the ROI
		Energy density	energy density measured within the ROI

Table A-2: List of the Region of Interest measurement values

Main Group	Sub Group	Notation	Description
Sections - Horizontal Vertical Long Axis Short Axis	Between borders	Total energy	total energy under the section's curve between the borders
		Maximum	maximum intensity along the section between the borders
		Minimum	minimum intensity along the section between the borders
		Mean	average intensity along the section between the borders
		Center of gravity	center of gravity determined between the borders
		Length between borders	distance between the border lines
	Whole profile	Maximum	maximum intensity along the total section
		Max. position	position of this maximum intensity
		Center of gravity	center of gravity determined along the total section
		Histopeak	maximum in the upper third part of the histogram
		Plat. uniformity	ratio between the full width at half maximum of the plateau's intensity in the histogram and the maximum intensity of the section
		Plat. edge steepness	normed difference of the effective radiation width at the intensities of 10% and 90% of the maximum intensity, scale factor is the 10% width
		Plat. multimodal?	Are there only one ore more maxima in the upper third of the histogram of the intensities of the section?
	Quality control	Level of Horizontal	average value of the curve between the borders
		2s	Twice the standard deviation of the average value
		Contrast	contrast as $\frac{(I_{max}-I_{min})}{(I_{max}+I_{min})}$

Main Group	Sub Group	Notation	Description
	Marker Marker	1/e² FWHM Fixed	• start and end position of the markers according to the criterion • intensity value at the markers, • width of the marked region, • set percentage (Fixed only)
		10/90 – 90/10	• height, 80% of maximal intensity • width of the ascent slope triangle • slope as $\frac{90\%-10\%}{L_{ascent}}$ • width of the descent slope triangle • slope as $\frac{90\%-10\%}{L_{descent}}$

Table A-3: List of the section measurement values

Appendix B Acceleration Delay

In the following section the conditions of the delayed frame acquisition during the scanning process are explained. With this knowledge it is possible to find the correct motor parameters for a correctly scanned laser line.

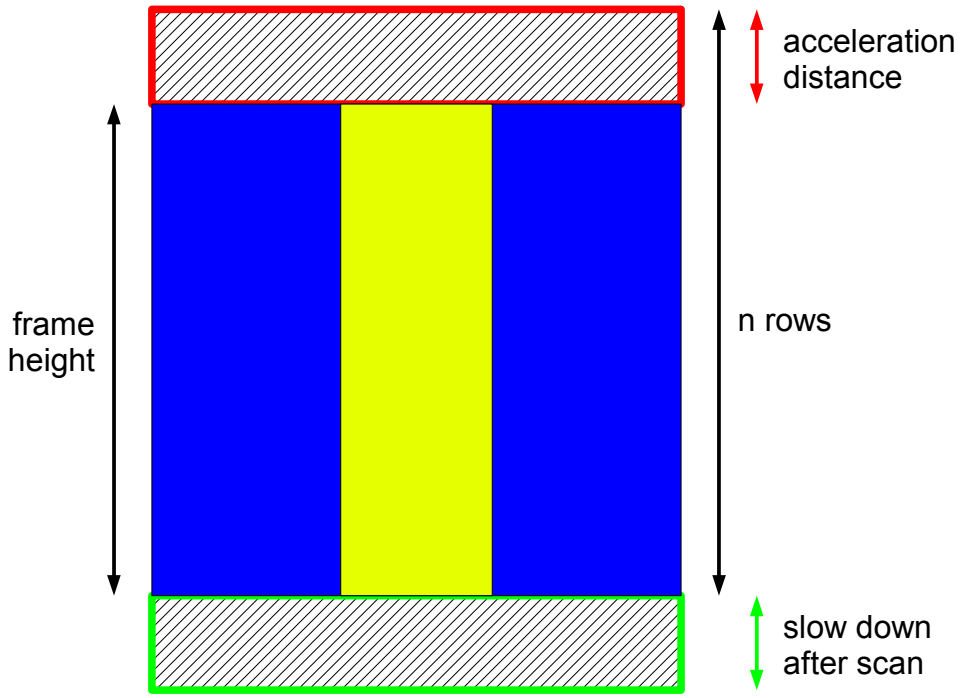


Figure B-1: Frame Plane During Scanning Process

Assuming that the acceleration phase is negligible short. In this case only the frame height (blue + yellow in B-1) has to be considered. The construction of the scanned frame is described by the following parameters:

- camera frame rate **b** [frames / s]
- motor step width **g** [mm/step]
- start position $\mathbf{p_{start}}$ [mm]
- end position $\mathbf{p_{end}}$ [mm]
- number of scan steps **n** (= frame row number)

and so it is

=> frame height $\mathbf{\Delta = | p_{end} - p_{start} |}$

=> row height $\mathbf{\Delta_{row} = \Delta / n}$

To consider an acceleration phase at the beginning of the scanning procedure additional parameters have to be defined as described below.

Additionally needed parameters:

- delay time t_a [s]
- acceleration distance $\Delta_a = ½ |a| * (t_a)^2$

Figure B-2: Velocity - Time - Phase Diagram

In B-2 the different phases of the cameras velocity are illustrated. The image acquisition for the scanned frame starts after the time phase colored in red, thus after the delay time t_a. It is:

- number of unconsidered rows m = b * ta at the beginning of the scan

  => new frame height $\Delta = | p_{end} - p_{start} | - \Delta_a$ with **n – 2*m** rows

The start position p_{start} and the end position p_{end} still define the complete moving distance of the motor unit. So it is necessary to shorten this distance by the acceleration distance which the motor will move during the acceleration delay time. The scanned image keeps the correct scaling in vertical direction.

The two additional input elements "Delay of acceleration" and "Distance of acceleration" are included into the **Motor Controller Options** dialog (see section 4.2.1.5.1) to define the acceleration behavior of the motor device.

The color of the status bar on the scan tab (see section 4.2.1.5) is changed between black and blue to show in which mode the scan is working. Black means that the motor is in the defined acceleration phase while blue shows that the scan phase is active.

Appendix C Release Notes

Version 2.5.3 / 2008 1 30th	
• Load INI-File via XML	Added, socket keeps unchanged! - only „local“ INI for a new graph.
• Tiff Object	Moved into Kern.
• Cameras (all)	Parameter-handling (Gain, Offset, Exposure) renewed. access by indexes as well as by physical values (e.g. Gain: 5.67 dB) possible. => useful for access by Script
• Script	intermediate result, soon more
• Console	no more access to script
• 2D View	Cursor position was displayed wrong at about 1 pixel to the upper right.

Version 2.5.3.2 / 2008 3 28th	
• Fortran Dll	Evaluations now are completely in C++.
• CST / BST	• moved into Kern • access of output values for Display and PV • XML control (on, off, position, automation)

Version 2.5.4 / 2008 5 14th	
• 3D View	Z-Zoom now from 200x to 1/200 x, Zoom is set to 1 with reset.
• Tiff Object	Enhanced to write strings and additional values to the Tiff Header.
• ROI	„show size“ off as default
• Camlux	• serial number reading stable • timeout at triggering is set to infinite
• CS	Value for "line averaging" is saved.
• Background correct.	Bug-Fix: Crash at background subtraction (corners, lines, ...) at loaded frames.

Version 2.5.4.5 / 2008 9 16th	
• ROI	Tool moved into Kern
• Sections	Evaluation values ported from Feld to Sectionanalyzer, calculations corrected (Histopeak, ...).
• Qt (Signals / Slots)	Signals coming not from the Qt-Thread can cause a crash, signals are substituted by Callbacks.
• BL2 Tiff	Tiff objects extended, additional position info.
• Tiff	Parting at 2GB, automatically appended suffix.
• Beamscan	• enhanced to digital • BS2Analyzer included, which fills and controls the scan“ • calculation of length to steps adapted in motor interface
• CamluxFP	Fps is obtained from the camera.
• Display	Item-selection-dialog layout changed (frame enlarged).
• Control	Control (its thread for image processing in the dispatcher) is not started before the complete graph is loaded.

Version 2.5.5.2 / 2008 10 14th	
• 2D View	Save menu is only active, if a frame is shown in the 2D View.

Version 2.5.5.3 / 2008 10 27th	
• XML	<saveFile> implemented.

Version 2.5.5.4 / 2008 11 10th	
• Section Analyzer	Evaluation of the sections adapted. The SectionAnalyzer directly gets all needed parameters for the further evaluation. Was needed for implementation of the scripting.
• Script	Script language enhanced.
• Callbacks	Signals changed to callbacks in some more code areas.
• GSP	„Handshake“-Bit of the AC-Profiler now is analyzed. No change for "normal" scan.
• Camera Interface	Changed „void setFPS(CameraFSP, double &)“ to „double setFPS(CameraFPS)“.

Version 2.5.5.5 / 2008 11 18th	
• Tools	„setParameterToFeld“ implemented. Needed for scripting to change settings without repainting the frame.
• Section Analyzer	All parameter used for evaluation are set earlier for scripting.
• XML	Camera settings (Gain, Offset, ExposureTime) changed from indexes to real values (dB, Counts, s).
• Script Console	Splitter between Input and Output implemented.
• Progr. View	Positions of splitter are saved in the INI file.

Version 2.5.5.6 / 2008 11 28th	
• Homogeneity matrix	Bug-Fix: With image correction single pixels could have a larger value as the camera dynamic allows. This is avoided now.
• CamluxFP	ML 3063 implemented.
• Camera ROI	Now minimal size is 64x64 pixels.
• Script	ß-Version finished.
• XML	Enhanced with SaveImage, SaveScreen, BGR.
• Sections	Spell check in SectionWindowData.

Version 2.5.5.7 / 2008 12 5th	
• Image Correction	Homogeneity matrix can be fitted from a 2D plane.
• Beamscan	Homogeneity matrix considered in the scanned frame.
• Main Window	file - Reset Configuration
• Cameras	Bug-Fix: Crash in FrameQueue repaired.
• Control Camera Tab	Camera-administration now is thread-safe.

Version 2.5.5.8 / 2008 12 10th	
• memory leaks	Bug-Fix
• Beamscan	• it was possible to disable the „Start-Button“ with fast clicks • „Motor reset at scan end“ default value corrected
• Main Window	file menu extended: • Reset Configuration • Reload Configuration • Script-Interpreter • General Settings → change working directory

Version 2.5.5.9 / 2009 1 8th	
• Items	Bug-Fix: in printWert(d,d,d) with iVorsilbeNenner < 0 was no denominator in unit, with iVorsilbeZaeler < 0 unit was missing.
• PVFrameItem	• addCSV improved for better dynamical scaling • fixedFormat now also for units % ° und "_" • dynamical scaling in CSV-output
• Section Analyzer	Some item texts changed.
• Beamscan	TiltX correction and calibration dialog implemented.

Version 2.5.6.0 / 2009 2 2nd	
• XML	Enhanced for calling scripts.

Version 2.5.6.1 / 2009 2 4th	
• 3D View	Bug-Fix: save as bitmap now always with best resolution
• Progr. View	bug-fix: zoom with time scale the scale position has been corrected

Version 2.5.6.2 / 2009 2 20th	
• CMU1394Interface	bug-fix: ML3720 reports the Max Gain correct now
• Control Camera Tab	Flip Frame is disabled with starting acquisition

Version 2.5.6.3 / 2009 3 17th	
• Sections	bug-fix: when switching from Gauß-fit to Line-fit the line function now is displayed
• Sections	bug-fix: x-position of the Line-fit is shifted about ½ pixel
• Sections	fit functions are displayed including units now
• Beamscan	bug-fix: Controller Main Settings are set to Grab at start-up

Version 2.5.6.4 / 2009 3 26th	
• Beamscan	TiltX from 2.5.5.9 changed to TiltY and enabled, manual settings of parameters possible
• Sections	label of fit function enlarged

Version 2.5.6.5 / 2009 4 28th	
• XML	BeamSections tag enhanced to transfer angle
• XML	separate info tags for CS, BS and ROI
• BSTool	addXMLInfo and processSTXML activated
• Section Window	enabling Borders-Tab elements thread safe, e.g. borderTypeChanged
• Section Analyzer	bug-fix: setBorder now also works at reference = 100% Max
• XML	enhanced to set borders in the sections
• XML	enhanced to position sections from 1 bis N and in y from bottom to top
• Progr. View	• all sub-graph zooms can now be reset in once as well • graph data CSV, values now can also be copied to the clipboard • graph data CSV, values now are printed in scientific numbers forma

Version 2.5.6.6 / 2009 4 29th	
• Beamscan	Tilt correction in X and Y, dialog for parameter selection improved

Version 2.5.6.7 / 2009 5 14th	
• Image Correction	• at creating a spherical HoMatrix for negative curvature inaccuracy eliminated • implemented generation of a approximate spherical saddle surface
• Beamscan	bug-fix: in Auto-Calibration of Tilt correction in X and Y
• XML frame section	bug-fix: Mode command is set earlier to set position at the same time

Version 2.5.6.8 / 2009 5 14th	
• XML loadImage	implemented
• XML loadFrame	bug-fix
• XML evaluation	response action was not conform with manual, changed

Version 2.5.6.9 / 2009 5 29th	
• CMU1394 Interface	bug-fix: camera-ROI is checked "Modulo Step" in both directions
• Info Window	• GSP – Inventor parameter is shown if present • Dongle-Number is shown, if Dongle is patched after May, 20th 2009
• Beamscan	bug-fix: the scanned frame was corrected again with each scan
• Scan Tab Motor	dialog elements are disabled instead of hidden
• Scan Tab Motor	enhanced with acceleration phase settings
• Scan Tab	status bar changes color with scan state
• XML	evaluate – csv: separator accepts escape sequences

Version 2.5.6.10 / 2009 6 10th	
• Scan Tab	enhanced acceleration phase settings
• Beamscan	LSD also with 1Hz usable
• Beamscan	corrections in Controller – Main-Tab – Main-Control Frame
• Beamscan	LSD frequency can be changed during acquisition
• Scan Tab	bug-fix: no enabling of elements by switching between tabs

Version 2.5.6.10 / 2009 6 10th	
• Beamscan	XML Info included
• Beamscan	XML Start / Stop implemented

Version 2.5.7.0 / 2009 6 22nd	
• Display	Item list – Unit-Frame improved
• Beamscan	motor delay only at start but not at the end phase

Version 2.5.7.1 / 2009 7 22nd	
• Camera Interface	bug-fix at requesting the cameras step width for changing the ROI
• Control Camera	flip frame is not disabled during acquisition any more
• Control Main	bug-fix: external triggering is now activated
• CS Tool	positioning slider's Max-Value is now changed on event to not interrupting GUI interface
• Camera Tab	ROI Spin boxes MaxValues is set thread safe now
• Progression View	bug-fix: PVChartGroup::addItem: Mutex.lock to add chart during acquisition
• Section Analyzer	bug-fix: Noise Kernel size limited to frame size perpendicular to the section

Version 2.5.7.2 / 2009 8 17th	
• XML	motor tag implemented
• Beamscan	bug-fix: "first scan hangs, if is has not been grabbed before. bug-fix applied from 2.5.2.5

Version 2.5.7.3 / 2009 8 20th	
• Display	bug-fix: Item list – Unit Frame improvement disabled
• Control	bug-fix: disabling the external triggering depends only on the ability of the camera to trigger, not of the connection of an LSD
• Beamscan	bug-fix:in the motor dialog the parameters were not enabled any more after the were no more hidden, corrected

Version 2.5.7.4 / 2009 9 18th	
• Control	bug-fix: in creating a spherical homogeneity matrix
• Display	acquisition time now shown with microseconds
• Histogram	menu "File" got a "close", saving the graphic as bitmap is now also possible as jpg and png
• Progr. View	saving the graphic as bitmap is now also possible as jpg and png
• Pointing Stability	saving the graphic as bitmap is now also possible as jpg and png
• 3D View	saving the graphic as bitmap is now also possible as jpg and png
• Menus	In the following tools the menu texts have been changed: Histogram, DisplayFormNew, PointingStability, ProgressionView, ThreeDView, 2D View, SectionTool, SectionWindow, Console
• 2D View	"load tiff-image" dialog got a minimum size for varying its width and height
• Sections	detachable labels for fit function parameters included all detachable labels got a framed layout
• Sections	bug-fix: when resizing the window with and without data section the minimum height is stable now

Version 2.5.7.5 / 2009 9 23rd	
• Control	bug-fix: with a frame loaded into 2DView having different size to the current camera now generating of a background image is impossible (SW crashed here) - also in Viewer
• Beamscan	menus to save raw camera data are disabled in BS
• 2D View	bug-fix: when loading a frame no background correction is done
• 2D View	load dialog is without .prf now (Beamscan I), .tif is preselected

Version 2.5.7.6 / 2009 9 28th	
• Beamscan	with loading frames into 2D-View the correction options are disabled
• Beamscan	branch created

Version 2.5.7.7 / 2009 10 13th	
• Control	"Truncate negative values" is disabled at first start-up
• Sections	font attributes of the detached labels are saved
• 3D View	bug-fix: at reset (e.g. load INI) the Z Slider is initialized correctly now
• BS Controller	spell check: Main-Tab
• 2D View	bug-fix: Tilt correction at activated 2D-View ROI

Version 2.5.7.8 / 4.11.2009	
• XML	Bug-Fix: Memory leak with loadFrame tag repaired.
• XML	loadFrame / loadImage report length and width of the loaded frame.
• XML	Bug-Fix: LoadConfig tag now also works with INI files saved by the Kern.exe, not only with "XML saved INI".

Version 2.5.7.9 / 2010 6 7th	
• Trigger Config.	Bug-Fix: Limit of delay comes now from the analogue LSD instead of 1000Hz.
• Camera Interface	New device ML3064 integrated.
• Control Motor	Bug-Fix: Limits of positioning edit fields are changed with the stage length now.

Version 2.5.8.0 / 2009 12 16th	
• all File Dialogs	Asking for Overwrite if file exists.
• Socket Tab	Included XML output formatting.
• Motor / LSD	COM ports are scanned and identified automatically, ports >9 are possible.
• Control Motor	Tab revised.
• Control	Start / Stop button is marked for scan mode.
• Beamscan	Bug-Fix: More stable when ending program while scanning.
• Control Socket Tab	Any Client is default now.

Version 2.5.8.0 / 2009 12 16th	
• XML	Bug-Fix: memory leak with loadFrame tag
• XML	loadFrame / loadImage reply width and height.
• XML	LoadConfig works now more global (except cameras).
• Control Trigger	With connecting a digital LSD (ML1630) the frequency can be set continuously.
• Control Trigger	Bug-Fix: Toggling between LSD and external+LSD does not clear the pulse width any more.
• Motor config	Dialog + setting parameters method revised.
• LSD config	Dialog revised.
• ML1630-Interface	Connection procedure revised.
• ML1610-Interface	Connection procedure revised.
• LSD's	Trigger parameters can by changed during LSD is running.
• Section Items	Got shorty in their description to differ them in the lists of Display and Pview.
• Section Items	Bug-Fix:Evaluation values of long axis are now correctly shown.

Version 2.5.8.1 / 2010 1 8th	
• XML	Graphics transfer for SectionTools, Histogram, ProgressionView. 3DView, 2DView CSV transfer of ProgressionView and Histogram.
• XML	Preview integrated.
• Beamscan	Bug-Fix: Reading TiltFlag of ML3063 from INI.

Version 2.5.8.2 / 2010 1 18th	
• Items	Width and height in 2D ROI now shows the values of ROI, frame values are in the root.
• 2D View	Max. scale implemented.
• Camera Frames	Fixed memory leaks.
• 2D View	Minimum size can be set by menu.
• 2D View	Bug-Fix in scales

Version 2.5.8.3 / 2010 2 9th	
• Main Window	Menu item to open the current working directory.

Version 2.5.8.4 / 2010 2 22nd	
• Progression View	Bug-Fix: CSV data were not saved well since V2.5.8.1.
• Progression View	CSV AutoSave function implemented.
• Save files	Bug-Fix: Default extension was incorrectly evaluated.
• ProgressionView	CSV data are split at ca. 130MB and get suffix S00X.
• Camera Interface	New method to calculate the step width at changing frame size.
• Control– Motor	Connection and parameter check reworked.

Version 2.5.8.5 / 2010 3 8th	
• Controller Camera	Edit box for focal length of far field lens implemented.

Version 2.5.8.6 / 2010 3 12th	
• ProgressionView	Bug-Fix: With changing the camera binning the charts are cleared now.
• ProgressionView	Feature: Minimizing single charts.
• Beamscan	Motor dialog revised.

Version 2.5.8.6 / 2010 3 12th	
• Beamscan	Scan Tab, Position values got limit depending on motor parameters.
• Beamscan	Scan- calculation of velocity and length corrected.
• Controller Socket	Bug-Fix: When loading the configuration now the default port number keeps unchanged.

Version 2.5.8.7 / 2010 4 15th	
• Kern	Bug-Fix: Memory leek with loading TIF images.
• XML	Bug-Fix: Motor tag caused crash if motor was not connected.
• XML	Motor tag enhanced with connect attribute.
• XML	Motor_info tag implemented.

Version 2.5.8.8 / 2010 5 3rd	
• Socket	Bug-Fix: Disconnecting by the external client while sending data does not block any more.

Version 2.5.9.0 / 2010 5 10th	
• Display	New unit mrad for camera plain for divergence values with far field lens.
• 2DView	Tiff-Info window implemented.
• Items	Correction in item descriptions of Beam- and Lab Sections.
• Items	Bug-Fix: Ellipticity and eccentricity had inconsistent units.
• Items	Descriptions of COG's completed.
• Trigger Dialog	Bug-Fix: Hard coded limit of delay removed.
• Beamscan	Bug-Fix: Position limits of Scan tab (Bug since V2.5.8.0).
• Control Motor	Target-Position keeps current with slider moving.
• Camera Interface	ML3064 integrated
• Control Motor	Bug-Fix: With resizing the stage length also the motor tab elements get current limits now.

Version 2.5.9.0 / 2010 5 10th	
• Beamscan	Row position of the evaluated scan line in a single frame can be varied and the region can be shown in the 2D View.
• Beamscan	Bug-Fix: Scan auto center function lost frame data.

Version 2.5.9.1 / 2010 5 3rd	
• Controller Motor	Bug-Fix: Input of micro steps parameter was not correctly accepted.
• SingleWindow	Bug-Fix: Checking Control-pointer at start-up.
• GSP ML8020	Bug-Fix: Requesting state of limit switches improved.

Version 2.5.9.2 / 2010 8 16th	
• Beamscan	Bug-Fix: Tilt parameters also loaded from INI file for the ML3064 camera.
• GigECamera	Interface ready for testing
• LogTool	improved LogTool
• MatroxFG	Improvements for usage of line CCD.
• ML-Lib	Save position of Log-file changed to user folder.

Version 2.5.9.3 / 2010 8 25th	
• Beamlux	Divergence -tool implemented.
• LogTool	revised
• Beamlux	M² Tool redesigned, Bug-Fix showing small length, saving sequence.
• LSD's	Possible to change trigger frequency while camera runs.
• GigECamera	Camera IP is shown at Controller Camera tab.
• Control_Trigger	Frequency-Slider got better scale ticks.
• Projekt-Files (ini)	Some default values corrected.
• LSD 16x0	Frequency-Slider index adapted.

Version 2.5.9.3 / 2010 8 25th	
• Control_Trigger	Trigger options shown on Main tab are improved for camera change with connected LSD.
• GigE	ICX1394 Camera labeled.

Version 2.5.9.4 / 2010 9 27th	
• LSD / Motor	tiny Bug-Fixes
• PointingStab	Bug-Fix in Scale method, tick position had no default.
• CameraInterface	PixelSwitch speed increased.

Version 2.5.9.5 / 2010 10 7th	
• BL2Analyzer	Bug-Fix: prevented memory overflow at evaluations in sections in mode Slit and Knife Edge
• Divergence Tool	activated by dongle key

Version 2.5.9.6 / 2010 10 12th	
• Beamlux	Bug-Fix: DivTool evaluated values can be cleared.
• Beamlux	Spell check: M² + DivTool.
• Beamlux	CSV Dialog in Histogram modified.

Version 2.5.9.7 / 2010 10 21st	
• MainSingleWindow	Bug-Fix: Crashed when Bundle Dll was missing.
• Script	Bug-Fix: Controller object was inactive.

Version 2.6.0.0 / 2010 11 2nd	
• Excimer Sample	Can now be used as line sample.
• BeamScan	ellipticity of HeNe sample camera can be changed here as well.
• Sections	displaying sections discrete (steps) when zoomed in, fit-curves still shown continuously, positions corrected.

Version 2.6.0.0 / 2010 11 2nd	
• XML	Buf-Fix: Camera – Auto Exposure did not work correctly.
• BeamLux	Spell check Marker text in Sections, Fixed Type percentage value included as item.
• Sections	Bug-Fix: COG output of section marker and Display/PV had been different, (pixel values but not physical values were used).

Version 2.6.0.1 / 2010 12 1st	
• Kern Socket	Bug-Fix: Socket crashed when client closed connection during local writing operations.
• GigECamera	NIR Camera integrated.

Version 2.6.0.2 / 2011 1 10th	
• Beamscan	Bug-Fix: Logical test of Tilt parameters corrected.
• Beamscan	Fit for suggesting Tilt parameters improved.
• Control	Syntax-Fix: Script interpreter Map – String.

Version 2.6.0.3 / 2011 1 14th	
• Kern	Bug-Fix: Logging filter of console is saved in INI file.
• Analyzer	Bug-Fix: Some Loops in evaluation protected against endless running.
• Camera-Node	Timeouts and log messages included in start and stop procedures.

Version 2.6.0.4 / 2011 2 14th	
• Section ConfigDlg	Option to select between digital and linear interpolation

Version 2.6.0.5 / 2011 4 19th	
• XML	Bug-Fix: Motor tag did not report current motor position without changing position.

Version 2.6.1.0 / 2011 3 2nd	
• XML Motor-Tag	Bug-Fix: With connecting to the XML interface now all motor attributes as shown on the motor tab are reported except of the device list.
• XML Motor-Tag	Bug-Fix: The state attribute in the motors answer has been changed to on/off and the port attribute now is integer as it is described in the manual. **Note: This is not compatible to the older versions and possibly has to be changed in the client's interface!**
• MainWindow	The status bar now shows the connection state of the XML interface.
• Display Tool	Bug-Fix: The column width was sometimes calculated incorrectly.
• Result Items	Some descriptions have been shortened.
• INI File	Bug-Fix: A backup of the configuration file prevents unpredictable effects if the program is killed during shutdown.
• ProgressionView	New menu item to delete all selected items.
• ProgressionView	Illustration of the single graphs and frame sizes optimized.

Version 2.6.1.1 / 2011 4 7th	
• GigE Dll	Bug-Fix: More stable with different camera types on the same LAN interface.
• XML Motor-Tag	The motor properties are now replied although a motor is not connected.
• Console	Log messages can be shown after start-up.

Version 2.6.1.2 / 2011 5 16th	
• GigE Dll	Bug-Fix: Horizontal flip and 8Bit mode activated.
• CamluxFP Dll	ML3745/3065/3066 and 3067 = new cameras with 1000x1000 pix integrated.
• Controller Camera	Bug-Fix: When setting the binning also the time base and the exposure slider are refreshed.
• 3D View	Auto-rotation added.

Version 2.6.1.3 / 2011 6 6th	
• Controller	The Camera ROI position input elements improved: values are corrected not before leaving the spin box.

Version 2.6.1.4 / 2011 6 6th	
• 2D View	XML upgrading to send the image as CSV data.

Version 2.6.1.5 / 2011 6 15th	
• MLLib	Bug-Fix: memory leak in fit routine repaired.
• CSV / Kern	In General Settings a country specific separator can be set as default for all CSV dialogs.

Version 2.6.1.7 / 2011 8 16th	
• Control	Bug-Fix: Memory leak in background correction routine repaired.
• Console	Bug-Fix: Scrolling improved.

Version 2.6.1.8 / 2011 8 30th	
• CSV	In CSV dialogs the linefeed is hidden for tables output.
• CSV - Prints	If no data are available an information is print into file or clipboard.
• Histogram	CSV to clipboard available
• General Settings	A customized working directory now is displayed correctly after restart.
• General Settings	The locale setting for CSV is now permanent after restart.

Version 2.6.1.9 / 2011 8 31th	
• Control Camera	Bug-Fix: Camera name is not read from INI file any more.

Version 2.6.1.10 / 2011 9 16th	
• 2D View	Bug-Fix: Original-size is now always rescaled with the change of aspect settings.
• Kern	Bug-Fix: INI - configuration is not saved with extension tmp anymore.
• Control Camera	Bug-Fix: ROI spin boxes now work as intuitively expected.

Version 2.6.1.11 / 2011 9 19th	
• Camera Control	Bug-Fixes: Scripting restored and event handling of initialization stabilized.

Version 2.6.2.0 / 2011 9 27th	
• Display	Bug-Fix: Item settings - initialization of decimal places are set correctly now.

Version 2.6.2.1 / 2011 10 25th	
• MLProtocol	Add-On for Protocol Generation of Evaluation Results.
• Control	Bug-Fix: Trigger frequency combo box on the main tab was not always present.
• Control	Tild dialog adjusted for ML3062, ML3065, ML3066 and ML3067.
• Control	Bug-Fix: Setting binning / camera ROI and then loading a picture could fail.
• Sections	Bug-Fix: Data memory was sometimes not adapted to the image size.
• 2D Arithmetic	Setting dynamic had to be limited to 30bit.
• Sequence View	Bug-Fix: Changing icon size while playing a sequence is not allowed.
• Sections	Bug-Fix: Length scale labeling improved.

Version 2.6.2.2 / 2011 11 22th	
• ProgressionView	Time-Scale and y-Scales improved.
• Sections	CSV output optional as 2D-table
• BeamScan	Bug-Fix: Automatically moving to start when canceling a scan is repaired.
• BeamScan	Bug-Fix: Average region of scanned frame repaired.
• Sections	Bug-Fig: Length between border value is refreshed when changing settings.
• Sections	Bug-Fix: Length scale improved for small values.
• General Settings	Global setting of time output format, affects CSV in ProgressionView, results in Sections
• 2D-View	Bug-Fix: length scale improved for small values

Version 2.6.2.2 / 2011 11 22th	
• ROI Tool	Shape Menu Items for circle and square are disabled during AutoSize because they can not be used then.

Version 2.6.2.3 / 2011 12 2nd	
• Sections	Bug-Fix: Avoid a division by zero when calculating COG.
• ProgressionView	Bug-Fix: Resize behavior while adding a new group improved.
• ProgressionView	Bug-Fix: Display of constant values improved.

Version 2.6.2.4 / 2012 03 28th	
• XML	Bug Fix: reporting "single frames" via XML also when ScanTab is active
• Kern	Bug Fix: mutual exclusion (Mutex) blockade removed
• MotorInterface	Bug-Fix: Blocking the command sending function repaired

Version 2.6.3.0 / 2012 01 13th	
• 2D View	Zoom included.
• ProgressionView	Scale of position coordinates now fits better to several camera magnifications.
Frame Grabber	Matrox CronosPlus included.
• 2D View	File Menu reorganized internally.
• GSP Interface	Defaults for Moving + Acceleration currents set to IPComm default.

Version 2.6.3.1 / 2012 02 8th	
• XML	Bug Fix: Reporting "single frames" via XML also when ScanTab is active.
• Control	Camera naming can be changed by the user.
• XML	XML commands can be logged in the console.
• Console	A logfile now can be activated / deactivated.

Version 2.6.3.2 / 2012 03 7th	
• Control	Bug-Fix: Camera name was not shown correctly after reinitialization.
• 2D Zoom	Zoom area adaption for fixed aspect ratio improved.
• DistanceTool	Bug-Fix: conflict with 2D Zoom removed.
• ROI Tool	Bug-Fix: conflict with 2D Zoom removed.
• Section Tools	Bug-Fix: conflict with 2D Zoom removed.
• Display Tool	Bug-Fix: the windows column widths are saved and restored now.
• 2D View	Bug-Fix: File Info window now closes with closing the 2D view.
• 2D View	Bug-Fix: menu to show File Info was not activated correctly.
• TiffHeader	Flip and Binning are included and are shown in File Info window.
• 2D View	FileLoad dialog improved.
• All Tool windows	Bug-Fix: Minimum window size was set wrong if it had been changed with an update.

Version 2.6.3.3 / 2012 03 27th	
• Control	Changing pixel size of analog cameras available again.
• Control	Contrast Slider for CronosPlus frame grabber added to Camera Tab.
• 2D View	File Info window shows Power parameters with active Power-Tool only.
• 2D View	Bug-Fix: Row data of a loaded file could not be exported as CSV.
• Kern	Bug-Fix: Mutual exclusion (Mutex) blockade removed.

Version 2.6.3.4 / 2012 04 9th	
• MotorInterface	Bug-Fix: Closed a leak in sending command function, function could block.
• StageControl	Timeout implemented to avoid blocking at possibly blocking motor command.
• Control Motor	Bug-Fix: Input of abs. and rel. motor position on control motor tab improved.

Version 2.6.3.5 / 2012 04 26th	
• Pointing Stability	Beam Position Stability is 4*sigma as printed in ISO 11670:2005 correction
• MotorInterface	Speed-Up the start-up procedure in the case of missing motor controller.

Version 2.6.3.6 / 2012 05 30th	
• Control Image Corr.	Bug-Fix: Switching between spherical and saddle shaped homogeneity matrix was disturbed by the Start/Stop button resulting in a wrong calculation.
• Control Image Corr.	Bug-Fix: Spin-Box of the saddle shaped matrix no more becomes red with negative values.
• MotorInterface	Speed-Up of start-up procedure now is downward compatible.

Version 2.6.3.7 / 2012 07 20th	
• Sections	Fit curves parameter are implemented as measurement items for Display, PV and XML.
• Sections	Fit tab cann be controlled by XML
• Sections	Noise tab cann be controlled by XML
• Beamscan Motor	Delay and Distance can be set by XML

Version 2.6.3.8 / 2012 08 29th	
• Display	Bug-Fix: With Pass/Fail the fail values were not printed (since 2.6.3.2)
• 2D View	Bug-Fix: Saving a loaded Tiff file and loading it again stopped the program

Version 2.6.3.9 / 2012 10 31th	
• 2D View	Bug-Fix: In a zoom area at the bottom of the image the touch of the last image row by the mouse pointer killed the process.

Version 2.6.3.10 / 2012 11 21st	
• Motor Interface	Response timeout increased and requesting the actual position interval increased after optimizing the COM communication.

Version 2.6.3.10 / 2012 11 21st	
• Motor Interface	Response timeout increased and requesting the actual position interval increased after optimizing the COM communication.

Version 2.6.3.11 / 2014 03 26th	
• ML1810	Bug-Fix: Matrox Meteor grab-start adapted to previous Cronos implementation.

Version 2.6.3.12 / 2014 05 08th	
• BeamScan	Bug-Fix: Workaround for Camlux error at repeating continuous scan with 600Hz camera triggering

Version 2.6.4.0 / 2012 06 27th	
• Console	Logging of the serial commands implemented.
• SequenceView	Bug-Fix: Changing the color scale when running a stored sequence works now.
• FrameView	Bug-Fix: Displayed intensity value in zoom corrected.
• Distance Tool	Displayed value in 2D-View switches between pixels and meter with changing the scale in 2D View.
• Distance Tool	Displayed precision now depends on the angle of the measurement line.
• ROI Tool	Displayed value in 2D-View switches between pixels and meter with changing the scale in 2D View.
• XML	Bug-Fix: in <saveImage> tag an empty "extension" was set to tif even if the name had an extension.
• ProgressionView	AutoSave Dialog now can set the separator.
• ProgressionView	AutoSave Dialog is closed automatically together with PV.
• MainWindow	Bug-Fix: General Settings Dialog is correctly canceled with the "Cancel" button.
• MainWindow	When changing working path a reload can be canceled.
• 2D View	Added menu to save a zoomed region bitmap.
• 2D View	Zoom can be moved exactly to the window border now.
• ProgressionView	Bug-Fix: Saving CSV, when automatically splitting files (> 130MB), the path information got lost by appending a suffix.
• ProgressionView	Bug-Fix: Saving CSV, when breaking the auto save procedure or changing the path while save mode was active the file header got lost.

Version 2.6.4.0 / 2012 06 27th	
• Control	Sequence interval limit increased from 1000 to 32767
• ProgressionView	Bug-Fix: With active FloatingAverage the beginning frames (before averaging was completed) had an empty time stamp.
• ProgressionView	If the time stamp includes separators also the CSV header for the time stamp is equipped with separators.
• CameraNode	Error messages of camera fails enhanced.
• LSDs	Bug-Fix: connection error after scanning the COM Ports eliminated
• Console	Bug-Fix: Log messages are not centered any more (some did before).
• Control-Trigger	Bug-Fix: when disconnecting an LSD at active trigger mode the Grab radio button was activated, but not the internal procedure. The camera was still waiting for a trigger pulse in grab mode.
• Sections	Fit curves parameter are implemented as measurement items for Display, PV and XML..
• Sections	Fit tab can be controlled by XML
• Sections	Noise tab cann be controlled by XML
• Beamscan Motor	Delay and Distance can be set by XML
• XML	Magnification included in Camera Tag.
• XML	Bug-Fix: <grab> is always running as latest command of a document.
• XML	Bug-Fix: memory leak at frame transfer.
• Console	XML message including CDATA section are shortened.
• Console	The number of shown lines in the console is limited to 500. Then the upper lines are deleted.
• Display	Bug-Fix: With Pass/Fail the fail values were not printed (since 2.6.3.2).
• 2D View	Bug-Fix: Saving a loaded Tiff file and loading it again stopped the program.
• XML	Bug-Fix: Activating <evaluation> once, leaded to spontaneous messages even if continuous = false was set or the list was empty.
• Control	GUI Frame for acquiring background now is enabled/disabled as a whole.
• ImageFilter	Bug-Fix: Removed memory leak when loading several Tiff images one after another.
• 2D View	Bug-Fix: Hiding/showing the FileInfo dialog now is thread save.

Version 2.6.4.0 / 2012 06 27th	
• XML	Bug-Fix: Camera ROI Left and Top could not been changed correctly.
• XML	Camera ROI step widths implemented in <info> tag.
• XML	Error handling in some subroutines improved.
• 2D View	Color table can now be shown with scale of Counts.
• Sections	Bug-Fix: CSV- and result output only possible if data are available.
• Console	Bug-Fix: End-of-line characters are removed from the logs.
• Controller	Bug-Fix: disabled start button while acquiring background or homogeneity image.
• ProgressionView	Bug-Fix: INI entries reorganized.
• 3D View	Better error handling.
• Control	Bug-Fix: improved error handling when changing motor controller.

Version 2.6.4.1 / 2012 10 24th	
• XML	Bug-Fix: Thread handling QDOM in Win7 with Multi-Bundle improved.
• XML	Command <frame><saveCSV> added.
• Sections	Reset Zoom button added.
• 2D View	Bug-Fix: In a zoom area at the bottom of the image the touch of the last image row by the mouse pointer killed the process.
• Arithmetic2D	Bug-Fix: Tool initialization improved.
• KernObjects	LineEdit elements made thread save with changing foreground color.
• Kern	Fixed font size for Window 7.
• GlobalSettings	Font of formula characters can be changed.

Version 2.6.4.2 / 2012 12 3rd	
• Arithmetic2D	Bug-Fix: correct file header for resulting frames is implemented in if saved with 2D View.

Version 2.6.4.2 / 2012 12 3rd	
• GigE-Kameras	Bug-Fix: Timeout for heartbeat increased.
• Control	Some spell check.
• General Settings	Now with tabs.

Version 2.6.4.3 / 2012 12 12th	
• Sections	Bug-Fix: units improved (Contrast = %, all % units in data section as factor < 1)
• GigECamera64	Interface for GigE cameras implemented for running with 32 bit and 64 bit OS.
• ProgressionView	Bug-Fix: AutoSave timer now stops correctly
• Sections	Bug-Fix: ROI marker positions were shifted 0.5 pixels
• Motor interface	Bug-Fix: COM Timeouts set after every new connection and with values as normally proposed.
• Camera ROI	Bug-Fix: Left / Top was calculated wrong, if the camera ROI was changed.
• Beamscan	Initializing 2D-View when starting Beamscan was improved.
• 2D-View	Warning if a very large original size shall be set.
• Sections	Bug-Fix: Detachable Labels sometimes were not visible at the first call under Win7-64.

Version 2.6.5.0 / 2013 03 19th	
• ProgressionView	Bug-Fix: ProgressionView now clears memory when the applications memory limit is reached at long-term measurements. If AutoSave is active the data will be saved before clearing.
• 2D-View	Bug-Fix: axis labeling improved.
• 2D-View	Color range limits for color scale implemented.
• Control	Bug-Fix: To activate the change of the Camlux option "increase dynamic..." also the binning mode had to be changed once.

Version 2.6.5.1 / 2013 04 08th	
• Control	Bug-Fix: changing the camera could lead to long delays in the application

Version 2.6.5.1 / 2013 04 08th	
• GigE camera	Implemented frame rate message
• GigE camera	Implemented BPC8301
• Beamscan	Bug-Fix: Calculating the scan velocity without frame rate value of the camera is prohibited.
• GigE camera	Packet size of frame transfer is automatically detected (Jumbo Frames of the LAN adapter) and sent to the connected camera. Adapting the LAN parameters is not necessary any more.

Version 2.6.5.2 / 2013 04 24th	
• Dispatcher	Bug-Fix: Color range limits could block the loading of Tiff images.
• 2D-View	Bug-Fix: Option Menu "Original Size" created wrong size after implementing the color scale and color range limits
• 2D-View	Bug-Fix: If the pixels had not a square shape or the aspect ratio was not fixed the rulers of saved bitmaps were scaled and printed incorrectly.
• 2D-View	Color range limits are also considered in saved bitmaps.
• 2D-View	To print the rulers when saving a bitmap now is optional and can be chosen in the file dialog.
• Control	Bug-Fix: Changing the camera's dynamics while Tiff images were loaded leaded to a incorrect scaling of the color ruler
• 2D-View	Bug-Fix: Changing the ROI size in the empty 2D-View window could lead to a crash of the application
• Control	Bug-Fix: Loading a Tiff image while the the background correction was active and not set to background image could hide the frame because of a zero division
• General Settings	The dialog was enhanced by settings of the packet size for data transfer of GigE cameras.
• GSP Interface	Bug-Fix: The Connection could fail because of a controller reset during initialization together with adverse timing behavior of the software.

Version 2.6.5.3 / 2013 05 16th	
• 2D-View	Bug-Fix: Minimum size, original size and changing view does not lead to extrem window size any more.
• 2D-View	Bug-Fix: Color range is now an additional save option.
• 2D-View	Settings of the CSV Dialog are stored in the INI file at program termination.
• Beamscan	2D-View menu implemented to save zoomed frames as bitmap.
• XML	<frame><saveImage> was enhanced with attributes to choose color scale and color range limits.

Version 2.6.5.3 / 2013 05 16th	
• Beamscan	Bug-Fix: On the Control Main Tab the Main Control options including camera triggering are disabled now with disconnecting an LSD. Using these options without LSD could lead to a frozen GUI.
• 2D-View	Bug-Fix: Loading Tiffs with bit depth different to the value set at the actual camera could lead to a frozen GUI, therefore the reprocessing was changed.
• 2D-View	Color Range Toolbar got spin boxes for entering color limits.

Version 2.6.5.4 / 2013 06 07th	
• BeamSections	Bug-Fix: The parameters of the fit functions hat no units.
• 2D-View	Bug-Fix: Any first frame of a new acquisition sequence was shortly shown with the last set color range limits although the toolbar was inactive.
• 2D-View	Bug-Fix: When deactivating the color range toolbar now the actually shown frame is refreshed.

Version 2.6.5.5 / 2013 06 14th	
• 2D-View	Bug-Fix: Unit prefix for intensity 0 at the current cursor position corrected.
• 2D-View	Bug-Fix: Color scale is not printed if the color range is set to 1 (Max=Min).
• 2D-View	Bug-Fix:The spin boxes of color range toolbar are disabled with the inactive toolbar to avoid undesired changes of the values.

Version 2.6.5.6 / 2013 08 27th	
• GigECamera	Bug-Fix: Indexing of the exposure time slider has not been set correctly.
• General Settings	The GigE tab is active only if the GigECamera-Dll has been loaded.
• Kern	The actual used store paths for TIF files, homogeneity matrices and results (= CSV values, data and bitmaps of the graphs) are restored with the next program start.
• XML	Bug-Fix: all commands with a path attribute for declaring a file name have got an additional check if the path has got a file name at the end.
• XML	The acquisition tag now has a delay attribute to pause after starting the camera before any additional command can be executed.
• GigECamera	Bug-Fix: Start/Stop behavior corrected
• LSD	Bug-Fix: device-specific offset of the delay time is added to the displayed value
• XML	The acquisition tag now has a waitNR attribute, so that the next command can wait for the end of a number restricted acquisition after the camera has bees started.

Version 2.6.5.7 / 2013 09 19th	
• Camera Node	Debug log messages for Auto-Exposure optimized.
• MotorInterface	Bug-Fix: security check for Channel < 1
• Beamscan	Bug-Fix: If after a scan a new single frame is acquired, a change back to the scan tab always activates the radio button "Current Frame" in the "Display" group box. So it is possible to get the last scan frame back by setting the Scan radio button.
• PointingStability	Bug-Fix: Typo "Symbol" instead of "Sample" at graphics settings
• ProgressionView	Bug-Fix: AutoSave file name without given extension works now correct.
• ProgressionView	Bug-Fix: Restarting the AutoSave timer works better now. Also the start procedure has been improved.
• LogTool	Closing the application now waits for finishing the write procedures to the log file.
• GigECamera64	Bug-Fix: Two cameras on one switch use the same host IP, which has been improved at the interface
• GigECamera64	Bug-Fix: Heartbeat interval now are 6 times oversampled and up to two missing beats are allowed before any error message
• GigECamera64	Reading from the UDP sockets allows up to 10 unsuccessful attempts before the connection is closed.

Version 2.6.5.8 / 2013 11 29th	
• GigECamera64	Bug-Fix: Setting any binning and closing the application resulted in a too small maximum sensor size after restart.
• MainWindow	Info window is not shown any more system modal if the XML interface is active, so that the remote controlling can always continue.
• FrameView	Bug-Fix: Choosing the options "Original Size" and "Minimum Size" is now considered with zooming as well.
• FrameView	Bug-Fix: The option to ignore an active Color Range setting when saving a bitmap is now also considered for the illustration of the color scale.
• PointingStability	Bug-Fix: Saving CSV data without time stamp now is possible
• Display	Bug-Fix: Scaling the columns also works now after changing the font size.
• MotorEmulator	Bug-Fix: Actual position is hold with stopping the motor
• MotorEmulator	Bug-Fix: Motor frequency can be changed
• MotorEmulator	Bug-Fix: Maximum length can be changed up to 2 meters now.
• FrameView	Bug-Fix: Window size stays constant with active Color Range toolbar and restarting the application.

Version 2.6.5.8 / 2013 11 29th	
• Control	Motor tab has been extended with buttons for predefined positions.
• GigECamera64	Bug-Fix: Triggering a GigE camera has been improved for infinite start up delay
• GigECamera64	Bug-Fix: internal memory reorganized
• GigECamera64	Bug-Fix: Ring buffer for temporarily saving image data corrected.
• ProgressionView	Time line scale improved to show smooth time intervals.
• GigECamera64	Bug-Fix: Illegal memory access at fast start/stop commands prevented.
• GigECamera64	Bug-Fix: Receiving camera answers improved

Version 2.6.5.9 / 2014 01 20th	
• XML	Bug-Fix: Saving frames as CSV sometimes got a txt extension in stead of csv
• Beamscan	Motor parameters to calculate the scan frequency are not fixed any more but used from the motor settings so that different motor interfaces can be used now correctly.
• Beamscan	Bug-Fix: GigE - Error message corrected.
• FrameView	Bug-Fix: Frame sizes which were not divisible by 4 where showen incorrectly when the color range was active.
• MotorEmulator	Maximum length now is 5 meter by default and can be up to 10 meters.
• Control Camera	Bug-Fix: If the exposure time changes because of changing the time base, now also the display of the FPS is corrected.
• FrameView	Bug-Fix: Color Range settings at very large frames destroyed the image

Version 2.6.5.10 / 2014 02 17th	
• Control	Bug-Fix: Changing the camera with active background correction could stop the application.
• FrameView	Bug-Fix: The File Load dialog does not work optimal with detail view of the files in combination with descending sort. Loading the wrong frames is prevented now.
• FrameView	Bug-Fix: Saving a frame as bitmap with disabled Color Range had faulty flags
• Control	Tilt button caption on Camera Tab corrected, this function is available for all ML306x cameras.

Version 2.6.5.11 / 2014 03 18th	
• Beamscan	Bug-Fix: Changing between the Control's Scan tab and the Main tab leaded to incorrect frame views.
• Beamscan	Bug-Fix: To start a new scan during the stage moves to the start position is prevented, but grabbing is allowed at this time.
• Beamscan	Bug-Fix: Reconnecting the motor could lead to an incorrect setting of the return speed which is also the maximum scan speed.
• ProgressionView	spelling corrections
• GigECamera64	Bug-Fix: Initializing after binning reset, changed error numbers, offset unit adapted for 8bit use, AutoSetting of Jumbo frames improved

Version 2.6.5.12 / 2014 05 08th	
• BeamScan	Bug-Fix: Workaround for Camlux error at repeating continuous scan with 600Hz camera triggering

Version 2.6.5.13 / 2014 07 23th	
• Console	Bug-Fix: Logging Flags were deleted all when erasing only one.
• GigECamera64	Bug-Fix: Calculating of network packet size was not correct
• GigEInterface	Included some missing GenICam Objects
• GigECamera64	Added frame rate changing for BPC8301
• Camlux	Fix: Exposure time is limited to 5 sec. to not reach internal timeouts.

Version 2.6.5.14 / 2014 08 19th	
• GSP	Bug-Fix: Configuration for OEM linear devices now reads the moving frequency from the GSP device at start-up.

Version 2.6.5.15 / 2014 08 21th	
• Controller	Bug-Fix: Repaired the single shot mode for GigE cameras.
• LSD	Bug-Fix: Single shot mode now always is internally set to 10Hz independed on the selected trigger frequency

Version 2.6.5.16 / 2014 09 2nd	
• 2D View	Bug-Fix: Correction of scaling factor for X and Y at large 2DView displays, of very small zoom area positioning and count values displayed in the status bar
• CameraInterface	Bug-Fix: Camera-Settings flag of GigE Camera data packing was not copied
• GigECamera64	Trigger port of BPC8301 set to line2
• GigECamera64	Bug-Fix: BPC8301 exposure time limits are not fixed but read from the camera.

Version 2.6.5.17 / 2014 09 8th

Version 2.6.5.18 / 2014 09 16th	
• LSD	Bug-Fix: Single shot fixed frequency changed from 10Hz to 12Hz because the LSD sometimes generated two trigger pulses for one snap shot because of a possible rounding error in its firmware.

Version 2.6.5.19 / 2014 09 25th	
• Kern	Property Page for the Windows Properties changed from German to English
Controllux	Reference speed decreased

Version 2.6.5.20 / 2014 10 15th

Version 2.6.5.21 / 2014 11 04th	
• GigECamera	Bug-Fix: Wrong error message at setting exposure times of up to 5 sec suppressed
• GigECamera	Bug-Fix: Cameras are set to internal defaults with each start-up
• MotorInterface	Bug-Fix: Changed motor parameters were not always restored at a software restart.

Version 2.6.5.22 / 2015 01 07th	
• LineTool	Canceling the color dialogs leaded to a black color as result.
• XML	Measurement item tags got an additional attribute for the Longnames

Version 2.6.5.23 / 2015 01 29th	
• LSD	Bug-Fix: With the setting of external triggering the LSD was started twice because of debouncing of the user controls for the trigger parameters. This debouncing now only acts while the controls are used.
• 2D View	Bug-Fix: With inactive aspect ratio now the window always can be resize to a very small minimum size.
• XML	Main tag extension to list all configuration files.
• Sections	Bug-Fix: Gauss Jordan routine for Gauss fit corrected.
• Kern	Bug-Fix: Image memory overflows are now better controlled and generates an error log.
• Kern	Bug-Fix Loading too large images is now better controlled and generates an eror log.
• Control	Bug-Fix: Changing the camera did not always set the check button for the homogeneity matrix correctly.

Appendix D RAID System

The measurement system can be equipped with a RAID system. In this case an Adaptec RAID controller is installed together with a back plane rack module containing two hard disk drives which are dedicated for a RAID usage. Such systems are configured and ready to use as RAID 1 containing one single array.

For further details of the RAID system please refer the Adaptec manuals on the Adaptec DVD (if one is delivered together with the measurement system) or see http://start.adaptec.com/.

Any fail of one of the hard disk drives causes an alert and read flashing warning lamps at the hard disk rack module. The alert relapses into silence after a few seconds while the red warning lamps continue flashing until the error will be repaired.

To see the actual state or to analyze an actually shown alert call the already installed **maxView Storage Manager**. This is a Java based application which runs within the Internet Explorer. It can be started with the icon shown in D-1.

Figure D-1: Desktop Icon

When starting the **maxView Storage Manager** at first a security warning is shown in the Internet Explorer which can be ignored. As next an authorized user must log in to continue loading the application.

Log in as user **Administrator** with the same password as it is known for the beamscan II configuration.

The **maxView Storage Manager** gives all necessary information about the actual RAID system.

A failed hard disk drive can be unplugged and reinserted while the system is still running.

Be sure to use spare disks which are dedicated for a RAID usage and have at least the same storage capacity ore more.

When changing a hard disk drive the controller has to rebuild the array on the new drive. This process can last several hours depending on the size of the array and the speed of the disks.

Such a synchronization process is indicated with flashing red LED at the hard drive rack module and can be traced in the **maxView Storage Manager** during the system still runs or when booting in the Adaptec controller's start-up menu (CTRL + A while booting – Main Menu – Manage Arrays).

D-2 shows the view of a rebuild process during the Windows system is still active. In the last column a process rate of 16% can be seen here.

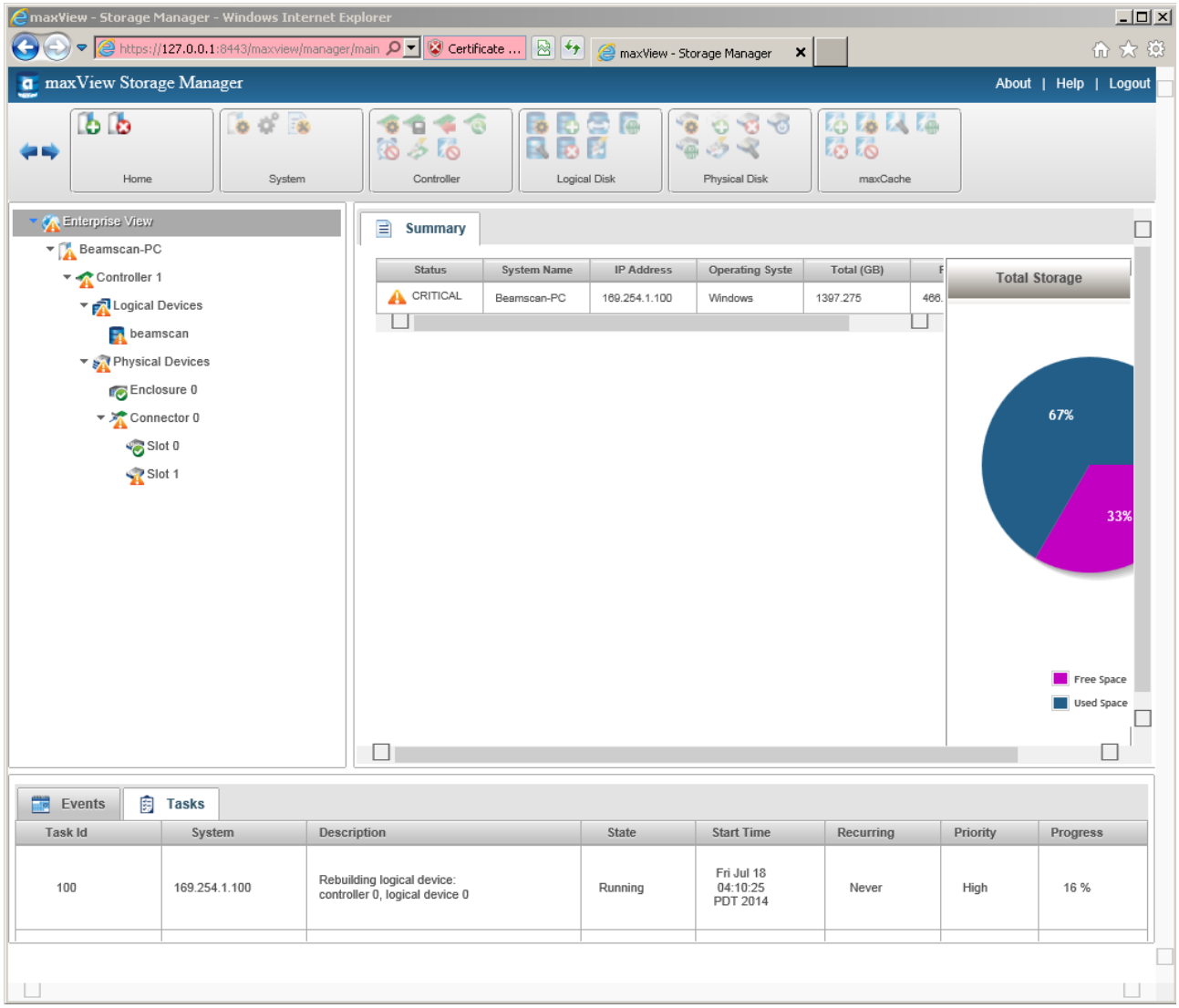


Figure D-2: Rebuilding process view in the maxView Storage Manager

Appendix E Metrolux End-User's License Agreement

This End-User License Agreement ("EULA") is a legal agreement between you and Metrolux GmbH. You agree that this EULA is enforceable like any written negotiated agreement signed by you.

This EULA applies to (the use of) Metrolux software, including Internet-based services, and all contents and programs contents offered by Metrolux (“Software”).

Please read this EULA carefully. By using all or any portion of the Software you accept all the terms and conditions of this EULA.

All products that Metrolux delivers to you, including documentation, software, hardware, data carrier, dongle, etc. (referred to as " Metrolux products" below) are subject to the terms stated below. All future orders will be based on these terms as well. If you disagree with these terms, please return the Metrolux products to us, postage prepaid, within seven days of receipt, and we will provide you with a refund.

1. Metrolux gives a warranty of 18 months from the date of delivery according to Metrolux general terms of business. This warranty is limited to significant defects in material and workmanship of the Metrolux products detected under normal use. Warranty claims must be made in writing during the warranty period. The documentation must contain a description of the defect and include sufficient proof for the defect detected in a Metrolux product. An entirely error-less operation of software is not – nor can it be – guaranteed by Metrolux.
2. If you receive defective Metrolux products, Metrolux's sole obligation is to repair or replace, at Metrolux's choice, any Metrolux product free of charge. Any replaced parts shall become Metrolux's property.
3. Metrolux is not responsible for any delays in delivery. Metrolux's entire liability for any damages to you or another party for any cause shall not exceed the price of the Metrolux product that caused the damage. Metrolux will in no event be liable for any damages caused by your failure to perform your obligations, or for any loss of data, profits, savings or any other consequential and incidental damages, even if Metrolux has been advised by you that such damages may be possible, or for any claims by you based on any third-party claim.
4. You may not try to copy, reproduce, or reverse-engineer any part of the Metrolux products, except for making archive copies of the software.
5. Except as stated above, there are no other representations or warranties regarding Metrolux's products, services or performance, expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The loss of a dongle in particular voids the license.

Final provisions

1. Additions to this agreement, including this clause shall require the written form.
2. In the event of any individual provision of this agreement being or becoming void, the validity of the other provisions shall in no way be affected. The invalid or unenforceable provision shall be replaced by one approved and valid provision that reflects its economic implications.
3. This agreement shall be governed by the laws of Federal Republic of Germany. The place of jurisdiction shall be Göttingen. All questions concerning the validity, the interpretation and the implementation of the contract contents are to be resolved at the place of jurisdiction of the licensor.

Metrolux software uses Qt Framework (developed by the Qt Company and the Qt Project) and is included under the terms of the GNU LGPL V3.0 (see http://fsf.org/ or the Metrolux data storage medium for details).

Appendix F Literature

DIN EN ISO 11145-PRA1
"Optik und optische Instrumente – Laser und Laseranlagen – Begriffe und Formelzeichen",
(EN ISO 11145/prA1:2004)

DIN EN ISO 11146-3
"Lasers and laser-related equipment – Test methods for laser beam widths, divergence angles and beam propagation ratios – Part 2: Intrinsic and geometrical laser beam classification, propagation and details of test methods", (ISO/TR 11146-3:2004)

DIN EN ISO 11670
"Laser und Laseranlagen – Prüfverfahren für Laserstrahlparameter - Strahllagestabilität", (ISO 11670:2003)

DIN EN ISO 15367-2.
"Laser und Laseranlagen – Prüfverfahren für die Bestimmung der Wellefrontform von Laserstrahlen – Teil 2: Shack-Hartmann-Sensoren" (ISO 15367-2:2005)

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