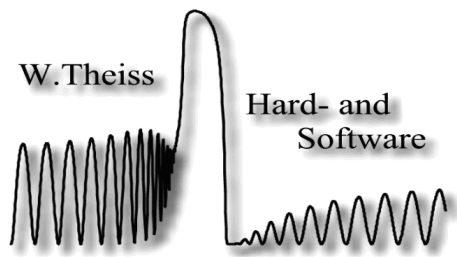


BREIN

BRight Eye Inspection Network

Software for optical production control of multilayer coatings

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BREIN

BRight Eye Inspection Network

by Wolfgang Theiss

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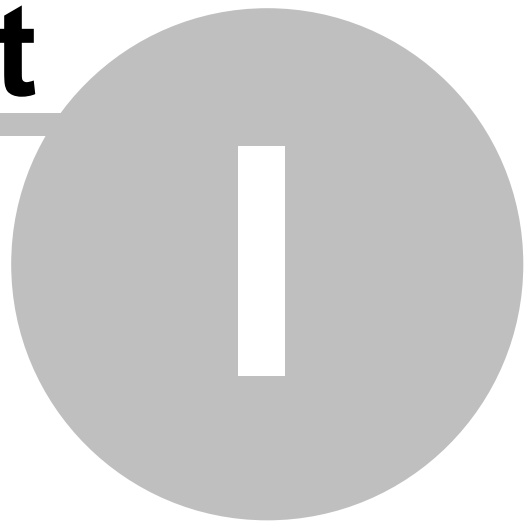
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Part



1 Overview

1.1 Introduction

BREIN

by Wolfgang Theiss

December 2015

W. Theiss – Hard- and Software for Optical Spectroscopy

Dr.-Bernhard-Klein-Str. 110, D-52078 Aachen, Germany

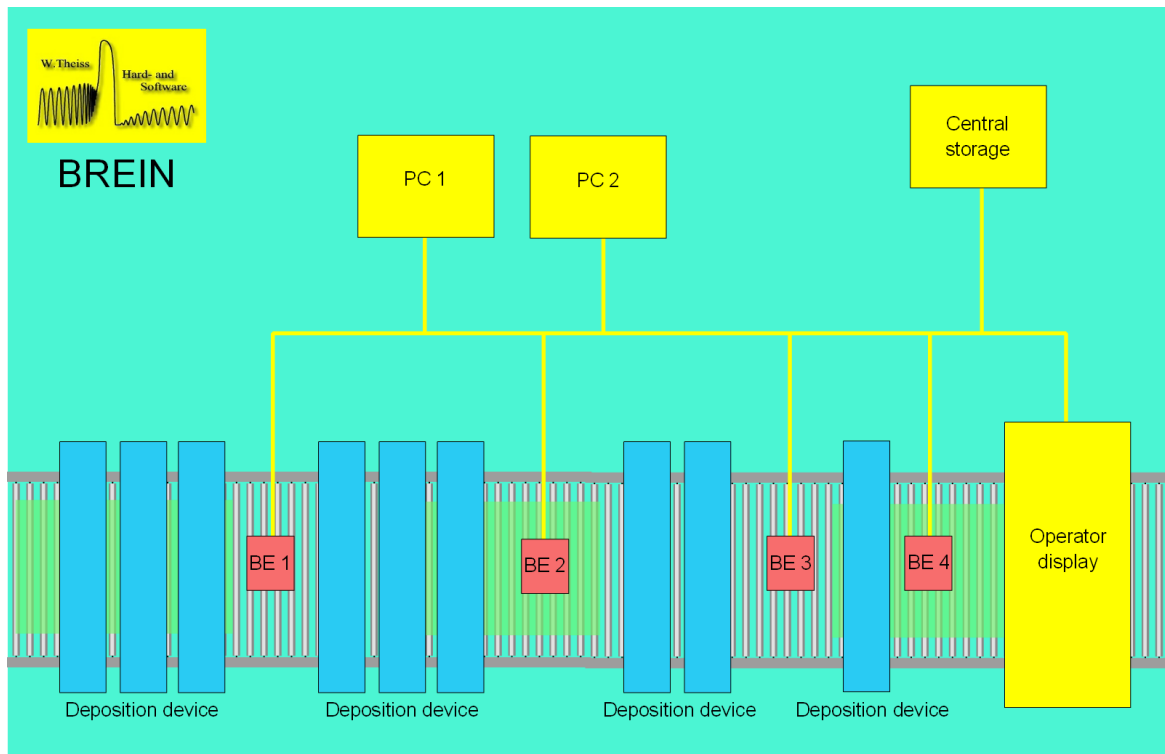
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The BREIN software has been developed to assist operators controlling thin film production devices. Optical spectra like transmittance, reflectance or ellipsometry data are recorded at appropriate positions in the production equipment. These stations are called 'Bright Eyes'. BREIN (which stands for BRight Eye Inspection Network) analyzes the measured data. In the simplest cases color coordinates are computed and displayed. In more advanced solutions an optical model is fitted for the currently produced coating, and information about film thicknesses and film composition is extracted. This information is displayed to the operators in order to simplify decisions about modifications of the settings of the deposition devices.

Note the objects in the sketch below which shows a typical BREIN application. Window panes are entering the deposition line from the left. After each important group of deposition devices (later on called DD) there is a bright eye station (BE1, BE2, ...) inspecting what has been produced. The measured data are stored in a central storage in the network, accessible by all participating PCs. One or more computers do the analysis work and store the results in the central storage. The main BREIN application collects all results in a database, and provides appropriate operator displays.



Spectroscopic hardware may be delivered by various instrument builders. The BREIN software is made by W.Theiss Hard- and Software. This part of the documentation deals with the software only.

Part



2 BREIN modules for glass coating production lines

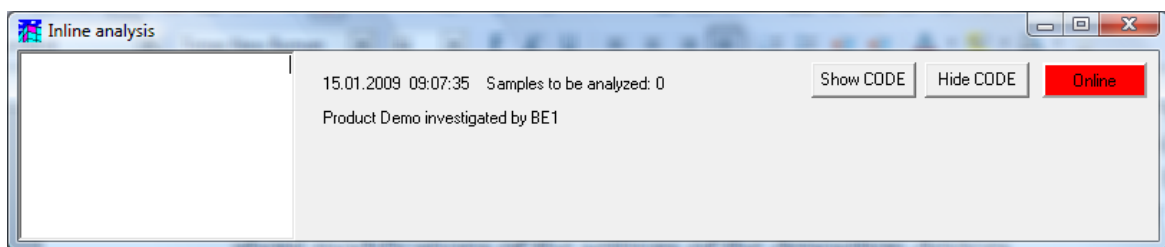
BREIN consists of several program modules that must run at the same time. All modules expect a text file named `brein_path.ini` in their program directory. The first line of text in this file contains the path to the central storage folder. This must be a network folder accessible to all modules. If `brein_path.ini` is missing, the modules work with the database subfolder in their own program directory.

For glass coating production lines the following programs are required:

2.1 Bright_eye_inline.exe

This program analyzes recorded inline spectra. In most cases single transmittance measurements are performed, but this is not a requirement – reflectance spectra or even sets of several spectra can be processed, too.

Taking a transmittance spectrum after each important functional layer, enough information is gathered to determine all film thicknesses of the coating. `Bright_eye_inline.exe` is supposed to work in the background – if displayed it looks like this:



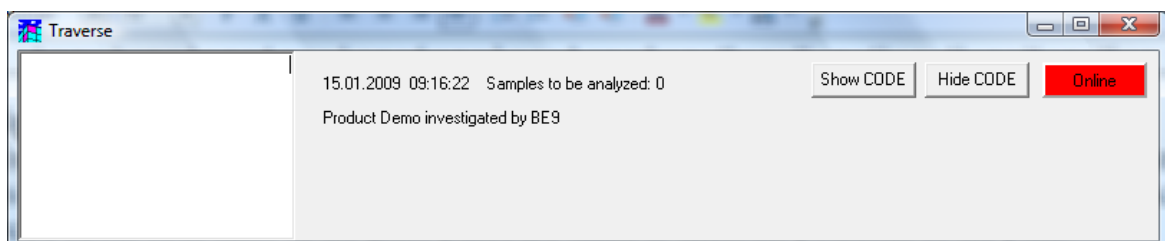
When the Online button to the right is switched on (its color is the designated online color) the program scans all directories for inline measurements for new data. If a new spectrum is found, it is analyzed and the results are stored in an appropriate folder of the BREIN database.

2.2 Bright_eye_traverse.exe

This program analyzes spectra recorded exsitu, i.e. outside the coating line. Here the hardware sees the completed coating. In the case of glass coatings, usually transmittance and reflectance spectra (from both sides of the glass pane) are taken at different positions of the pane.

`Bright_eye_traverse.exe` analyzes sets of spectra taken at various positions. It permanently scans the specified input folder for new spectra and detects, if all required spectra taken at a certain position are present. If that's the case, the data are processed and the results are stored in a BREIN database folder.

The program works in the background. If shown on the screen, it looks very much like `bright_eye_inline.exe`:

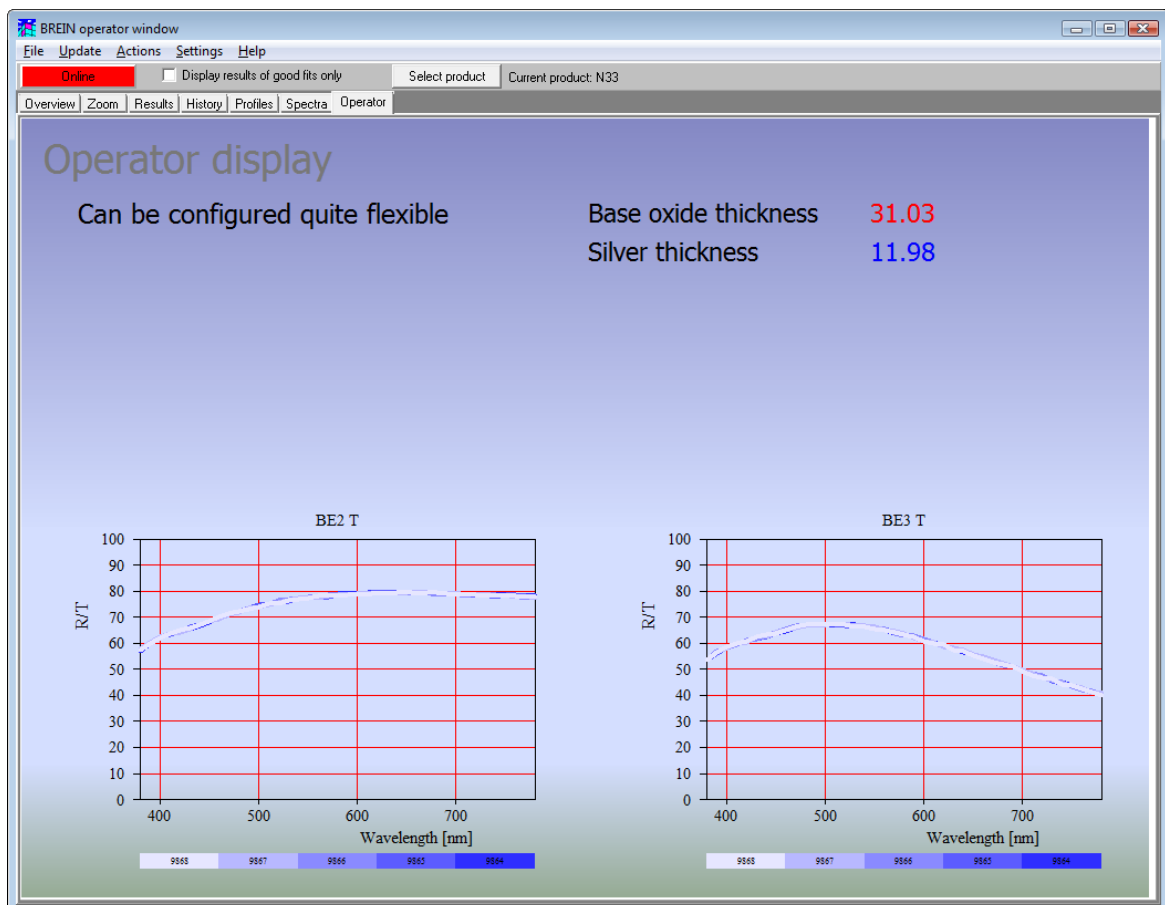


In most BREIN applications bright_eye_traverse is the most heavily used component, usually analyzing 3 spectra (transmittance and reflectance from both sides) for several positions across the panes. In order to speed up the analysis the program can run several fits in parallel if it is working on a PC with several cores.

2.3 Brein.exe

This is the main program that contains the visual interface to the operators. It permanently scans for new results in the relevant database folders and adds new data to the BREIN database.

When the program starts the so-called **Operator display** is shown:



BREIN can be configured to be online or offline at start-up. You can switch between online and offline state clicking the button in the upper left corner of the window. The button changes its caption from online to offline (or the other way round) and its color. The colors indicating the state can be user-defined (see below).

BREIN displays

The BREIN program offers various displays for informing the operators.

The **Results** tabsheet shows the content of the database as a grid of values as follows:

BREIN operator window

File Update Actions Help

Offline ☐ Display results of good fits only Select product Current product: N33

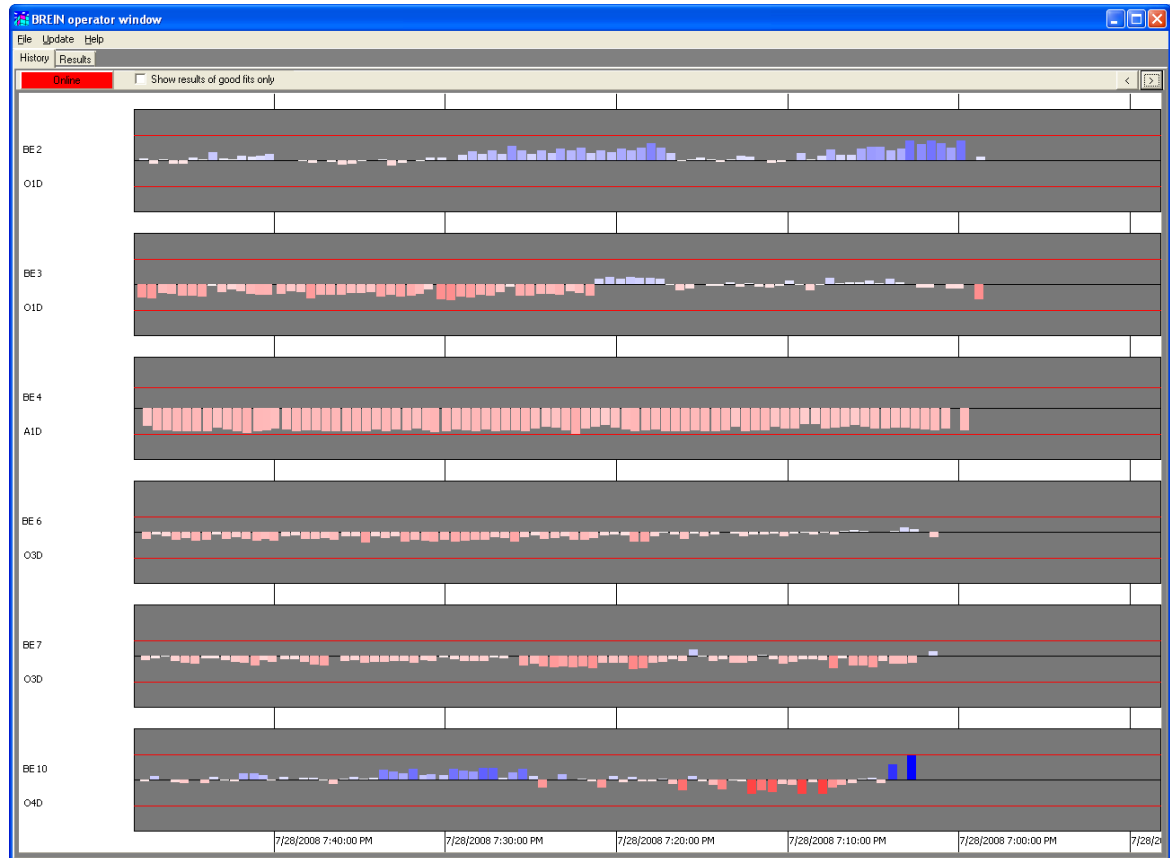
Results History Profiles Spectra Operator

Bright eye Pane Data export

All < All >

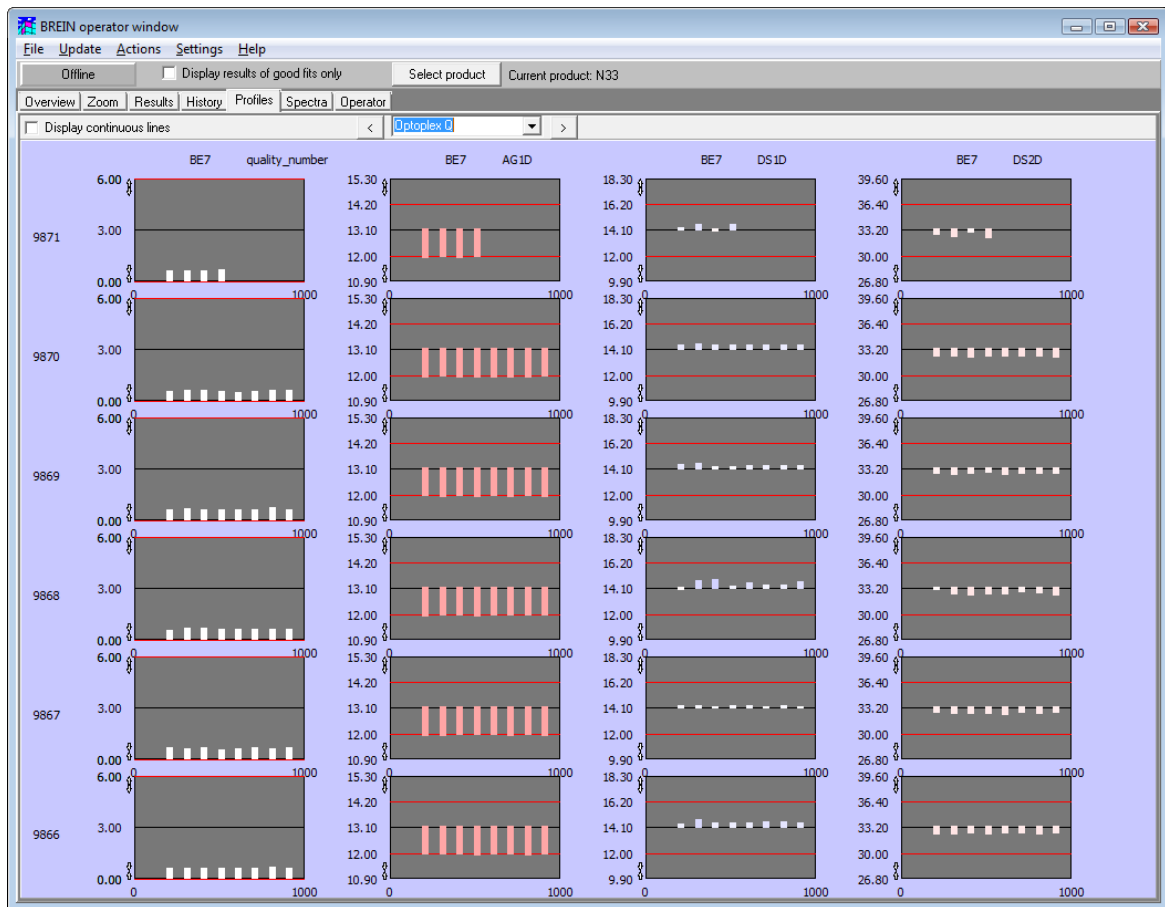
Time	BE	Pane_index	Status	Quality_num	Quality_string	GLDB	GLA1	GLA2	GLA3	GLA4	GSD	GS_A_F	GS_B_F	AG1D	B1D	DS1D	DS1_A_
22.07.2010 08:50:04	BE7	9835	OK	0.35739714	Good	1.10000002	5.44177914	25.25942039	10.62600517	1.08835	30.968	40.0000	37.4887	11.98	2.10	14.32142	60.0000
22.07.2010 08:50:01	BE7	9835	OK	0.29424466	Good	1.10000002	5.44177914	25.25942039	10.62600517	1.08835	30.948	40.0000	37.8245	11.97	2.10	14.28492	60.0000
22.07.2010 08:50:01	BE7	9835	OK	0.39520732	Good	1.10000002	5.44177914	25.25942039	10.62600517	1.08835	31.055	40.0000	38.7953	11.97	2.10	14.29442	60.0000
22.07.2010 08:50:00	BE7	9835	OK	0.29659482	Good	1.10000002	5.44177914	25.25942039	10.62600517	1.08835	30.982	40.0000	37.3710	11.97	2.10	14.26659	60.0000
22.07.2010 08:49:57	BE7	9835	OK	0.21800989	Good	1.10000002	5.44177914	25.25942039	10.62600517	1.08835	31.130	40.0000	39.3243	11.98	2.10	14.27265	60.0000
22.07.2010 08:49:57	BE4	9838	OK	0.12391215	Good	1.10000002	5.38757801	25.34704781	10.52016544	1.07751	30.857	40.0000	33.6228	11.99	2.10	14.36327	44.1797
22.07.2010 08:49:45	BE5	9837	OK	0.12872533	Good	1.10000002	5.43543243	25.32787514	10.61360645	1.08708	30.988	40.0000	38.0639	11.97	2.10	14.30698	49.7335
22.07.2010 08:49:43	BE2	9840	OK	0.11179045	Good	1.10928237	5.33228016	25.30589485	10.41215932	1.06645	30.919	35.1928	40.0000				50.0999
22.07.2010 08:49:35	BE3	9839	OK	0.12013245	Good	1.10000002	5.38974571	25.69034767	10.52439785	1.00000	31.036	40.0000	30.9387	11.95	2.10		50.0999
22.07.2010 08:49:30	BE7	9834	OK	0.29679517	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.864	33.1323	40.0000	11.94	2.10	14.19057	60.0000
22.07.2010 08:49:28	BE7	9834	OK	0.24886224	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.731	32.5933	40.0000	11.98	2.10	14.23777	60.0000
22.07.2010 08:49:26	BE7	9834	OK	0.27093762	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.915	34.0981	40.0000	11.96	2.10	14.35304	60.0000
22.07.2010 08:49:26	BE6	9835	OK	0.12786794	Good	1.10000002	5.44177914	25.25942039	10.62600517	1.08835	31.043	40.0000	40.0000	12.00	2.10	14.18503	60.0000
22.07.2010 08:49:24	BE1	9841	OK	0.15963416	Good	1.10000002	5.38295460	25.54303169	10.51112652	1.07659	30.1000	30.1000					50.0999
22.07.2010 08:49:23	BE7	9834	OK	0.23140550	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.923	32.6952	40.0000	11.98	2.10	14.36319	60.0000
22.07.2010 08:49:21	BE7	9834	OK	0.28317899	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.898	31.1118	40.0000	11.93	2.10	14.55386	60.0000
22.07.2010 08:49:18	BE7	9834	OK	0.29804283	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.863	34.4527	40.0000	11.95	2.10	14.48692	60.0000
22.07.2010 08:49:16	BE7	9834	OK	0.29527930	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.826	31.9137	39.9746	11.96	2.10	14.13936	60.0000
22.07.2010 08:49:13	BE7	9834	OK	0.37178040	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.968	32.5834	40.0000	11.97	2.10	14.10037	60.0000
22.07.2010 08:49:13	BE4	9837	OK	0.14042950	Good	1.10000002	5.43543243	25.32787514	10.61360645	1.08708	30.988	40.0000	38.0639	11.97	2.10	14.03143	60.0000
22.07.2010 08:49:00	BE5	9836	OK	0.08233131	Excellent	1.10000002	5.40582752	25.72406578	10.66153622	1.08116	30.800	40.0000	36.6602	11.95	2.10	14.12846	53.3346
22.07.2010 08:48:59	BE2	9839	OK	0.12348074	Good	1.10000002	5.38974571	25.69034767	10.52439785	1.00000	31.007	40.0000	30.9387				50.0999
22.07.2010 08:48:49	BE3	9838	OK	0.07817639	Excellent	1.10000002	5.38757801	25.34704781	10.52016544	1.07751	30.857	40.0000	33.6228	11.99	2.10		50.0999
22.07.2010 08:48:47	BE7	9833	OK	0.28088179	Good	1.10000002	5.36977100	25.78835106	10.48534679	1.04478	30.952	40.0000	36.9482	11.99	2.10	14.63309	54.2866
22.07.2010 08:48:44	BE7	9833	OK	0.30035913	Good	1.10000002	5.36977100	25.78835106	10.48534679	1.04478	31.009	40.0000	32.9517	11.95	2.10	14.67131	55.5280
22.07.2010 08:48:42	BE7	9833	OK	0.30663389	Good	1.10000002	5.36977100	25.78835106	10.48534679	1.04478	30.969	40.0000	37.0203	11.94	2.10	14.03046	56.9026
22.07.2010 08:48:42	BE6	9834	OK	0.13063131	Good	1.10000002	5.34214783	25.57746696	10.48352909	1.06842	30.579	31.8109	40.0000	11.95	2.10	14.05699	60.0000
22.07.2010 08:48:40	BE1	9840	OK	0.13997467	Good	1.10928237	5.33228016	25.30589485	10.41215932	1.06645	30.1000	30.1000					50.0999
22.07.2010 08:48:39	BE7	9833	OK	0.31917241	Good	1.10000002	5.36977100	25.78835106	10.48534679	1.04478	31.003	40.0000	32.0952	11.97	2.10	14.53067	60.0000
22.07.2010 08:48:37	BE7	9833	OK	0.23656809	Good	1.10000002	5.36977100	25.78835106	10.48534679	1.04478	31.017	40.0000	31.1412	11.93	2.10	14.71600	56.6564
22.07.2010 08:48:34	BE7	9833	OK	0.27939582	Good	1.10000002	5.36977100	25.78835106	10.48534679	1.04478	31.112	40.0000	34.3631	11.96	2.10	14.33944	60.0000
22.07.2010 08:48:32	BE7	9833	OK	0.28938368	Good	1.10000002	5.36977100	25.78835106	10.48534679	1.04478	31.010	40.0000	31.7321	11.95	2.10	14.79089	56.9891
22.07.2010 08:48:29	BE7	9833	OK	0.30023324	Good	1.10000002	5.36977100	25.78835106	10.48534679	1.04478	30.967	39.2776	34.5959	11.93	2.10	14.56523	60.0000

The most important display is called **History** – you can activate it by clicking on the **History** tabsheet:



At the bottom you see a timeline that slowly moves to the right. The various vertical bars show the BREIN results. The scale of the timeline can be changed by the 2 buttons at the upper right. Clicking the > button moves the right end of the timeline more into the past, the < button does the reverse.

The tabsheet **Profiles** shows the results of the traverse analysis:



The **Spectra** tabsheet displays the last spectra that were recorded at the individual bright eye stations. Usually all spectra are shown simultaneously. You can inspect a single spectrum closer by pressing the Ctrl-key and clicking on a spectrum. A mouse click with the Ctrl-key pressed down brings you back to the display of all spectra.

The graphics settings for each spectrum are pre-configured. You can modify the graphics settings by a mouse click on a spectrum with the Alt-key pressed down. This opens a graphics settings dialog which allows to modify the appearance of the graph. Please see the **Graphics course** delivered with BREIN for the meaning of the individual items.

For each spectrum you can show a reference spectrum besides the measured data. In order to do so, you have to store the reference data in a text file (xy-format, name: reference__R.txt if R is the name of the spectrum) in the bright eye's directory. The spectral unit of the measured data and the reference spectrum must be the same.

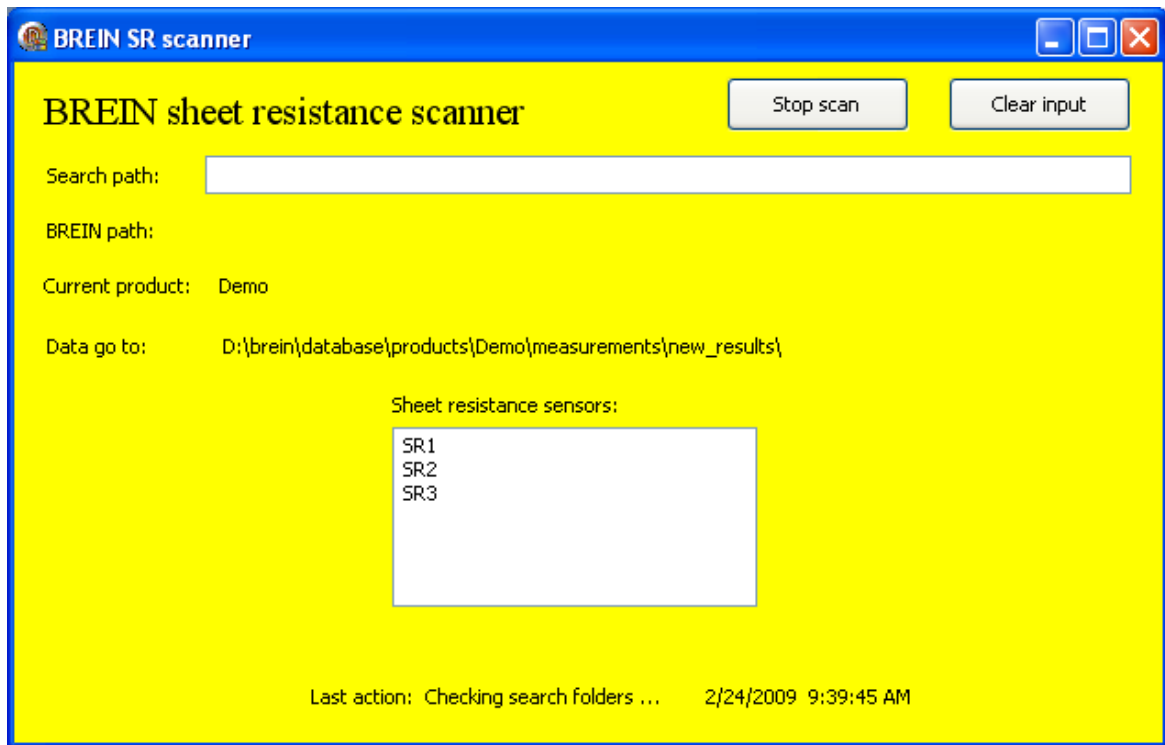
Up to 6 operator displays can be configured in a flexible manner, showing any combination of text, parameter values, spectra and quality information.

A tabsheet called **Predict** can be used to visualize properties of glazing products which are built using the last produced coating.

2.4 SR_scanner.exe

If your monitoring system has sheet resistance probeheads you can enter their measured values into the BREIN database by running the sr_scanner.exe program. There is nothing to analyze in this case – the measured values are taken from datafiles and show up as results like color coordinates or layer thicknesses.

The program is easily configured. When you start it up it looks like this:



The first line specifies the search path where the scanner program looks for new sheet resistance files. If you have 3 sheet resistance probeheads labeled SR1, SR2 and SR3, you must list them in the central box of the program. Text files with the sheet resistance values in the first line must be placed in subdirectories of the search path named like the sensors, e.g. C:\temp\sr_transfer\SR1. The settings of the path and the sensor names will be saved to an ini-file when you shutdown the program. When the program starts again, it processes the content of the ini-file.

The scanner program scans the folders searchpath\SR1, searchpath\SR2 and searchpath\SR3 for new data. Use the **Stop scan** button to stop the automatic scan, and press it again to start. You can clear the input folders by pressing the **Clear input** button.

In order to enter sheet resistance values into the BREIN database, one of the deposition devices (see below) must define parameters SR1, SR2 and SR3. These parameters are then taken into account when a new database file is created.

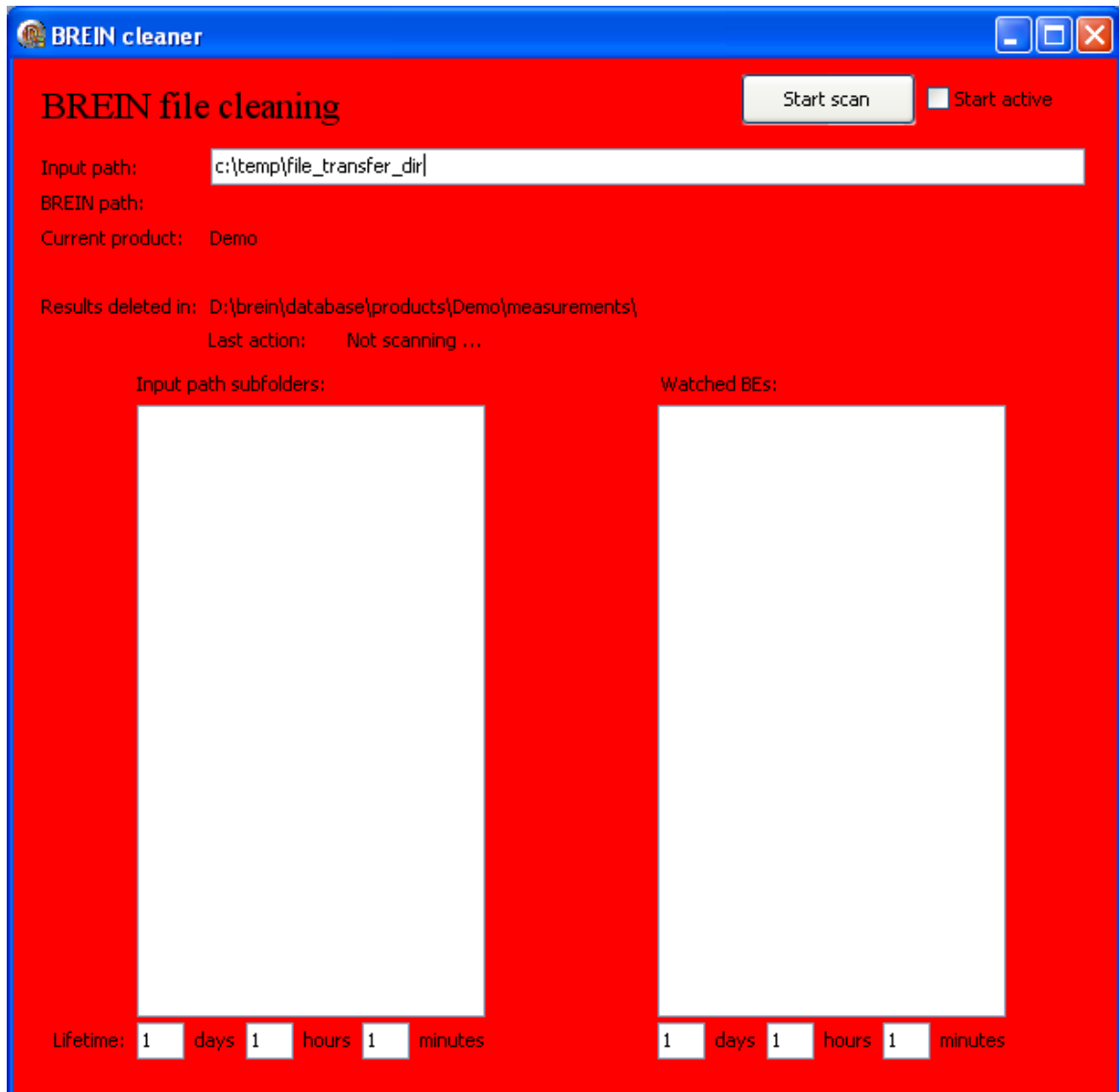
The demo product delivered with BREIN has three parameters SR1, SR2 and SR3 already built-in.

2.5 BREIN_cleaner.exe

This program is used to avoid that files with measured data or results pile up in certain directories if they are not processed by BREIN for some reason. If there are many thousand files in a single directory, Windows Explorer can get quite slow and serious work may be blocked.

BREIN_cleaner is usually operated parallel to BREIN, and you should put it in the brein_autostart.ini file. However, it can be started as an individual program if you want to clean folders before you start BREIN itself.

BREIN_cleaner looks like this:

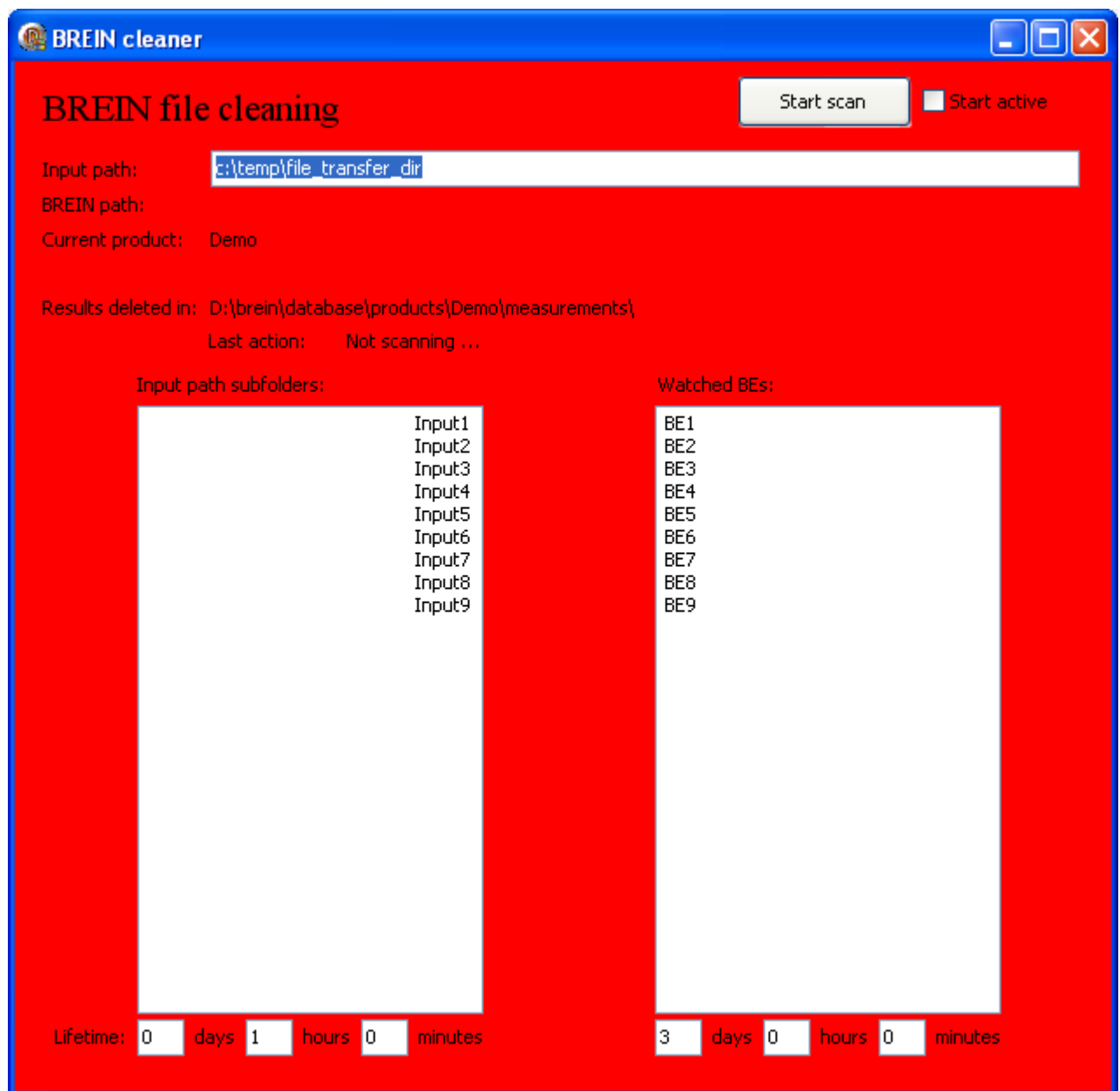


The program allows to watch 2 groups of folders for files which are overaged.

In cases where BREIN is configured to pick up measured data files in network folders outside the BREIN database, you can specify a input path in the top field of the program. The various input folders within this common path are specified in the lower left section called Input1, Input2, ... in the following.

Within the BREIN database, BREIN_cleaner will watch those folders which are listed in the lower right section (called BE1, BE2, ...). For each listed subfolder, BREIN_cleaner deletes all overaged files in the /new, /in progress and /analyzed subdirectories. For each product the /new_results folder is cleaned as well.

For both sections you can specify the tolerated age of file by stating the days, hours and minutes. In the following example all files older than 1 hour in the input folders are deleted. In the BREIN database files older than 3 days are deleted:



When you make changes in the BREIN_cleaner settings the new settings are stored in the file brein_cleaner.ini in the program directory. When the software starts it loads the settings from this file.

2.6 Zeiss scanner

This module reads data files generated by the Zeiss Optoplex NG.Q software. These files contain all spectra of a scan across the width of the pane, measured exsitu outside the coating line. The scanner module scans a transfer directory for new data. Both the Optoplex software and the scanner program must be able to read and write to this folder.

Once a data file is found the scanner generates a special transfer file (extension *.scn) and stores it in the appropriate BREIN subdirectory so that it gets analyzed by the bright_eye_traverse.exe analysis module. Bright_eye_traverse.exe must be configured to look for *.scn files in this case.

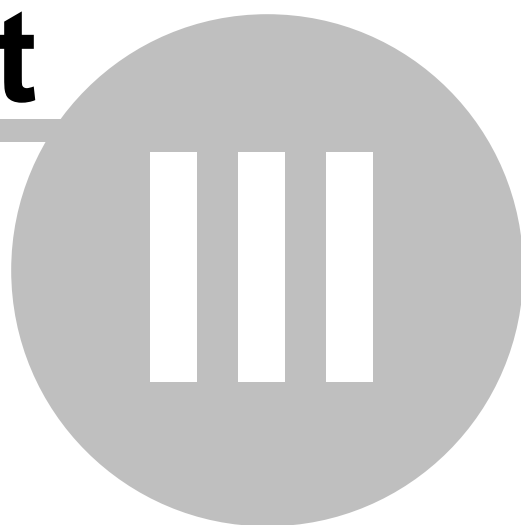
The Zeiss scanner software reads the file brein_scanner.ini at start-up. The individual lines of this file

have the following meaning:

Line #	Meaning	Example	
1	Transfer path	h:\zeiss_transfer\	
2	Bright eye	BE5	
3	Flag to indicate automatic product identification	False	
4	Number of scan files to be created	1	
5	Number of spectral positions in the Zeiss data file	125	

The setting of line 4 controls how many scan files are generated. The default value is 1. In this case a scan file with the extension *.scn like 45467.scn is generated. If 2 or more scan files are generated, the individual files get extensions like *.sc1, *.sc2, and so on. In this case several instances of the bright_eye_traverse program must be used, each of which handling one type of scan file. This is usually done by running each instance of bright_eye_traverse on a different PC, increasing the total available computational power this way.

Part



3 Interfacing BREIN

3.1 Transfer of spectra to BREIN

Measured spectra are passed to BREIN using network folders which can be accessed both by BREIN and the data acquisition software. Each probehead saves its spectra to a separate folder (named after the probehead), for example BE1, BE2 or BE3. BREIN permanently scans these folders. As soon as new data are detected the analysis starts.

Each spectrum is stored as a simple textfile with a wavelength column and a data column (holding the reflectance or transmittance values), separated by a tab character or a blank.

The filenames are used to transfer important information to BREIN. They must start with the identification of the sample (a string) followed by the separator '___' (3 underscores) and the identifier of the spectrum type (e.g. 'RF' for film side reflectance, 'RB' for backside reflectance, 'T' for transmittance, ...). The file extension must be *.xy. Valid filenames are 2345___T.xy or VR34P123___RF.xy.

If the probehead scans the sample, i.e. it is able to measure several spectra for each sample at different positions, the position where the spectrum has been recorded must be specified by three additional coordinates x, y and z. x is the position along the long side of the pane, while y specifies the position across the pane perpendicular to the x-direction. z denotes the height and is not used in most BREIN applications. x, y and z have to be a position in mm as integer numbers. These numbers must be included in the filename, separated with '___'. The transmission spectrum of Sample 76893 taken at x = 600 mm, y = 1450 mm and z=345 mm is stored in the file 76893___T___600___1450___345.xy. If no z-value is specified you can skip the z-coordinate in the filename and use names like 76893___T___600___1450.xy.

3.1.1 Mechanism of writing spectrum files

Since BREIN permanently scans the network folders for new measured spectra, one must exclude that it detects and tries to read a file which is not yet complete. There is a simple mechanism to avoid this conflict: The data acquisition software first writes the spectrum to a file with an extension different from *.xy. This file is not recognized by the BREIN search which is limited to *.xy files. When the file is completely written and closed, the data acquisition software renames the file to the designated filename such that the file can be found by BREIN. The rename operation of Windows is safe for this purpose.

3.1.2 Correction files

Measured data can be corrected while they are imported for analysis. The correction can be set for each bright eye individually. A correction spectrum (which must have the same unit as the spectrum) must be stored in spc-format (binary file format, these files can be generated best using the user interface in BREIN) using names like correction___R.spc if R is the name of the spectrum.

If a correction spectrum is found for a bright eye spectrum, the measured data are multiplied with the correction spectrum, wavelength by wavelength.

3.1.3 The fate of measured data in BREIN

When BREIN starts data analysis for a spectrum, the spectrum file is moved to other folders used for BREIN work. Depending on the BREIN setup, the measured data files may be deleted or stored in archive directories (see below). So you cannot be absolutely sure that your measured data files will still exist after BREIN analysis.

3.1.4 Remarks on data acquisition

BREIN needs absolute reflectance and transmittance spectra of the samples for correct analysis. Usually the following three measurements are required:

- the raw dark spectrum D (light source switched off or black reference sample is used)
- the raw spectrum Ref of the reference sample (no sample in case of transmittance, a reference mirror with known absolute reflectance R_{abs} in case of reflectance)
- the raw spectrum S of the sample

It depends very much on the stability of the spectroscopic hardware and the environment how frequently the dark and the reference spectra have to be updated.

Finally the transmittance is then given by

$$T = (S-D)/(Ref-D)$$

and in case of reflectance one gets

$$R = R_{abs} * (S-D)/(Ref-D)$$

The R and T values computed according to the expressions above are to be passed to BREIN.

If your spectrometer software generates R or T spectra in percent, i.e. the data range is 0 ... 100, you do not have to change the range to 0 ... 1. The required division by 100 can be taken into account when BREIN is configured for your coating line.

3.2 Export of results

The results obtained by BREIN are stored and managed internally. The following sections describe BREIN options to export results for external data processing.

3.2.1 to Excel

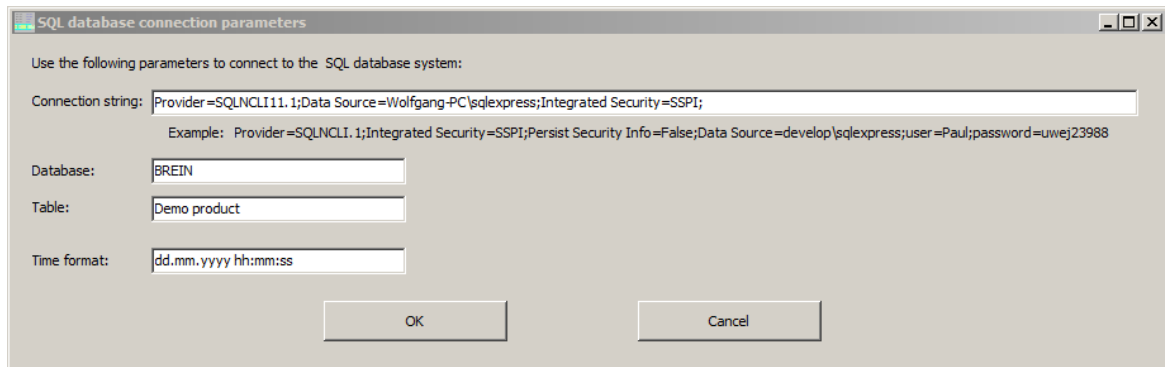
The content of the results page can be exported to an external file using 3 formats. Go to the tab "Results" and click on the button "Data export". In the following file dialog you can select one of 3 output formats: BREIN can generate Excel 2007 files (*.xlsx), comma separated text files (*.csv) or Excel 97 files (*.xls).

3.2.2 to an external SQL database

BREIN can automatically export results to an external SQL database. In order to use this mechanism BREIN has to be connected to the external database and tables with a suitable structure have to be created in the external system.

3.2.2.1 SQL database connection

The connection to the external SQL system is defined in the following dialog (Menu command "Settings/SQL export of results"):



The connection string defines the SQL server and the SQL user identification. Finding the right connection string might be difficult - it is recommended to get internet assistance for your SQL system. The example given below works for a Microsoft SQL Server 2012 with Windows authentication:

Provider=SQLNCLI11.1;Integrated Security=SSPI;Data Source=Wolfgang-PC\sqlexpress;

In addition to the connection string the name of the **database** and the **table** name have to be specified.

If the SQL system uses a different time format than the Windows system BREIN is running on, you can define the **time format** to be used for SQL export.

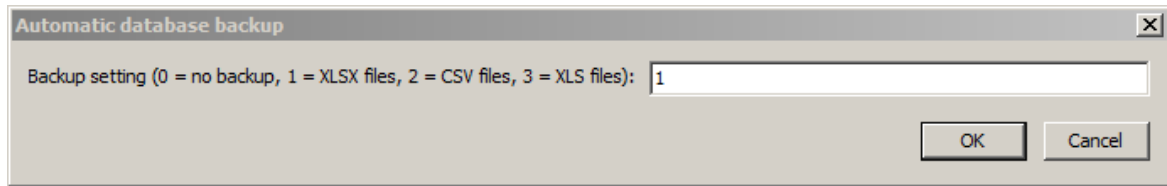
3.2.2.2 Table structure

The external database must have a suitable table with a structure exactly matching the structure of the results page of BREIN. In order to generate the proper table structure you can visit the tab "Panels" and click on the button "Generate SQL script".

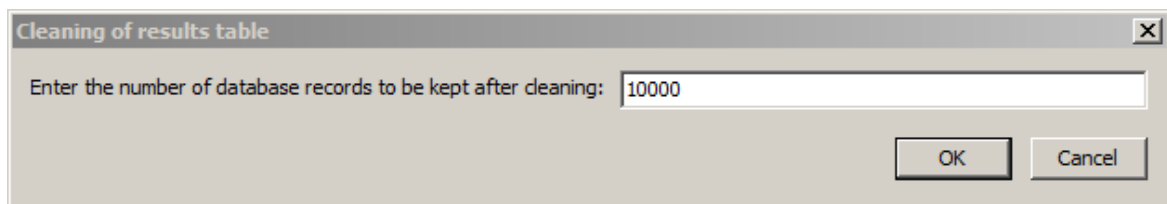
In the folder of the current BREIN product, 2 text files are generated. The first named "sql_script_product_stats_checks.sql" contains the SQL script to generate a table for the BREIN statistics checks results. The second is called "sql_script_product.sql" and contains the script to generate the results table. This is identical to the text that appears in the text field below the "Generate SQL script" button.

3.2.3 Automatic backup

BREIN can be configured to automatically generate backups of the results. Execute the menu command "Settings/Automatic database backup" and select one of the file options in the following dialog:



In the case of options 1, 2 or 3 BREIN will generate automatic backup files in the subfolder `database_history` of the current product. The files are generated at midnight. After the data are successfully stored, BREIN deletes records from the results table in order to avoid handling of too many records. Use the menu command "Settings/Number of database records to be kept at midnite cleaning" to set the number of records to survive the cleaning action:



Note that the number of records which are kept after cleaning determines how far you can go back in time in BREIN history graphs.

3.3 BREIN viewer

The BREIN viewer application shows the content of the main operator display on a separate computer. This feature of BREIN has been initially introduced in July 2017. In order to make it happen execute the following configuration steps.

Configuration of BREIN:

- Generate a transfer folder in the network. Brein.exe must have the right to write files in this folder. The viewer applications need only the right to read files.
- Update your brein.exe with a version generated 2017-7-12 or later.
- Start brein.exe and exit again - this generates additional items in the brein.ini files which hold information concerning the new feature.
- Edit brein.ini in the BREIN program folder: Enter the path to the transfer folder below the line 'BREIN viewer path' (enter something like 'z:\transfer\brein_viewer\' including the final backslash).
- Edit brein.ini: Enter an integer number below the line 'BREIN viewer timer events skipped between exports'. By default BREIN updates its screens at timer events which happen every second. Generating screenshots for external viewers does not need to happen every second - instead, it is recommended to leave out a number of events before generating the next screenshot. If you enter the number 4 a new screenshot is generated every fifth timer event, i.e. every 5 seconds.

Configuration of BREIN viewer:

- Enter the path to the transfer folder in the second line of the file `brein_viewer.ini` which is located in the program folder (where `brein_viewer.exe` sits).
- The viewer fetches a new screenshot after regular timer intervals. The length of these intervals can be set in milliseconds in the 4th line of the ini file.

3.4 Export of results for external programs

You can automatically export results to an Excel file in the BREIN viewer folder discussed in the section above. The export happens whenever screenshots for the BREIN viewer application are generated.

Use the item "BREIN viewer number of exported records" in the brein.ini file to set the number of records that are exported. A setting of 30 means that the most recent 30 results are written to the file.

Part

IV

4 BREIN configuration

The configuration of BREIN solutions is complex, since the settings of various software modules must be coordinated. Usually BREIN is delivered pre-configured by W.Theiss Hard- and Software. This documentation gives some details which are good to know for introducing new products to BREIN or modifying existing products.

4.1 Graphical user interface

BREIN comes with a user interface that allows some modifications of existing products in a simple way, without having to know too much about the internal structure of the software. This section describes what you can do and how.

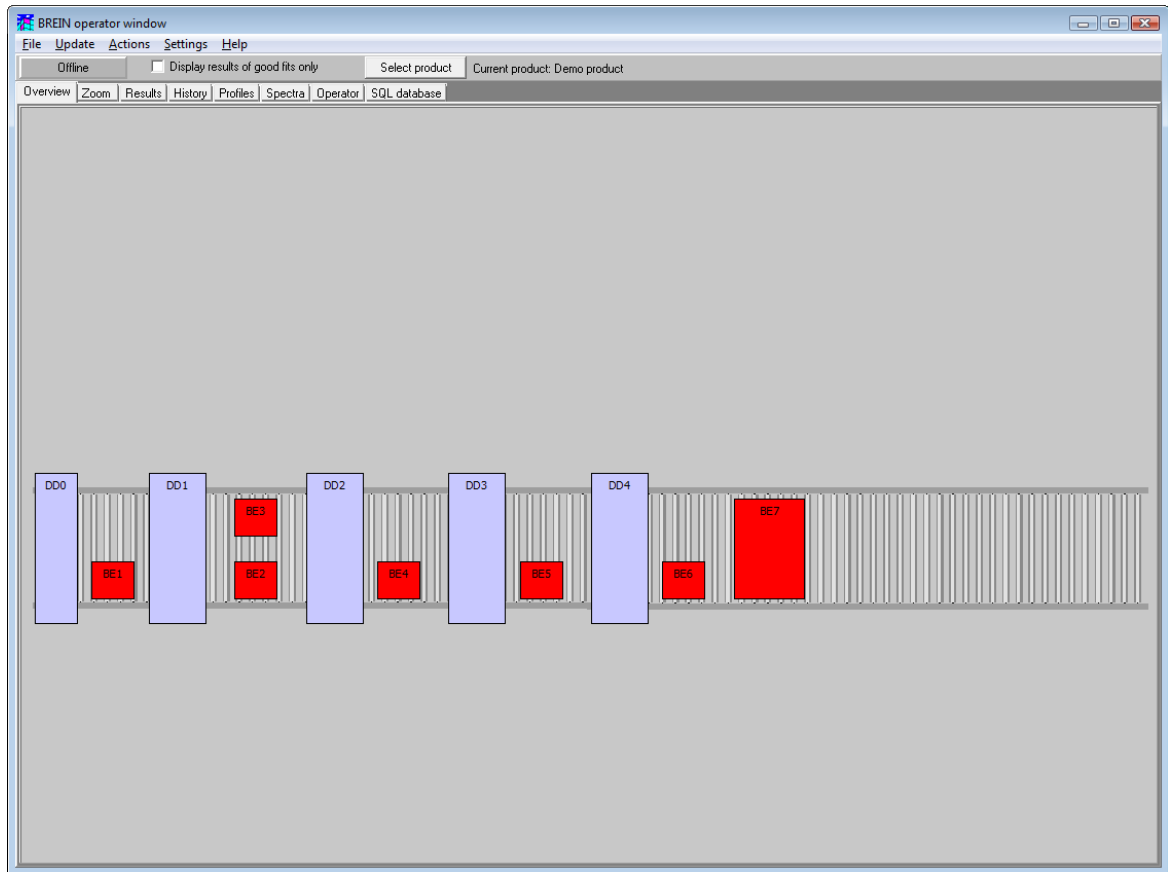
4.1.1 Password protection

In order to make changes to BREIN product definitions, you must be logged in knowing the BREIN password. There is a menu item **Actions/Log-in to modify product** which is followed by a password dialog. The default password is '1b2r3e4i5n'. Please use the menu command **Actions/Change password** to change the password as soon as you start to work with BREIN modifications. When you are done with configuring work, please use **Actions/Log-out after modifying product** to protect your settings from un-authorized changes.

Once you are logged-in, new tabsheets and menu items are visible, giving access to several product settings (see below).

4.1.2 Tabsheets Overview and Zoom

These 2 tabsheets give a graphical representation of the BREIN system, showing the factory, the coating line, the deposition devices and the various bright eye stations:



A mouse click on an object pops up a dialog showing the object's parameters that can be changed. The most important objects are the deposition devices and the bright eyes. Clicking on a deposition device brings up the following dialog:

DD1

Name: DD1

Left: 15.00000

Top: 29.00000

Width: 3.00000

Height: 12.00000

Fill color

Edge color

Select metafile

Kill metafile

OK

Cancel

Parameters:

Number of parameters: 3

Parameter # 1

Name: BE2 L*

Tolerated min.: 80.00000000

Target value: 90.00000000

Tolerated max.: 100.00000000

Decimals: 8

Deposition checked by: DD1

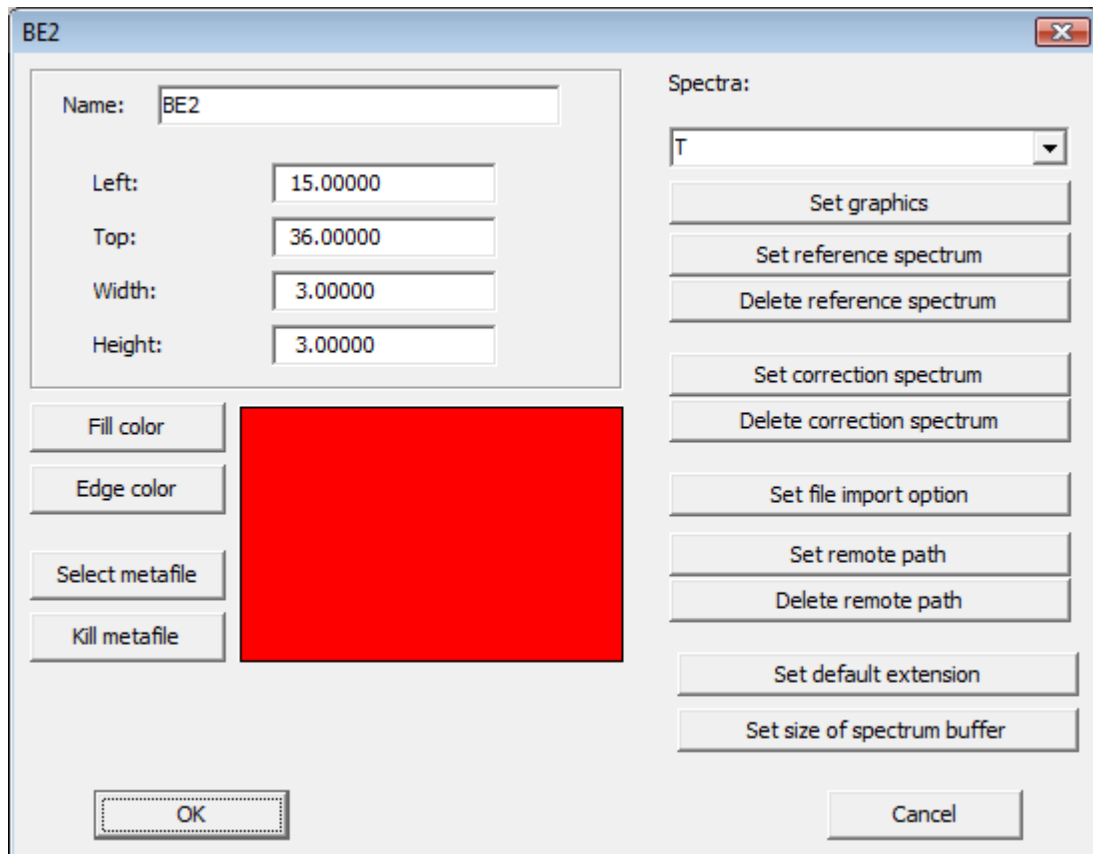
The left side of the dialog is used to set the position and appearance of the object in the **Overview** and **Zoom** tabsheets. Usually there is no need to modify these settings.

On the right side you can modify the parameters that belong to this deposition device. Usually the parameters are thickness values of deposited layers. Using the large up and down arrow buttons you select a parameter, and then you set the target value, the tolerated minimum and maximum value for this parameter and the number of digits for showing the number in the BREIN displays.

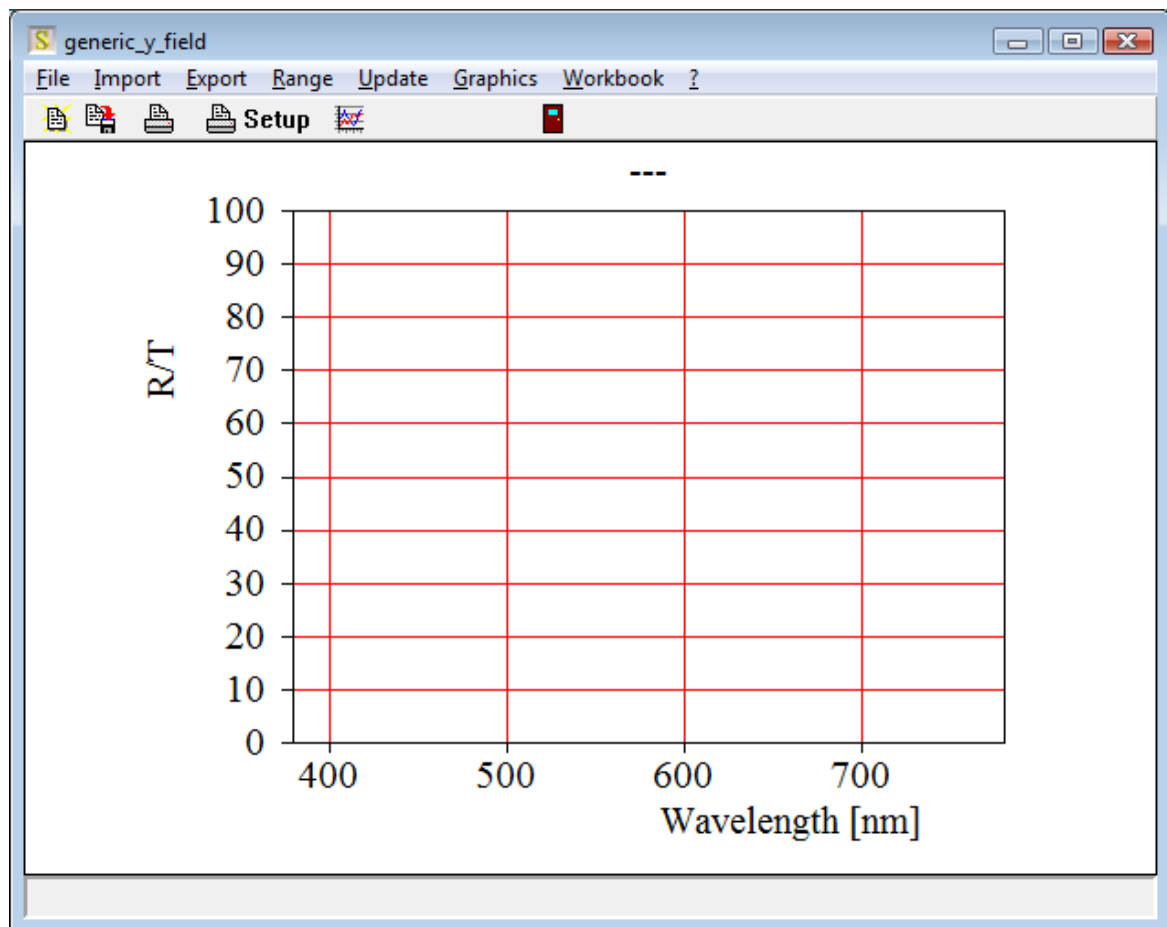
Please do not change the name and the number of parameters, unless you are a very experienced BREIN user and you know exactly what it means to change the name of a parameter.

Press **OK** to leave the dialog. **This will make your changes permanent by re-writing the corresponding ini-files.**

Clicking on a bright eye, you will get this:

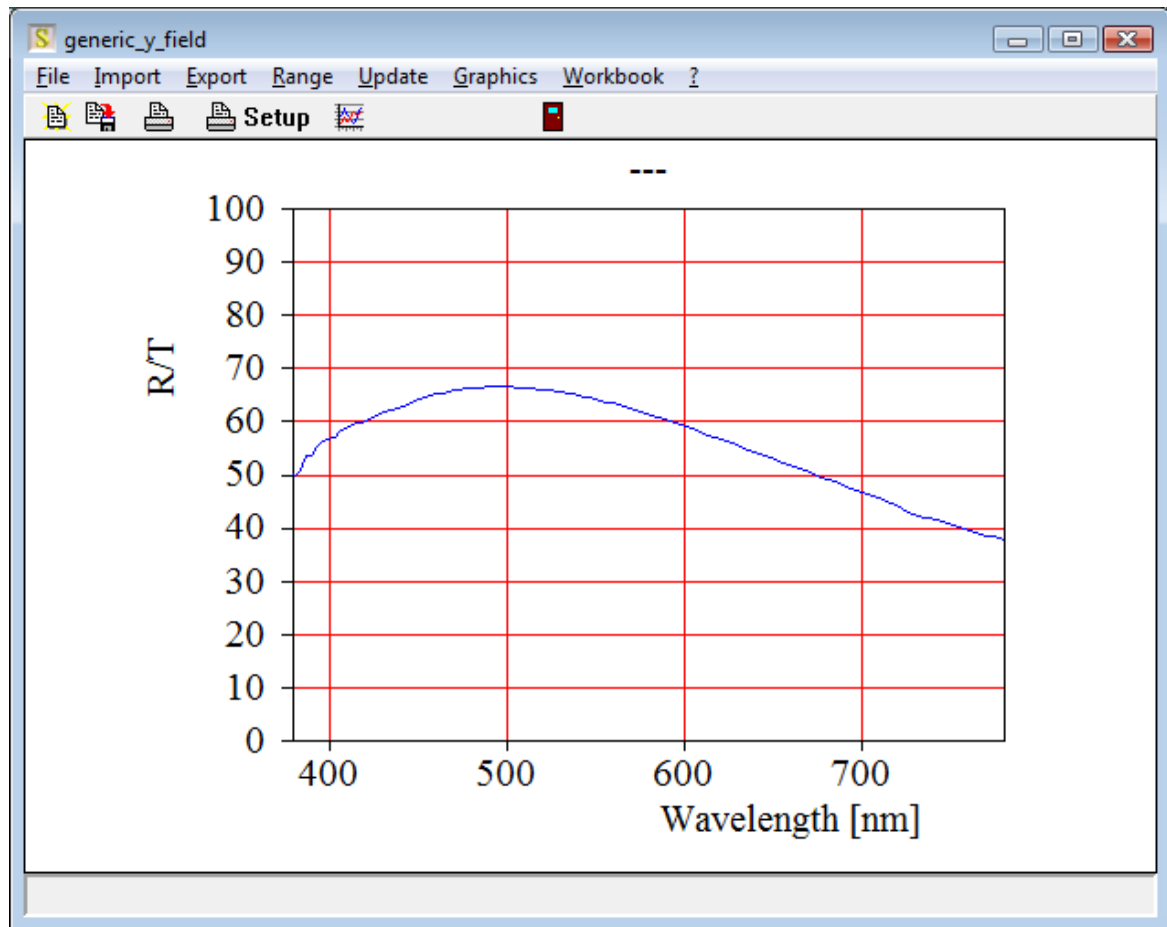


Almost all settings should never be changed after a reasonable initial setup, with a few exceptions. Use **Set graphics** to change the appearance of a spectrum in BREIN displays. Please consult our **Graphics course** in order to select appropriate graphics parameters. If you would like to display an ideal reference spectrum (which represents the spectrum of the ideal product at this position in the coating line) you can press the button **Set reference** spectrum. You will get a graph like this:

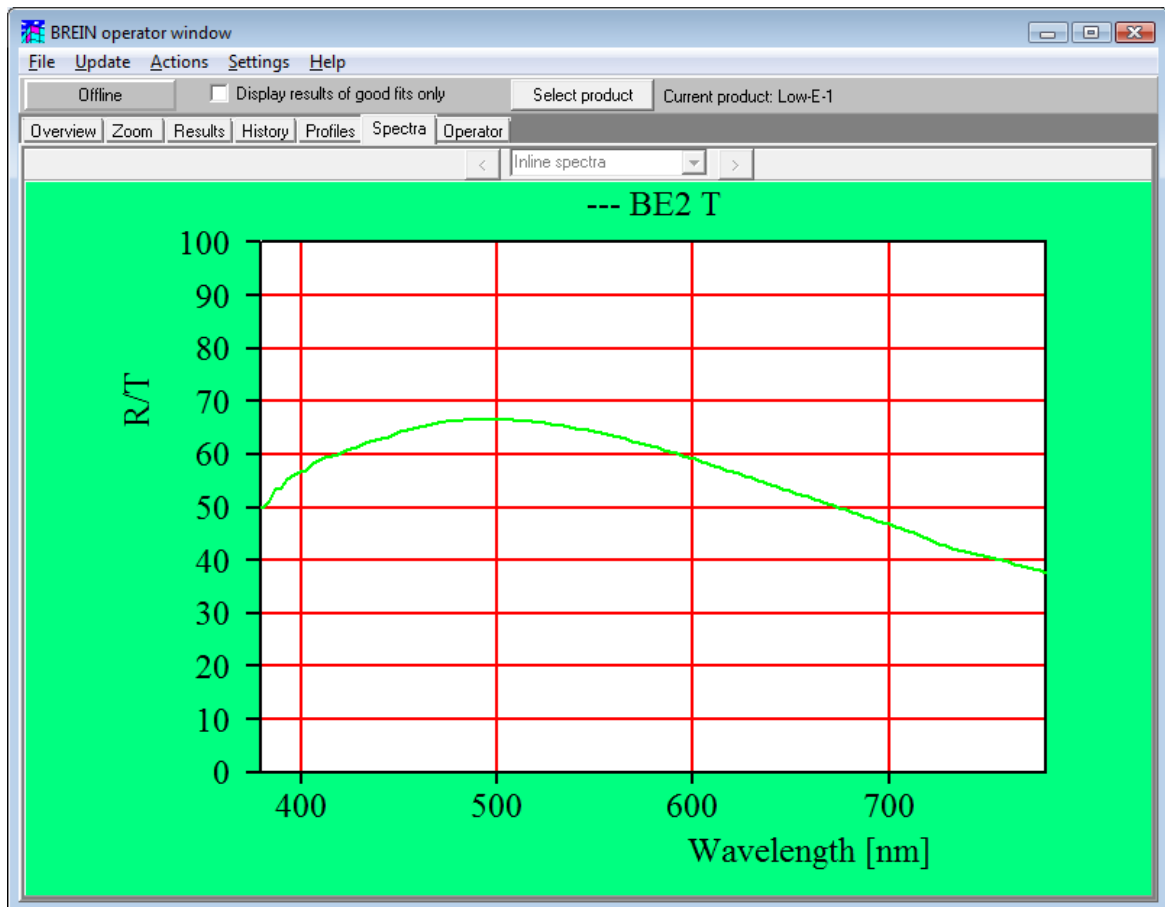


If there is a reference spectrum defined already, it will be displayed in the graph.

Use the **Import** command to load the wanted spectrum from a file, or from the clipboard if you have copied a spectrum to the clipboard (using our CODE software, for example).

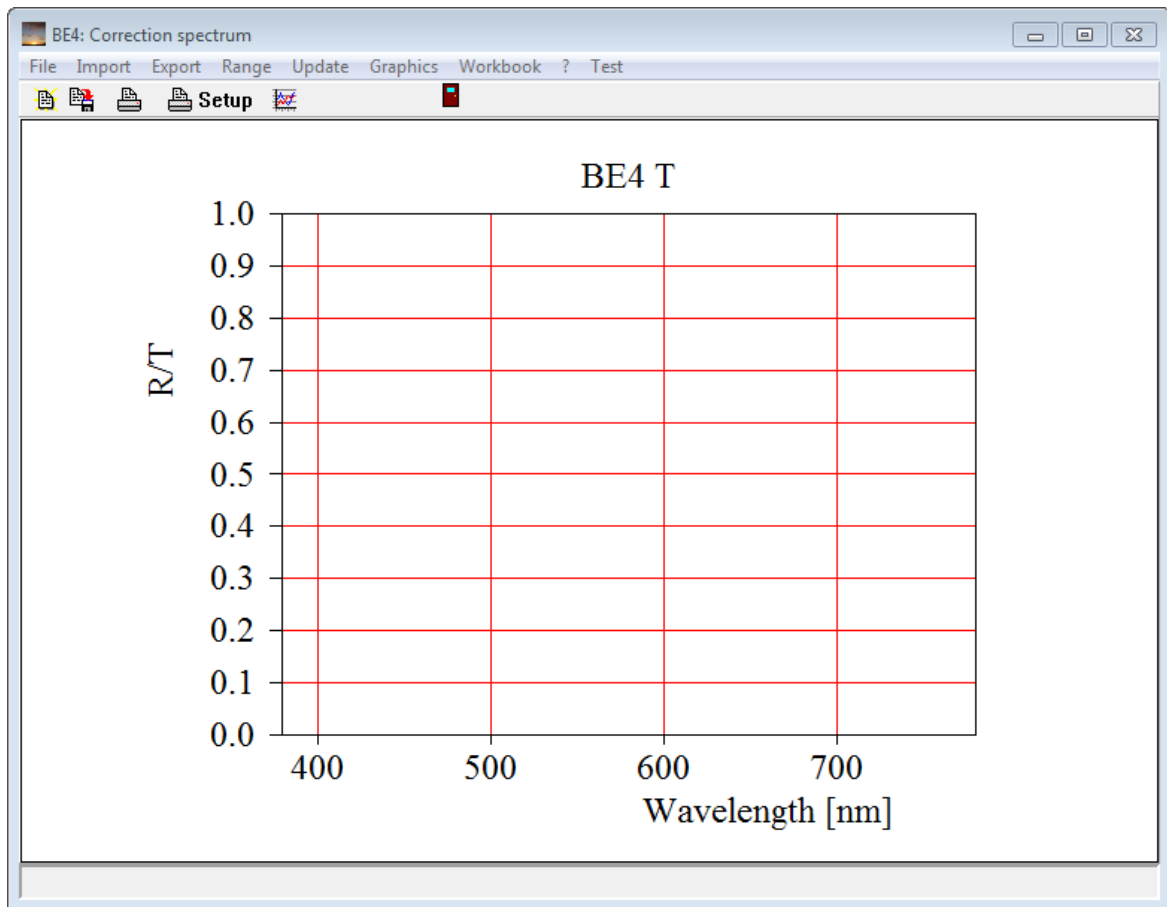


Once you have imported a reference spectrum it will be displayed in the BREIN displays as a green line:

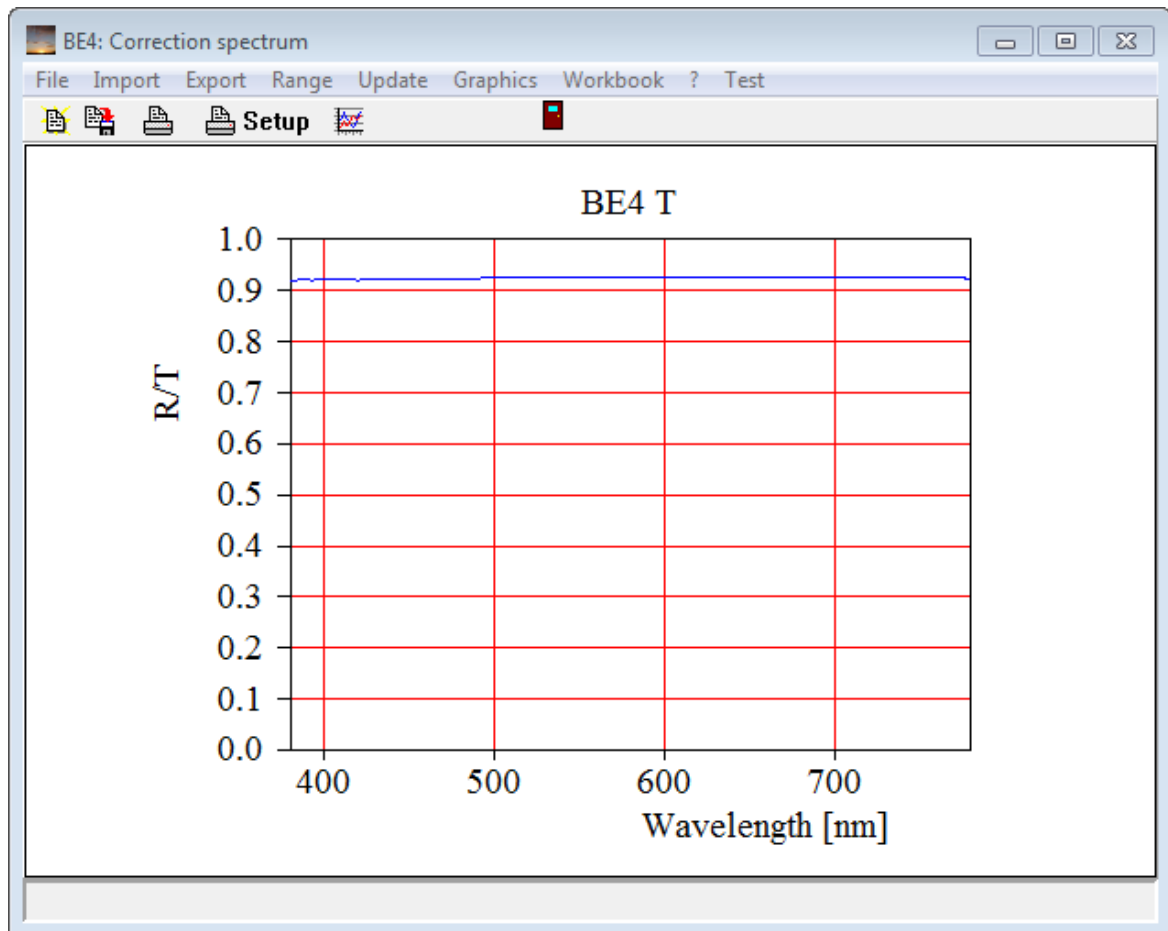


If you do not want to see the reference spectrum any more, press the button **Delete reference spectrum**.

The same way you can generate **Correction spectra**. Use the buttons **Set correction spectrum** and **Delete correction spectrum**. Incoming measured data are multiplied by the correction spectrum. The button **Set correction spectrum** brings up the following window:



You can use the **Import button** to load a spectrum from file, or one of the workbook commands to read the correction spectrum from workbook cells. Once you have loaded the wanted correction factor like in this example



you can close the window again. The correction spectrum is saved to a file in the folder of the current bright eye, using the name of the spectrum and writing the data in SpectraCalc format (binary file). In the example above the filename is correction__T.spc. When a BREIN product is loaded BREIN looks for correction files and loads the data if they exist.

Clicking the **Delete correction spectrum** deletes the correction file for the current product - no correction to incoming spectra is applied then.

Use the button **Set size of spectrum buffer** to define how many spectra this bright eye station collects in a buffer. In the spectrum display you can show these spectra in order to give the operators overview over the development of the spectra in time. For inline spectra a reasonable number is 5. In the case of bright eyes which perform a line scan of the panes with several spectra, it is recommended to set the buffer size to the number of spectra recorded along the line scan.

4.1.3 Submenu Settings

Here you find the following menu commands:

4.1.3.1 Settings/Objects

This command opens the **Overview and Zoom tabsheets** to give you the chance to click on the various objects (see above).

4.1.3.2 Deposition device parameters

Setting the deposition device parameters can be very tedious going through all deposition devices in the graphical representation of the coating line. The "Settings" submenu "Deposition device parameters" allows to set all parameters in a workbook sheet.

The menu command "Write to workbook" writes the current settings to a worksheet and opens the workbook.

With "Open workbook" you can show the workbook at anytime.

"Read from workbook" reads the settings from the workbook and modifies the deposition devices.

In addition to defining names and values of parameters you can enter the settings for temporary target values. These are described in the next section.

4.1.3.2.1 Temporary target values

You can define 3 different sets of temporary target values, namely "Current thickness values", "Current color values" and "Current color and thickness values". For each BREIN product you can use only one of these 3 possible sets. The operators can push the button "Temporary targets" to store the current values as target values for the production. These values are temporary, i.e. they are not part of the product definition. At any time the operators can click the button "Permanent targets" to return to the target values specified in the product definition by the BREIN administrator.

Once the parameters of the deposition devices have been written to the workbook, you will find 3 rows labeled "Temporary targets set 1", "Temporary targets set 2" and "Temporary targets set 3". Set 1 is used for thickness values, set 2 for color values and set 3 for color and thickness values. For each parameter which should get a temporary value you have to enter the name of the bright eye and a position range, like "BE5 (1200 ... 2000)". When the operator presses the "Temporary targets" button the target value for the parameter is taken from the given bright eye in the specified position range.

You can translate the following text fragments to the language of your operators if you like:

- Permanent targets
- Temporary target values
- Temporary targets set 1
- Temporary targets set 2
- Temporary targets set 3
- Use current thickness values as temporary target values?
- Use current color values as temporary target values?
- Use current color and thickness values as temporary target values?
- Go back to permanent target values?

In order to do so, please use the menu command 'Settings/Change lyrics' and edit the translation table that will open.

4.1.3.3 Settings/History

Use this command to define the appearance of the History tabsheet. You will get the following dialog:

History display parameters							
<input checked="" type="checkbox"/> Show history reverse (i.e. time moves from right to left) Select group color							
Transmission	BE	BE1	BE2	BE3	BE4	BE5	
	Parameter	T_BE1	T_BE2	T_BE3	T_BE4	T_BE5	
a*(T)	BE	BE1	BE2	BE3	BE4	BE5	
	Parameter	a_BE1	a_BE2	a_BE3	a_BE4	a_T_BE5	
b*(T)	BE	BE1	BE2	BE3	BE4	BE5	
	Parameter	b_BE1	b_BE2	b_BE3	b_BE4	b_T_BE5	
Thickness	BE	BE2	BE2	BE3	BE4	BE5	
	Parameter	DIEL1	AG1	DIEL2	AG2	DIEL3	
	BE						
	Parameter						
	BE						
	Parameter						
	BE						
	Parameter						

Each history display group is represented by 3 lines, having the same color. In the first column, at the top position, you have to enter the title of the group. Starting from the top, BREIN will move down and generate group by group, until the first empty title cell is found.

In order to assign a color to a group, select a cell in one of the 3 lines that define the group, and press the **Select group color** button. This will open a color dialog.

Starting at the third column from the left, you can enter the parameters you want to be displayed in the current group. The bright eye has to be specified (in the row labeled BE) and the parameter name (in the row called 'Parameter').

The parameter history is shown from left to right, i.e. now is on the left side and the past on the right. If you prefer time reversal, you can activate the **'Show history reverse'** checkbox and the time will move from right to left. This option will also affect the history plots in operator displays. It is a global setting which is used for all products.

Press OK to make your settings permanent.

4.1.3.4 Settings/Profiles

This command opens a dialog to define the **Profiles** display:

BE	Parameter	Samples displayed	Range minimum	Range maximum	Direction
Optoplex Q	DIEL1	4	0	3200	2
	AG1	4	0	3200	2
	DIEL2	4	0	3200	2
	AG2	4	0	3200	2
	DIEL3	4	0	3200	2
BE	Parameter				
	Samples displayed				
	Range minimum				
	Range maximum				
	Direction				
BE	Parameter				
	Samples displayed				
	Range minimum				
	Range maximum				
	Direction				

The **Profiles** display shows parameter values vs. position, usually thickness values measured across the panes using a scanning detection system running on a traverse.

The strategy here is similar to the one described above (History display).

In each group you have to define the bright eye (BE), the parameter name and the number of samples to be displayed (the latest sample is shown on top, while older ones are pushed down in the display as soon as new results are received). The number of samples must be the same for all parameters.

The **Range minimum** and **Range maximum** numbers define the position range, i.e. the dimension of the traverse system. The value of **Direction** can be 1, 2 or 3, representing the x-, y- or z-direction. In the case of traverse data, the direction parameter must be 2.

If you check the **'Show profiles reverse'** checkbox the profiles will be shown reverse, i.e. the maximum value will be on the left and the minimum on the right. This setting is global - it affects all profile plots (also those in operator displays) in all products.

4.1.3.5 Settings/Spectra

Use this command to do settings for the spectra display:

Group	BE	BE1	BE2	BE3	BE4	BE5	BE6
Insitu	BE						
	Spectrum	T	T	T	T	T	T
	Display mode	0	0	0	0	0	0
Exsitu	BE	BE7	BE7	BE7			
	Spectrum	T	RF	RG			
	Display mode	2	2	2			
	BE						
	Spectrum						
	Display mode						
	BE						
	Spectrum						
	Display mode						
	BE						
	Spectrum						
	Display mode						

For each group, enter the BE names and the spectrum names of all spectra that you want to see. Specifying the display mode you can control what is shown:

Display mode	Effect
-1	The last measured spectrum is shown
0	The last x spectra are shown - the number x of displayed spectra depends on the setting for 'spectrum buffer' (see the section about the tabsheet 'Overview and Zoom' above). This option is recommended for inline spectra if the operators should see the last 3 to 5 spectra measured by the associated BE.
1	This option is recommended for bright eyes which scan a single pane with several spectra along the x-axis. A group of spectra are shown - the number of spectra depends on the setting for 'spectrum buffer' (see the section about the tabsheet 'Overview and Zoom' above). Only spectra of the last pane are shown. Set the size of the spectrum buffer to the number of positions along the x-axis.
2	This option is recommended for bright eyes which scan a single pane with several spectra along the y-axis. A group of spectra are shown

	- the number of spectra depends on the setting for 'spectrum buffer' (see the section about the tabsheet 'Overview and Zoom' above). Only spectra of the last pane are shown. Set the size of the spectrum buffer to the number of positions along the y-axis.
3	This option is recommended for bright eyes which scan a single pane with several spectra along the z-axis. A group of spectra are shown - the number of spectra depends on the setting for 'spectrum buffer' (see the section about the tabsheet 'Overview and Zoom' above). Only spectra of the last pane are shown. Set the size of the spectrum buffer to the number of positions along the z-axis.

4.1.3.6 Settings/Operator display 1, 2, 3, 4, 5 or 6

A so-called 'operator display' is a kind of 'free style' screen where you can mix texts, parameter values and spectra in a flexible way. So you can compose a view which gives the operators just the information they need to know.

At the moment you can show

- Labels (plain text)
- Numbers (parameter values) as text
- Spectra (graphical)
- Quality information (as text)
- Parameter history (graphs)
- Parameter profiles (graphs)

In any of these groups, you can have as many objects as you like.

BREIN offers 4 different operator displays which may be shown on their main window pages. In addition, operator displays can be shown in their own windows on separate screens.

The display parameters are entered in dialogs like this which opens with the menu command **Settings/Operator display 1 (or 2, 3 or 4)**:

Operator display dialog

Background image

Select background graphics from file

Get background graphics from clipboard

Select object color

Numbers	BE	BE5	BE5	BE5	BE5	BE5	BE5
Parameter	DIEL 1	AG1	DIEL 2	AG2	DIEL 3	DIEL	
X	55.00	55.00	55.00	55.00	55.00	55.00	5
Y	45.00	50.00	55.00	60.00	65.00		4
Height	2.50	2.50	2.50	2.50	2.50		
R	0	0	0	0	0		
G	0	0	0	0	0		
B	0	0	0	0	0		
Digits	2	2	2	2	2		
Display mode	7	7	7	7	7		
Position	400 ... 4000	1000	1000	1000	1000		
Spectra	BE						
Spectrum							
x							

OK Cancel

In the top panel you can define a background picture which you can import from a metafile or by copying an image from the clipboard. In this case the clipboard must contain a metafile. You can generate metafiles using our CODE or SCOUT software, or Microsoft Paint that comes with Windows Vista.

For each element you have to specify x and y coordinates that determine where the object will appear. The numbers must be given in % of the display area. The same holds for numbers like Width and Height which have to be entered for some objects.

For text displayed you can specify the color by indicating the RGB values. If you select a cell in a text object column, you can press the **Select object button** to get a color dialog. The selected color will be used to enter its RGB coordinates into the table.

4.1.3.6.1 Labels

Labels are single text lines that can be drawn at the wanted position in the selected color. The height parameter specifies the height of the letter 'M' in % of the total height of the drawing area.

4.1.3.6.2 Numbers

These objects are used to display obtained values to the operators. Besides the parameters for text displays you can define the number of decimals to be displayed by setting **Digits**. If the bright eye determines the parameter for various positions like a spectrometer system moving on a traverse, you can set the Position for which you want to see the parameter value. You can also display average values by specifying a position range with expressions like '800 ... 1200'. Brein uses the string '...' to identify a range definition - if the string occurs in the text the number before '...' is used as range minimum and the number to the right as range maximum.

Number objects can show parameter values in different ways. The appearance is determined by the **Display mode**. The following tables summarize available display modes:

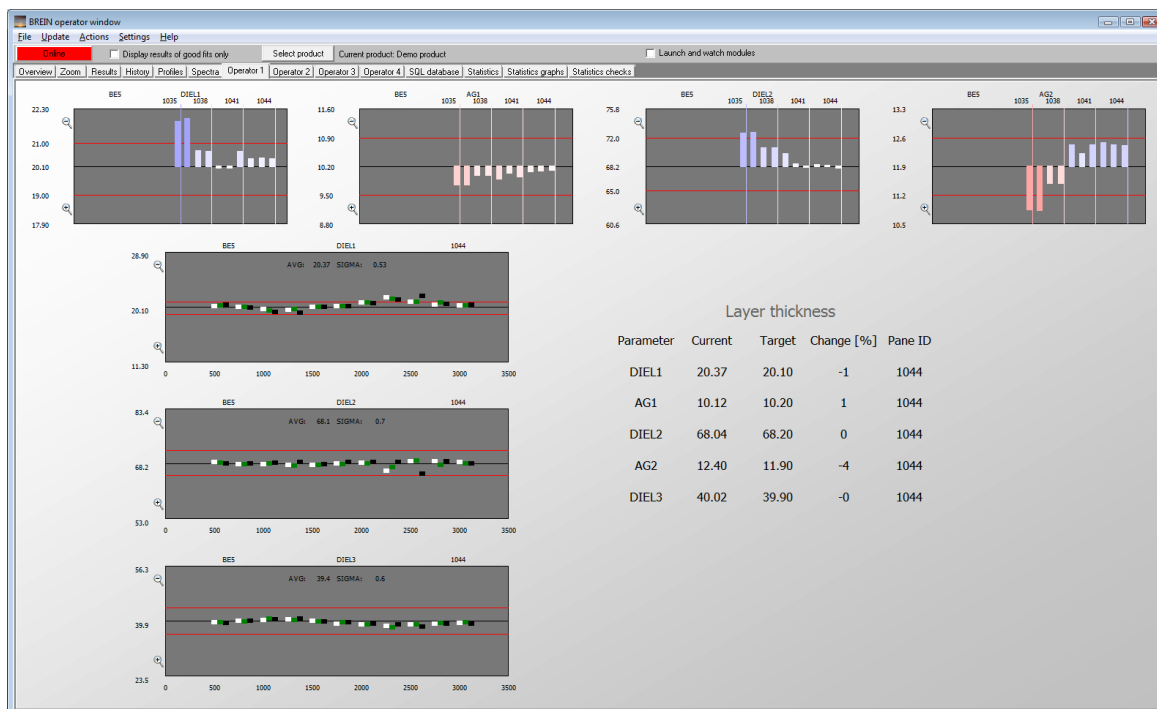
Horizontal, i.e. column headers written from left to right:

Display mode	Meaning
1	Show the current parameter value only
2	Show the current value and the target value
3	Show current value, target value, and the required parameter change (in %) to reach the target
4	Show the parameter name, current value, target value, and the required parameter change (in %) to reach the target
-4	Show column names according for display mode 4 (this is used to generate a kind of table header in the operator view)
5	Same as 4, but the 'change percentage' is shown with 1 decimal instead of no decimal at all
6	Show the parameter name, current value and target value
-6	Generate the header for display mode 6
7	Show the parameter name, current value, target value, the required parameter change (in %) to reach the target and the pane ID
-7	Generate the header for display mode 7
8	Show the parameter name and the required parameter change (in %) to reach the target
-8	Generate the header for display mode 8

Vertical, i.e. column headers written from top to bottom:

Display mode	Meaning
103	Show current value, target value, and the required parameter change (in %) to reach the target
104	Show the parameter name, current value, target value, and the required parameter change (in %) to reach the target
-104	Show column names according for display mode 4 (this is used to generate a kind of table header in the operator view)
105	Same as 4, but the 'change percentage' is shown with 1 decimal instead of no decimal at all
106	Show the parameter name, current value and target value
-106	Generate the header for display mode 6
107	Show the parameter name, current value, target value, the required parameter change (in %) to reach the target and the pane ID
-107	Generate the header for display mode 7
108	Show the parameter name and the required parameter change (in %) to reach the target
-108	Generate the header for display mode 8

The screenshot below gives an example where numbers with display mode 7 and -7 are shown:



4.1.3.6.3 Spectra

Spectra are defined by their position coordinates x and y as well as their size (width and height). Of course, the bright eye and the name of the spectrum must be given as well:

Operator display dialog

Background image

Select background graphics from file

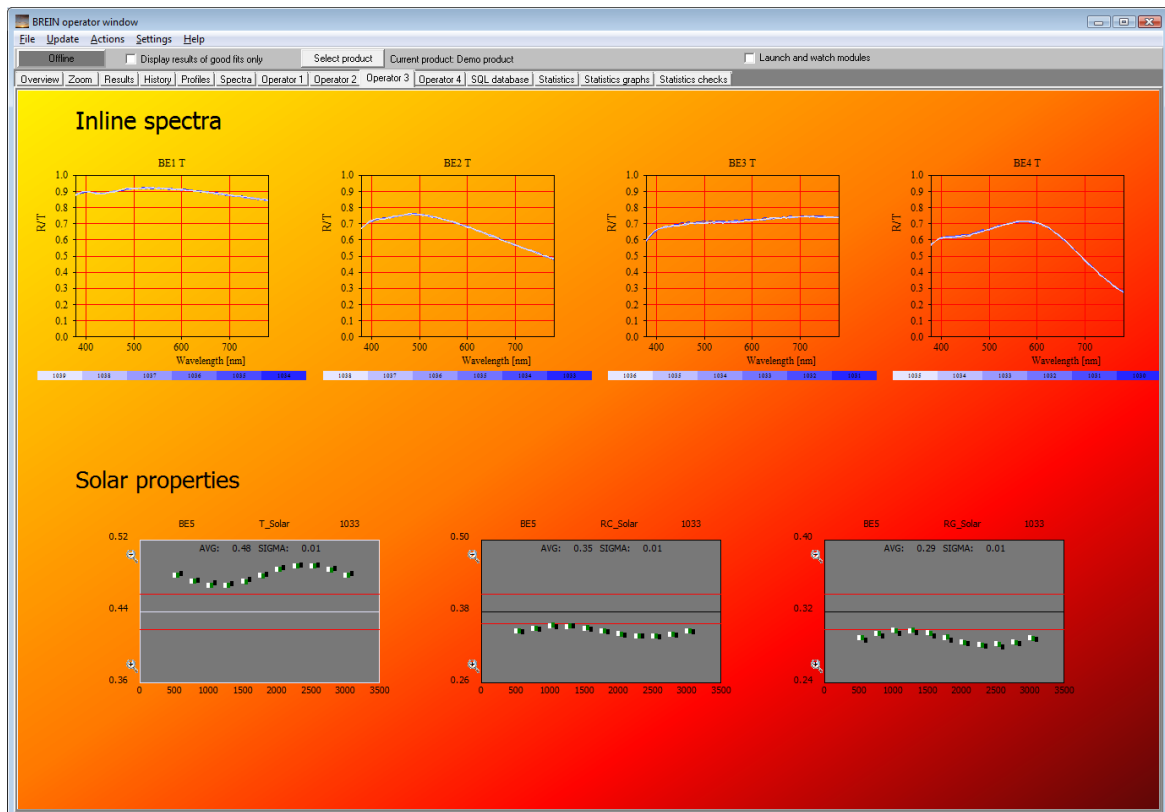
Get background graphics from clipboard

Select object color

	G	128	0	0	0	0
	B	128	0	0	255	255
	Digits	2	2	2	2	2
Spectra	BE	BE1	BE5			
	Spectrum	T	T			
	x	0.00	50.00			
	y	60.00	60.00			
	Width	50.00	50.00			
	Height	40.00	40.00			
Quality strings	BE	BE1	BE5			
	x	25.00	75.00			
	y	50.00	50.00			
	Height	4.00	4.00			
	g	255	0			
	b	0	0			
	b	0	255			

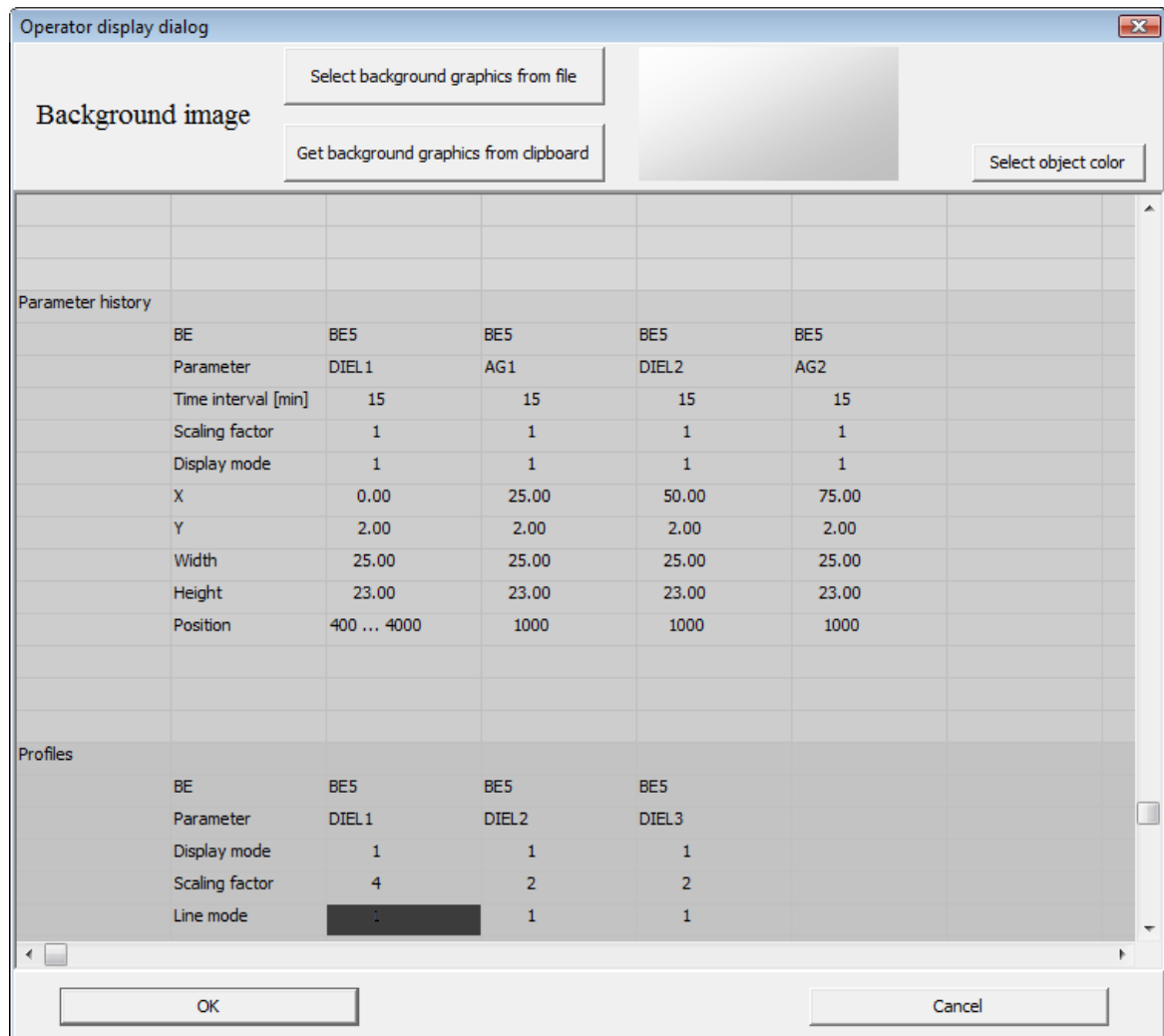
OK Cancel

The example below shows 4 transmittance spectra in an operator display:



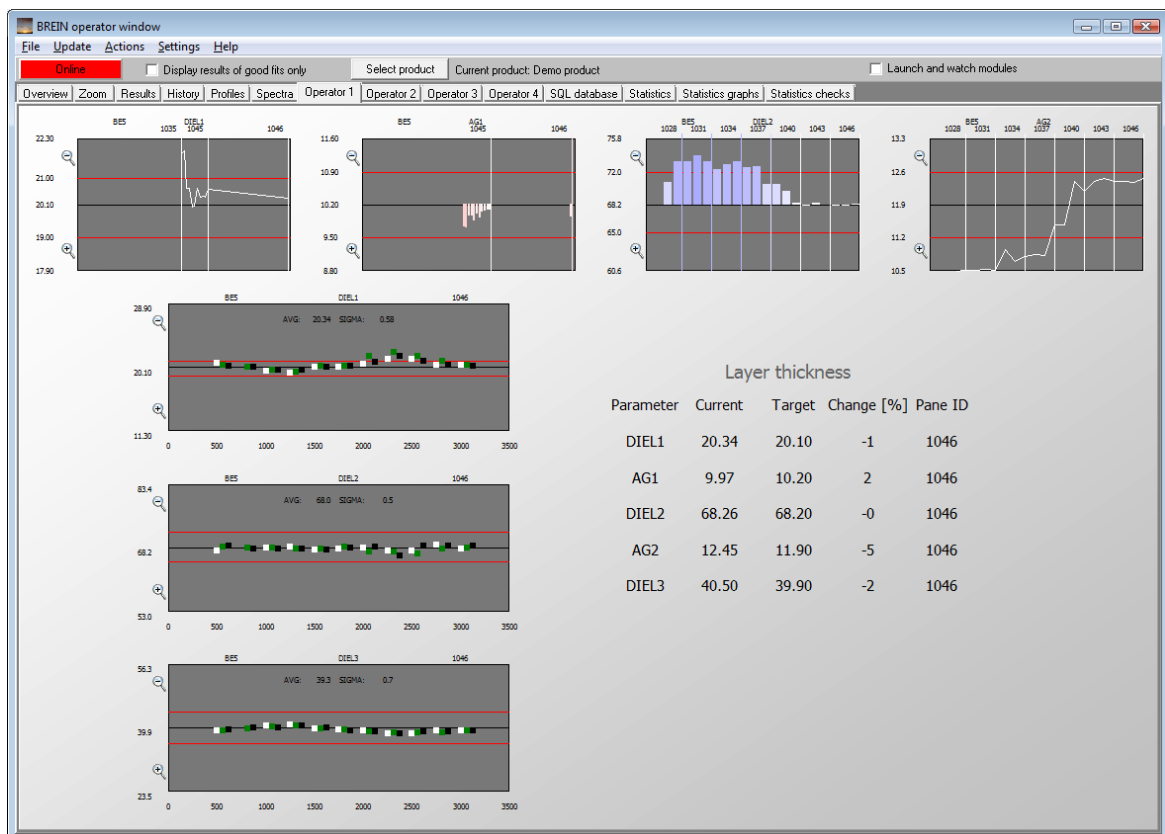
4.1.3.6.4 History plots

History plots in operator views are very similar to the graphs shown on the **History** page: They display the evolution of a parameter vs. time. The dialog for setting the display parameters is shown below. Besides the selection of the bright eye and the parameter you have to define the time period of the display. The number is given in minutes. In the case of a scanning bright eye station you have to specify the position for which you want to see the values. If you enter a specific position (like 1000 in the example below) you have to make sure that there is a measurement at this position. If not the graph will remain empty. As shown for the parameter DIEL1 you can also specify a position range by typing in the minimum value and the maximum value, separated by the text '...'. In this case BREIN will take the average of the parameter in this position range.



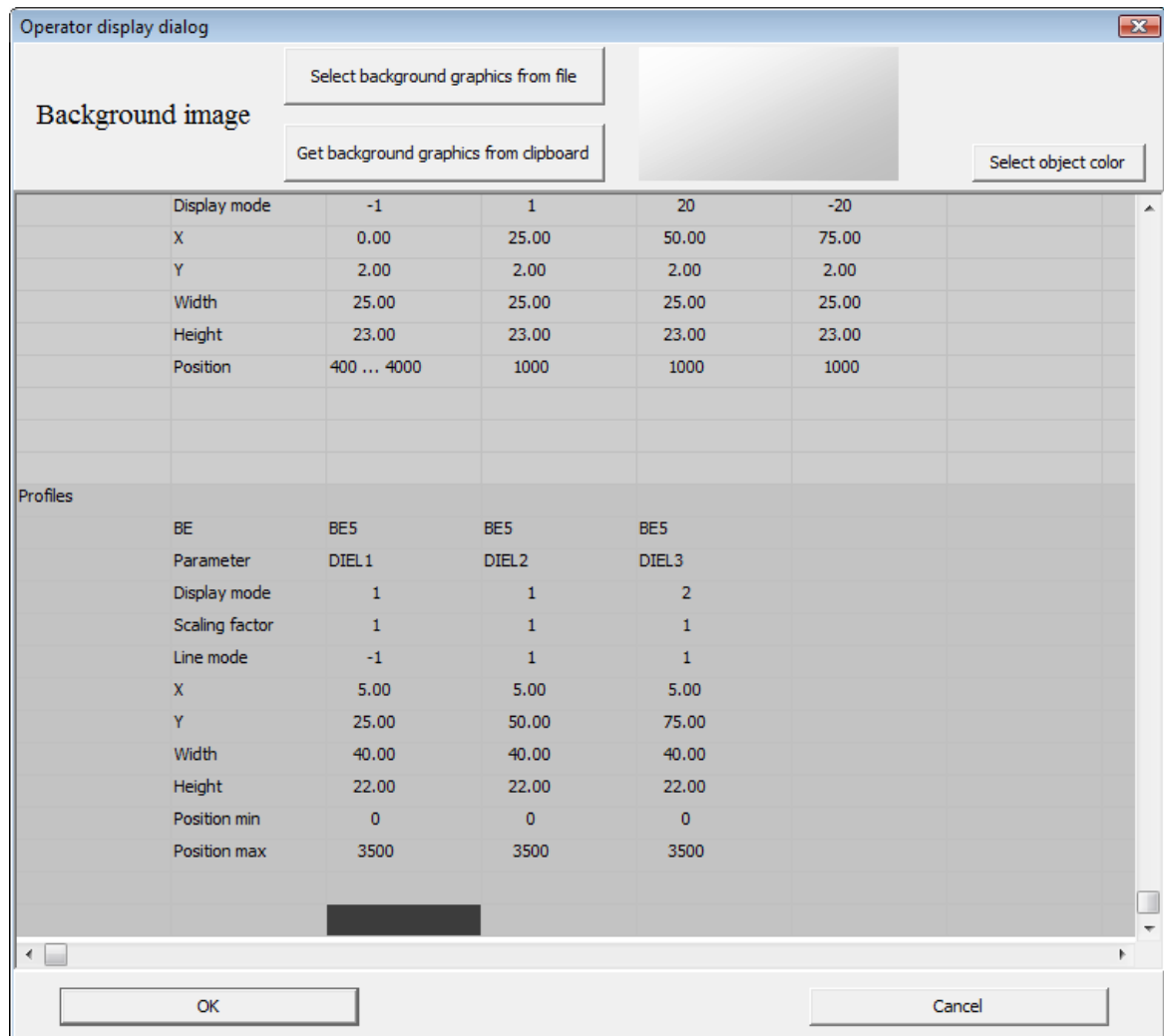
The screenshot below shows 4 different history plot objects in the top row. They use different display modes.

- Display mode 1: Bar graph with linear time axis
- Display mode -1: Line graph with linear time axis
- Display mode >10: Graphs using bars plotted next to each other, no time linearity, the number of bars to be drawn is the value of the display mode, i.e. display mode 23 shows 23 bars, display mode 15 shows 15 bars
- Display mode <-10: Line graph with equal spacing between values, no time linearity, the number of values to be drawn is the absolute value of the display mode, i.e. display mode -23 shows 23 values, display mode -15 shows 15 values



4.1.3.6.5 Profile plots

Objects of this type show parameter profile plots, i.e. graphs showing values vs. position.



Each graph will show 3 sets of data, drawn in different colors: White shows the last sample the name of which is displayed in the upper right corner of the graph. Red is the color for the previous sample, and black represents the next oldest sample. This shall put the operators in the position to view changes of the profiles in time - at least a little.

The line mode parameter controls the style of data drawing:

Line mode -1 : Bar graphs

Line mode 1: 'Dot' graphs

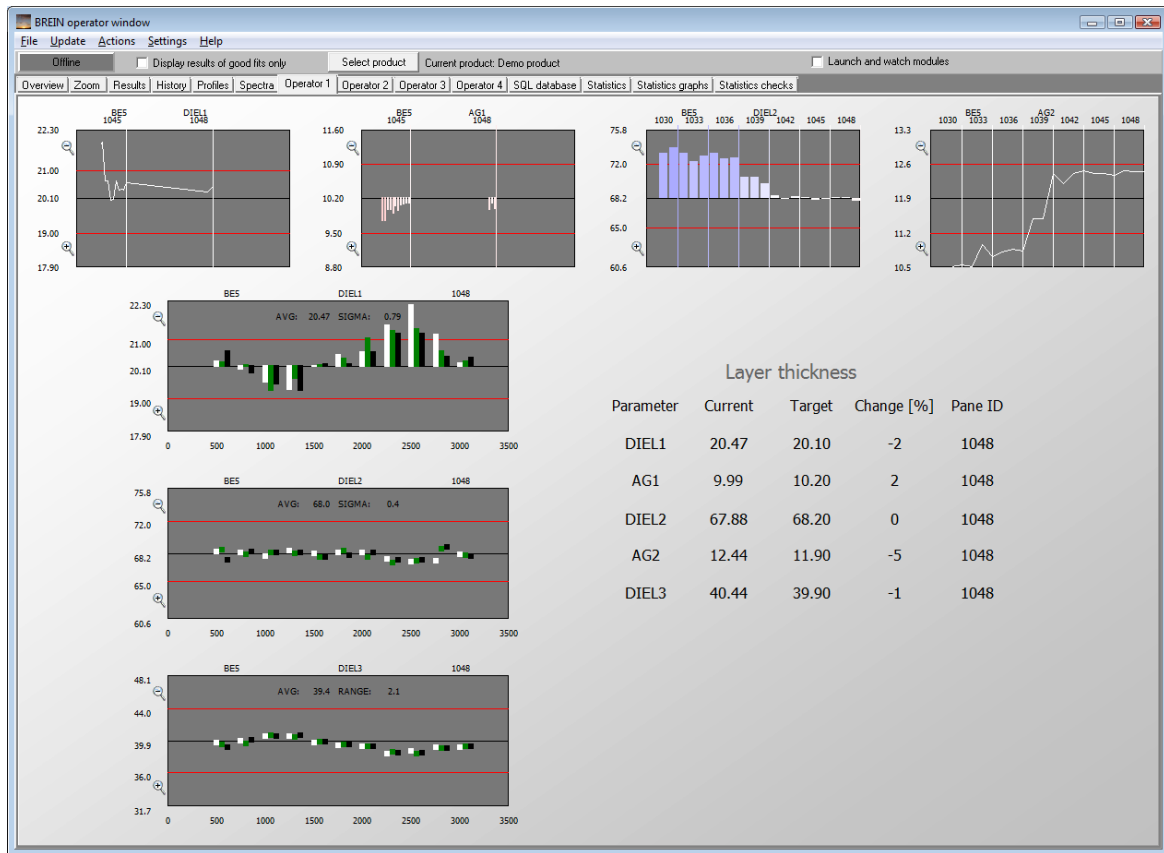
The display mode parameter is used to define which numbers are displayed in the upper part of the graphs:

Display mode 1: The average and the standard deviation sigma of the profile are shown

Display mode 2: The average and the parameter range (maximum value - minimum value) are shown

Display mode 3: The average and the parameter range (maximum value - minimum value, expressed in % of the average) are shown

Here is an example of profile plots (lower left side):



4.1.3.7 Settings/Analysis method

If you modify the method to analyze measured data you might want to record somehow which method has produced the results stored in a database record. In order to do so you can set an integer number as identification or version of the analysis method. Use the command **Settings/Analysis method/Set index** to specify this number.

The analysis method is made up by the files *code.wcd*, *fit_parameters.fps*, *first_position.fps* and *other_position.fps* stored in each bright eye folder. Not all of these files are required for each bright eye, so some may be missing. You can store these files as an indexed analysis method using the command Settings/Analysis method/Save to directory. Within the folder of the current product, BREIN will generate a directory analysis_method and therein a folder named after the current index of the analysis method. Within this folder the method files are stored for each bright eye.

In order to load a stored analysis method, use the command Settings/Analysis method/Set index first to specify the wanted index and then apply the command Settings/Analysis method/Load from directory.

Alternatively to deposit analysis methods in BREIN database folders you can store method files in an SQL database system (see the 'SQL section' below for connection details). If the current BREIN product is called ABC and it is analyzed with a single bright eye station BE1, the database must contain a table named ABC_analysis_method which must have fields defined by the following sql-script:

```
USE [BREIN]
```

```
GO
```

```
/****** Objekt: Table [dbo].[ABC_analysis_method]
```

```
Skriptdatum: 09/10/2010
```

```
14:43:58 *****/
```

```
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
SET ANSI_PADDING ON
GO
CREATE TABLE [dbo].[ABC_analysis_method](
    [index] [int] NOT NULL,
    [description] [nvarchar](max) NULL,
    [BE1_code] [varbinary](max) NULL,
    [BE1_fit_parameters] [varbinary](max) NULL,
    [BE1_first_position] [varbinary](max) NULL,
    [BE1_other_position] [varbinary](max) NULL,
    CONSTRAINT [PK_ABC_analysis_method] PRIMARY KEY CLUSTERED
(
    [index] ASC
)WITH (PAD_INDEX = OFF, STATISTICS_NORECOMPUTE = OFF,
IGNORE_DUP_KEY = OFF, ALLOW_ROW_LOCKS = ON,
ALLOW_PAGE_LOCKS = ON) ON [PRIMARY]
) ON [PRIMARY]

GO
SET ANSI_PADDING OFF
```

If there are more bright eye stations the table must have more fields of type varbinary (these are so-called BLOB fields). Ask W.Theiss Hard- and Software for support if you want to generate proper database tables for BREIN methods.

4.1.3.8 Settings/Statistics graphs

If one of the bright eye stations performs linear scans of the panes (e.g. profile measurements across the width, perpendicular to the motion of the panes in the coater) you can compute and display statistical values of the parameters. Available are the *average*, the *minimum* and the *maximum*, the *range* (the difference between the maximum and the minimum value) and the standard deviation *sigma*. You can generate several graphs which are displayed on the page **Statistics graphs**.

The quantities which can be shown on the 'Statistics graphs' page are defined in the section **Settings/Statistical specifications** (see below).

The settings are done in the following dialog:

Statistics graphs parameters

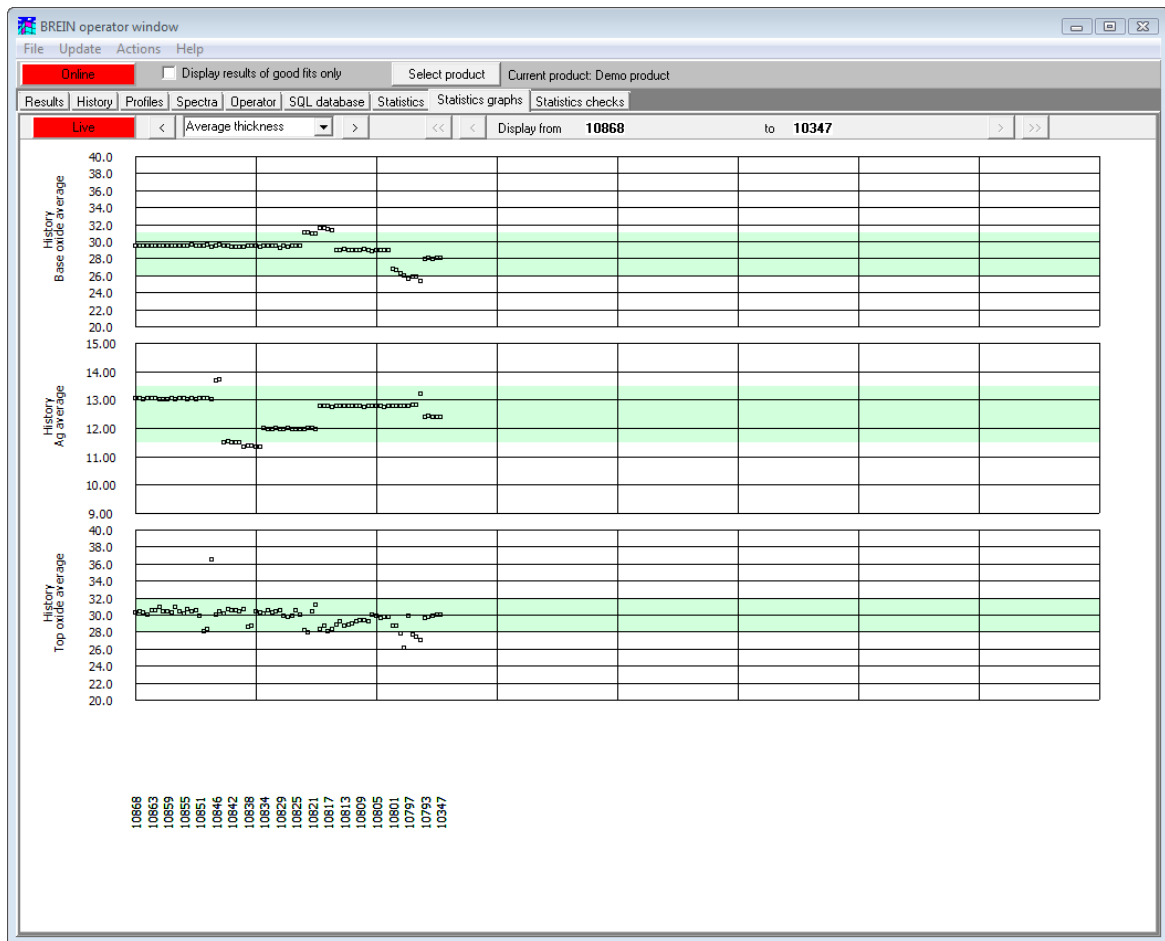
Select group color

Average thickness						
	Display type:	History				
	Parameters:	Base oxide average	Ag average	Top oxide average		
Standard deviation						
	Display type:	History				
	Parameters:	Base oxide sigma	Ag sigma	Top oxide sigma		
Profiles						
	Display type:	Profile Y				
	Parameters:	Base oxide average	Ag average	Top oxide average		
	Display type:					
	Parameters:					
	Display type:					
	Parameters:					
	Display type:					
	Parameters:					
	Display type:					
	Parameters:					

OK Cancel

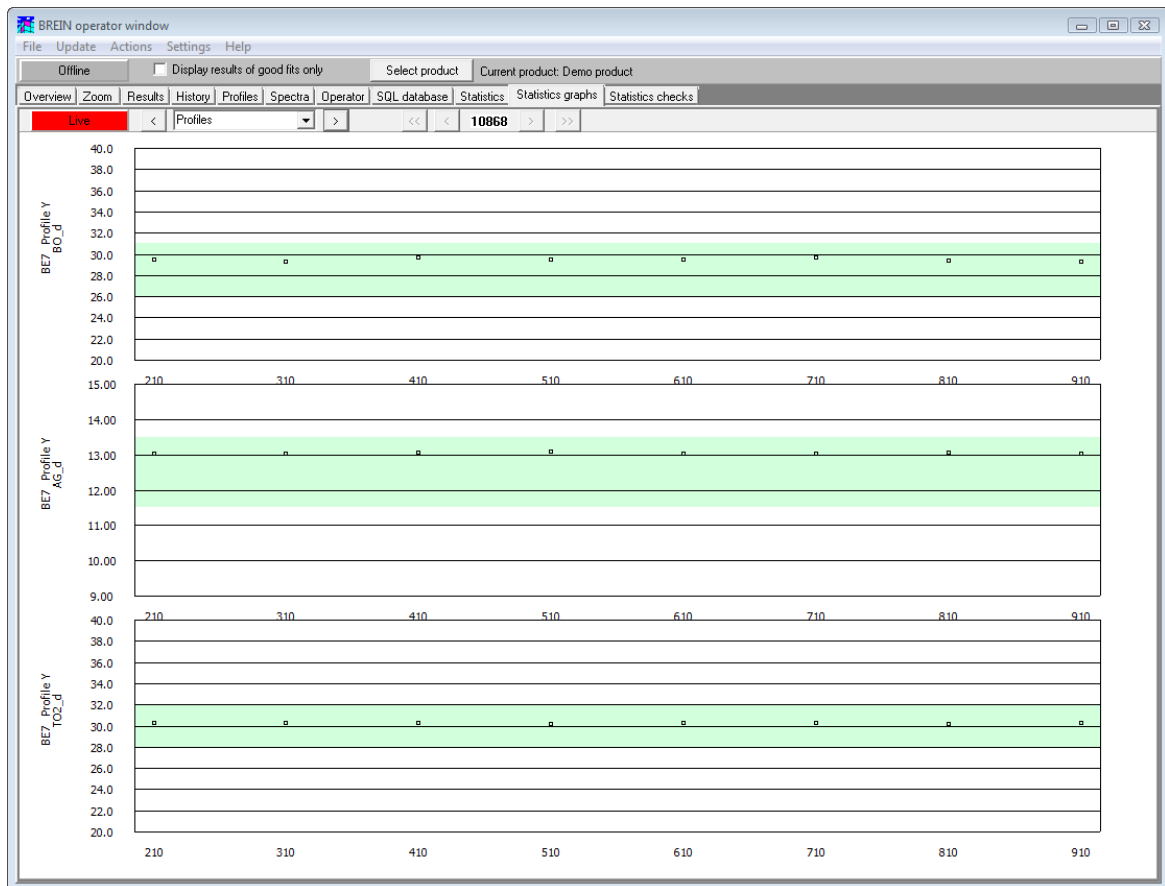
The shown settings define three groups of graphs showing three graphs each. For each group you can set the **display type** which must be either 'History', 'Profile X', 'Profile Y' or 'Profile Z'. The 'History' type shows the development of the values for a number of panes, the others show the profiles for an individual pane which were used to generate the average value.

A 'History' plot looks like this:



In the upper left corner you can click on the **'Live'** button to switch from a live graph (showing the last 240 panes) to a historic plot which lets you move deeper into the past, using the buttons <<, <, >, >> in the upper right section of the window.

An example of a profile graph is given below:



4.1.3.9 Settings/Statistical specifications

Use this command to set specifications for line scans which can be used to decide if a pane should be rejected or not. The dialog looks like this:

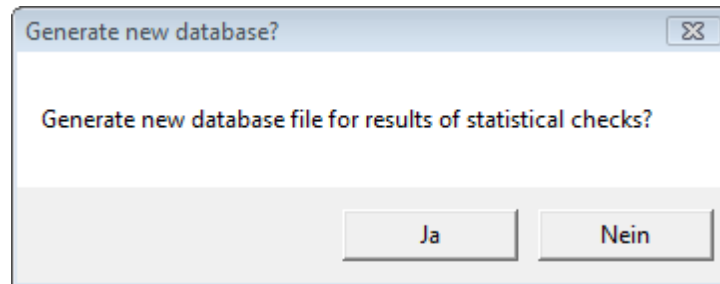
Statistical target specifications				
Name of specification	Base oxide average	Base oxide sigma	Ag average	
BE	BE7	BE7	BE7	
Parameter name	BO_d	BO_d	AG_d	
Quantity (avg, range, sigma)	avg	sigma	avg	
Target value	28.0	0.00	12.50	
Tolerated minimum	26.0	0.00	11.50	
Tolerated maximum	31.0	2.00	13.50	
Display: Minimum	20.0	0.00	9.00	
Display: Maximum	40.0	5.00	15.00	
Display: Ticklength	2.0	1.00	1.00	
Display: Decimals	1	2	2	
Critical quantity (yes/no)	Yes	No	Yes	

OK Cancel

A specification must have a name which is to be used in the definition of statistics graphs (see

above). You have to specify a bright eye (BE) which must be one that performs a line scan. The parameter to be statistically inspected is given by 'Parameter name'. As statistical quantity you can select 'avg', 'range' or 'sigma' which mean the average, the range (i.e. the difference of the largest and the smallest value of the scan) and the standard deviation. For each statistical quantity you can set the target value and values for the tolerated minimum and maximum. For the statistics graphs you have to specify the minimum and maximum of the display range as well as the ticklength and the decimals. Finally you have to declare a quantity as critical for rejection or not. A pane is marked as 'Bad' if at least one critical value is out of specification.

Once you close this dialog you are asked if you want to generate a new database table for the computed data:



Caution! If you answer here with 'Yes' all current data in the table are lost! You should generate a new database file only if you have changed the number and the names of the parameters.

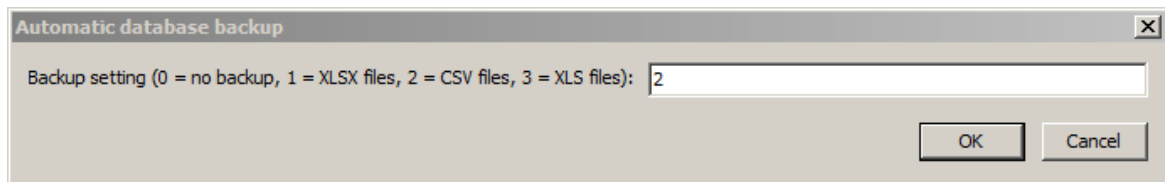
The computed quantities are shown on the page 'Statistics checks' which might look like this:

Time	Pane ID	Specification	Base oxide average	Base oxide sigma	Ag average	Ag sigma	Top oxide average	Top oxide sigma
30.08.2010 16:57:12	10845	Bad	29.6	0.14	13.70	0.01	30.4	0.08
30.08.2010 16:56:28	10844	Good	29.5	0.13	11.51	0.03	30.2	0.14
30.08.2010 16:55:42	10843	Good	29.5	0.13	11.52	0.03	30.7	0.08
30.08.2010 16:55:10	10842	Bad	29.4	0.13	11.50	0.03	30.6	0.09
30.08.2010 16:50:45	10840	Good	29.4	0.12	11.50	0.04	30.4	0.11
30.08.2010 16:50:00	10839	Bad	29.4	0.10	11.36	0.03	30.6	0.08
30.08.2010 16:49:16	10838	Bad	29.5	0.14	11.38	0.03	29.6	0.13
30.08.2010 16:48:33	10837	Bad	29.5	0.18	11.36	0.03	28.7	0.12
30.08.2010 16:47:46	10836	Bad	29.5	0.17	11.34	0.04	30.4	0.09
30.08.2010 16:47:04	10835	Bad	29.4	0.15	11.34	0.03	30.2	0.13
30.08.2010 16:46:16	10834	Good	29.5	0.27	11.95	0.03	30.1	0.10
30.08.2010 16:45:32	10833	Good	29.5	0.12	11.95	0.04	30.6	0.06
30.08.2010 16:44:47	10832	Good	29.5	0.10	11.97	0.03	30.3	0.09
30.08.2010 16:35:37	10829	Good	29.3	0.18	11.95	0.04	30.6	0.09
30.08.2010 16:34:52	10828	Good	29.5	0.08	11.98	0.03	29.9	0.10
30.08.2010 16:34:07	10827	Good	29.4	0.11	11.98	0.02	29.7	0.04
30.08.2010 16:33:22	10826	Good	29.5	0.10	11.98	0.03	29.9	0.07
30.08.2010 16:32:38	10825	Good	29.5	0.15	11.98	0.03	30.5	0.09
30.08.2010 16:32:34	10824	Good	29.5	0.22	11.98	0.03	30.0	0.11
30.08.2010 16:31:08	10823	Bad	31.0	0.09	11.97	0.04	28.1	0.14
30.08.2010 16:30:24	10822	Bad	31.0	0.12	11.98	0.04	27.9	0.07
30.08.2010 16:28:10	10819	Bad	31.5	0.21	12.77	0.01	29.3	0.14
30.08.2010 16:27:25	10818	Bad	31.5	0.12	12.79	0.04	28.7	0.08
30.08.2010 16:25:56	10816	Bad	31.3	0.22	12.75	0.02	28.3	0.10
30.08.2010 16:25:11	10815	Good	28.9	0.20	12.78	0.03	28.9	0.10
30.08.2010 16:24:33	10814	Good	29.0	0.17	12.79	0.02	29.2	0.07
30.08.2010 16:24:33	10813	Good	29.0	0.17	12.79	0.02	28.7	0.10
30.08.2010 16:24:32	10812	Good	29.0	0.15	12.78	0.02	28.8	0.11
30.08.2010 16:24:32	10811	Good	28.9	0.07	12.78	0.02	29.0	0.06
30.08.2010 16:20:44	10809	Good	29.0	0.11	12.78	0.02	29.3	0.06
30.08.2010 16:20:25	10808	Good	29.1	0.09	12.76	0.01	29.3	0.07
30.08.2010 16:20:25	10807	Good	29.0	0.19	12.79	0.02	29.2	0.08
30.08.2010 16:20:25	10806	Good	28.9	0.18	12.77	0.02	29.9	0.09
30.08.2010 16:20:25	10805	Good	29.0	0.12	12.77	0.03	29.9	0.10
30.08.2010 16:20:25	10804	Good	28.9	0.13	12.77	0.02	29.6	0.10
30.08.2010 16:20:25	10803	Good	28.9	0.21	12.75	0.02	29.7	0.06
30.08.2010 17:28:47	10868	Good	29.4	0.14	13.04	0.02	30.2	0.07

Critical quantities are shown in red or green depending on their value. The column 'Specification' is drawn green if all critical quantities are within specification and red if at least one is out of target.

4.1.3.10 Settings/Automatic database backup

Use this command to activate or de-activate an automatic database backup. If activated, every day BREIN saves the content of the results database to a file in the product subfolder 'Database_history'. You can specify the format of the file in the following dialog:



4.1.3.11 Settings/Lifetime of database records

If you generate database backups every day, it makes sense to drop old results from time to time in order to keep the size of the database reasonable. You can control the deletion of database records by setting the maximum number of database records.

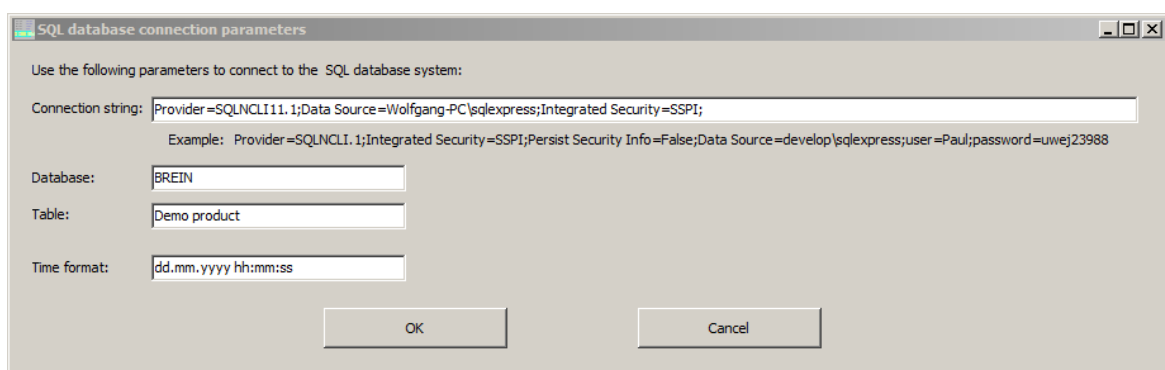
In versions of BREIN prior to April 2012 a lifetime of database records was used to limit the number of database records. This has been changed after re-structuring the internal storage of results.

If automatic database backup is switched on, BREIN will do a backup at midnight and then check if too many database records exist and delete an appropriate number.

The deletion of old records can also be activated using the menu command **Actions/Remove old database records**.

4.1.3.12 Settings/SQL export of results

BREIN can export incoming new results to an external SQL database. The table of the external database must have field types and names exactly matching those in the BREIN results database. In addition, you have to specify the SQL connection parameters in the following dialog:



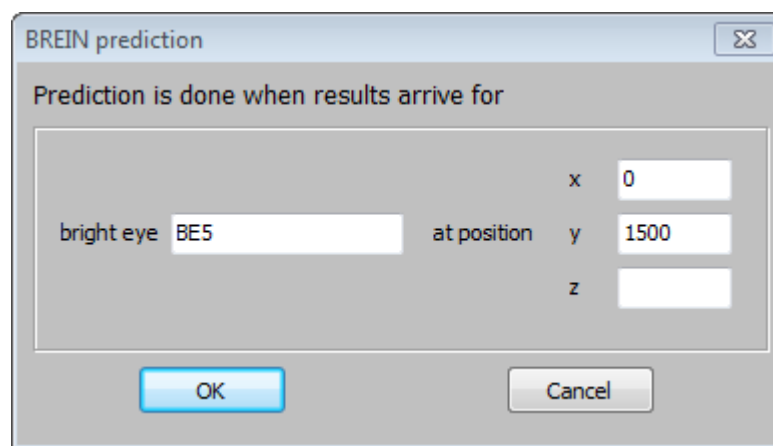
4.1.3.13 Prediction

Here you can define settings used to generate the content of the **Predict** tabsheet.

A typical 'prediction' application is the forward computation of the properties of a double or triple glazing, one of the panes being the just produced product. In this case BREIN must transfer the obtained thickness values from the results table to the object doing the prediction. Details are explained below.

4.1.3.13.1 Trigger

The prediction graph is updated when new results arrive for a certain bright eye and a user-defined position. The dialog to enter these settings looks like this:



The dialog box is titled "BREIN prediction" and contains the text "Prediction is done when results arrive for". It has three input fields: "bright eye" with the value "BE5", "at position" with "x" set to "0", "y" set to "1500", and "z" set to an empty field. There are "OK" and "Cancel" buttons at the bottom.

'Bright eye' specifies the name of the bright eye which is watched for the trigger event.

The coordinates x, y and z define the sample position that raises the trigger. For these quantities you can specify ranges like "1500 ... 1600" or "-100000 ... 100000" or single numbers like "1550".

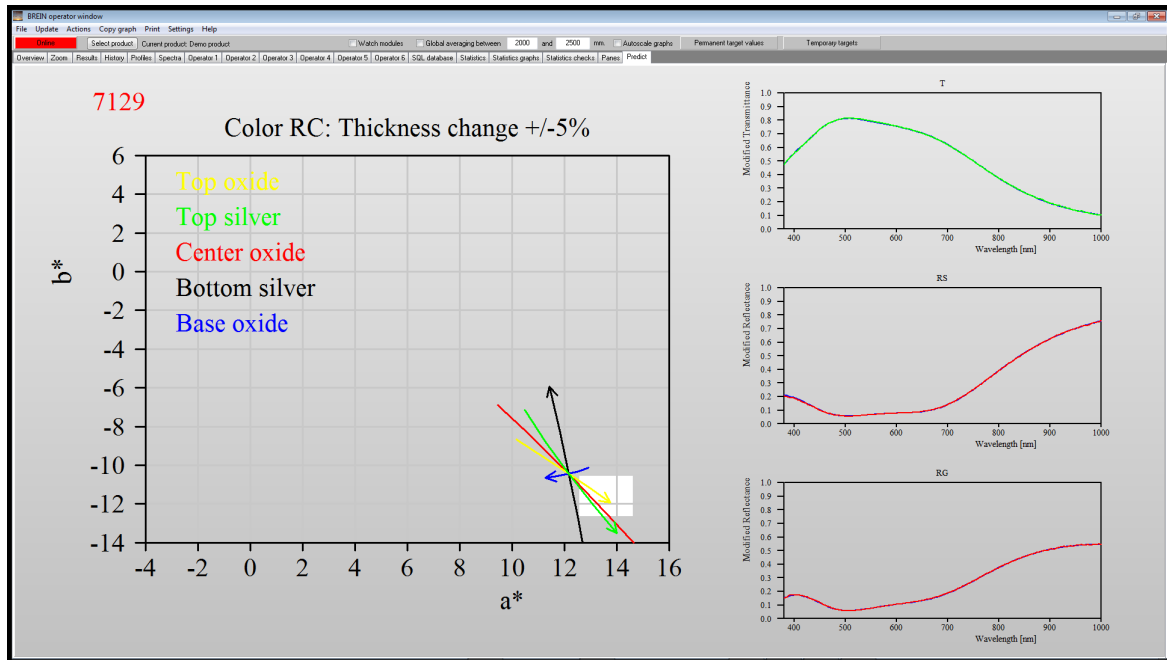
4.1.3.13.2 CODE configuration

The **Predict** tabsheet shows the first view of a CODE configuration that you can modify here. The configuration must be saved to the file prediction.wcd in the product folder. When a product is loaded BREIN reads the configuration from this file.

When a trigger event happens BREIN goes through all fit parameters of the prediction configuration and compares their names with all parameter names for which results have been obtained. If agreement is found the parameter value is passed to the prediction configuration. Measured spectra are passed to the prediction configuration when matching spectrum names are identified.

When the transfer of values is finished the prediction configuration is updated including the graph in the tabsheet.

You can use the prediction mechanism to visualize how the coating which is produced right now will perform in the final glazing product. Or you can generate graphs that help the operators to predict how modifications of the coater settings will affect the coating properties. Here is an example for a double silver low-e coating, showing the result of the fit procedure on the right side (by simulating the spectra once more and comparing to the measured spectra). In the main part of the screen the operators see the prediction how 5% changes of the layer thicknesses will influence the position of the coating in the color plane (b^* vs. a^*):

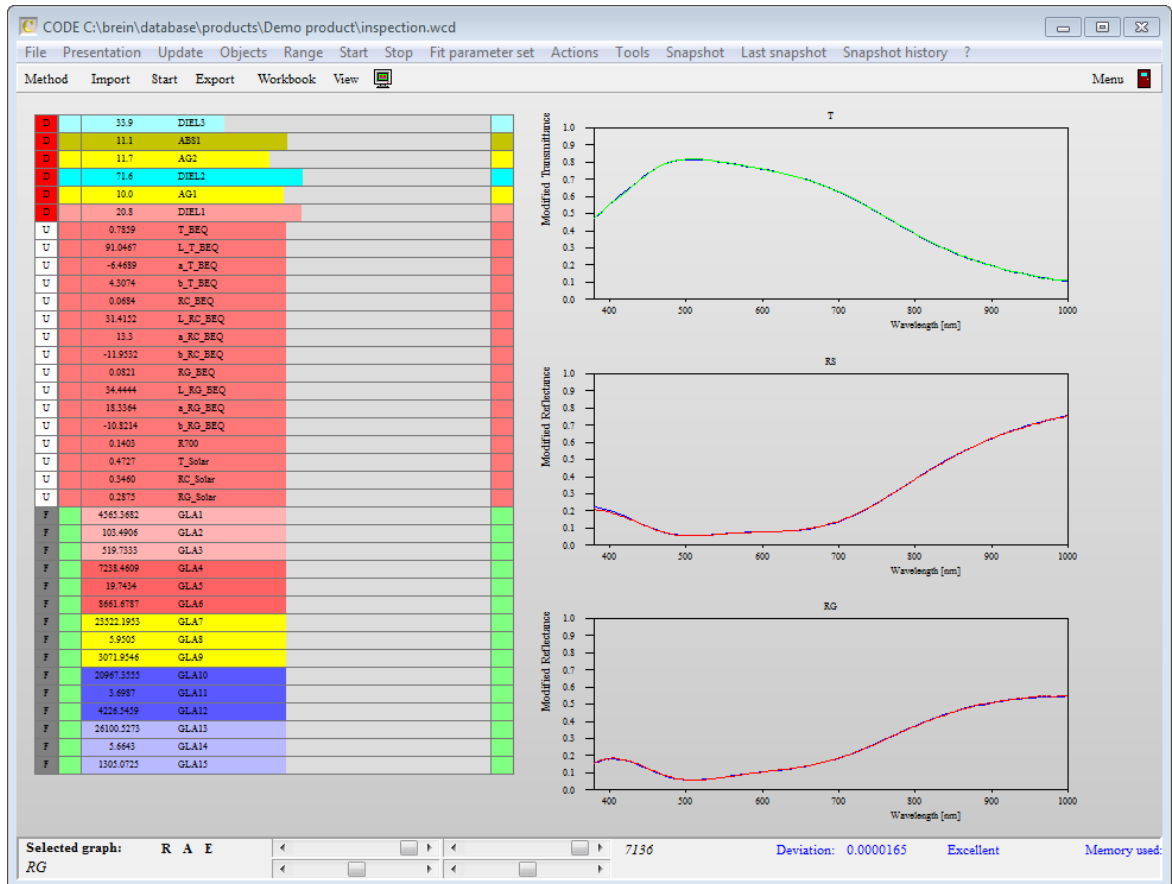


Mouse clicks and mouse moves are forwarded to the underlying CODE view that generates the **Predict** graph. That means that you can integrate sliders or other interactive elements on this page. Note, however, that the update of the **Predict** page is done only once in a second - so the responsiveness is significantly different from CODE itself.

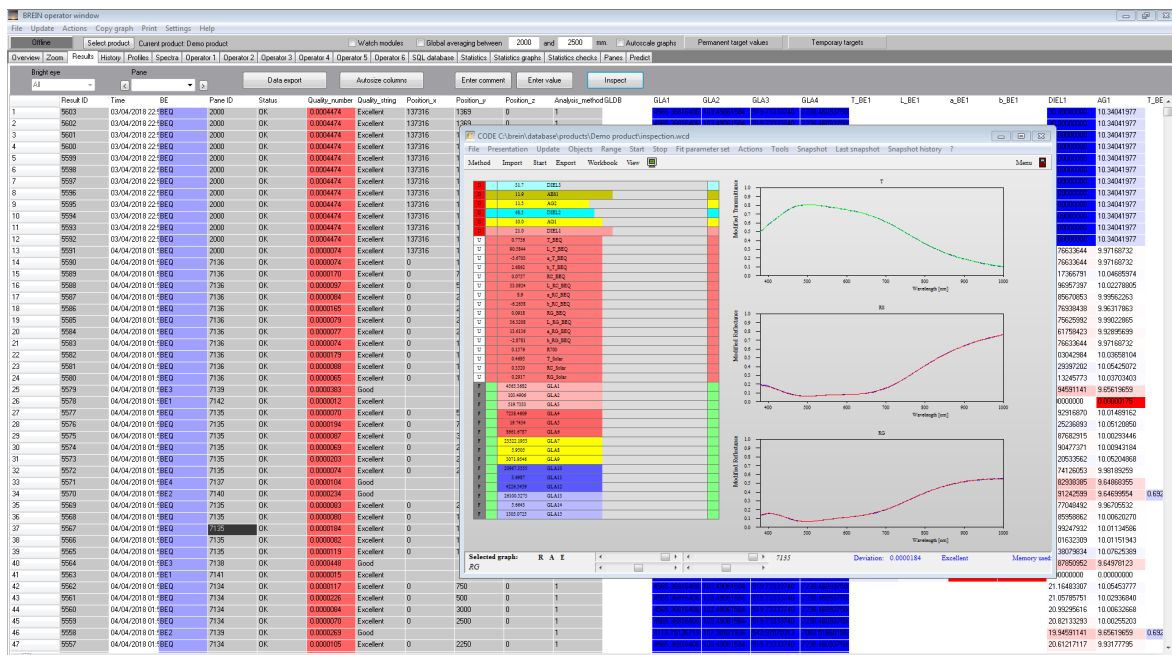
4.1.3.14 Inspection

This command opens a separate CODE window that loads the configuration inspection.wcd in the product folder (if it exists). You can use this CODE instance to verify a fit result or to check what would happen if you would change some of the parameters.

If you just want to inspect and verify correct fit results for traverse spectra you can simply take the configuration code.wcd which is used by bright_eye_traverse.exe to perform the fit. That might look like this:

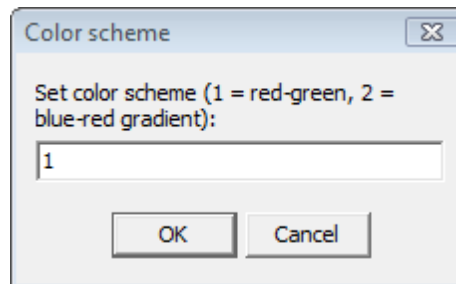


Once you have defined the configuration inspection.wcd in the product folder you can visit the 'Results' tab of BREIN, select the row of results you are interested in, and click the 'Inspect' button. BREIN will now load the fit results and the spectra to the 'Inspection' window and open it:



4.1.3.15 Settings/Color scheme

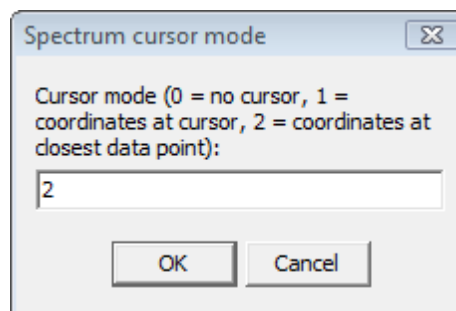
Coloring values in the Results database or on the History and Profiles pages is done using one of the following color schemes:



<i>Color scheme</i>	<i>Meaning</i>
1	Results within specification are drawn green, those outside tolerated limits are drawn red
2	Values below the tolerated minimum are displayed in red, above the tolerated maximum in blue. Parameter values in the tolerated range are drawn in a color between red and blue, indicating the value of the parameter

4.1.3.16 Settings/Cursor mode

The page 'Spectra' shows the recent measured data that were analyzed by BREIN. You can get numerical information about the data by moving the mouse cursor over the spectra. The following options are available:



4.1.3.17 Settings/Online color and Offline color

Settings/Online color

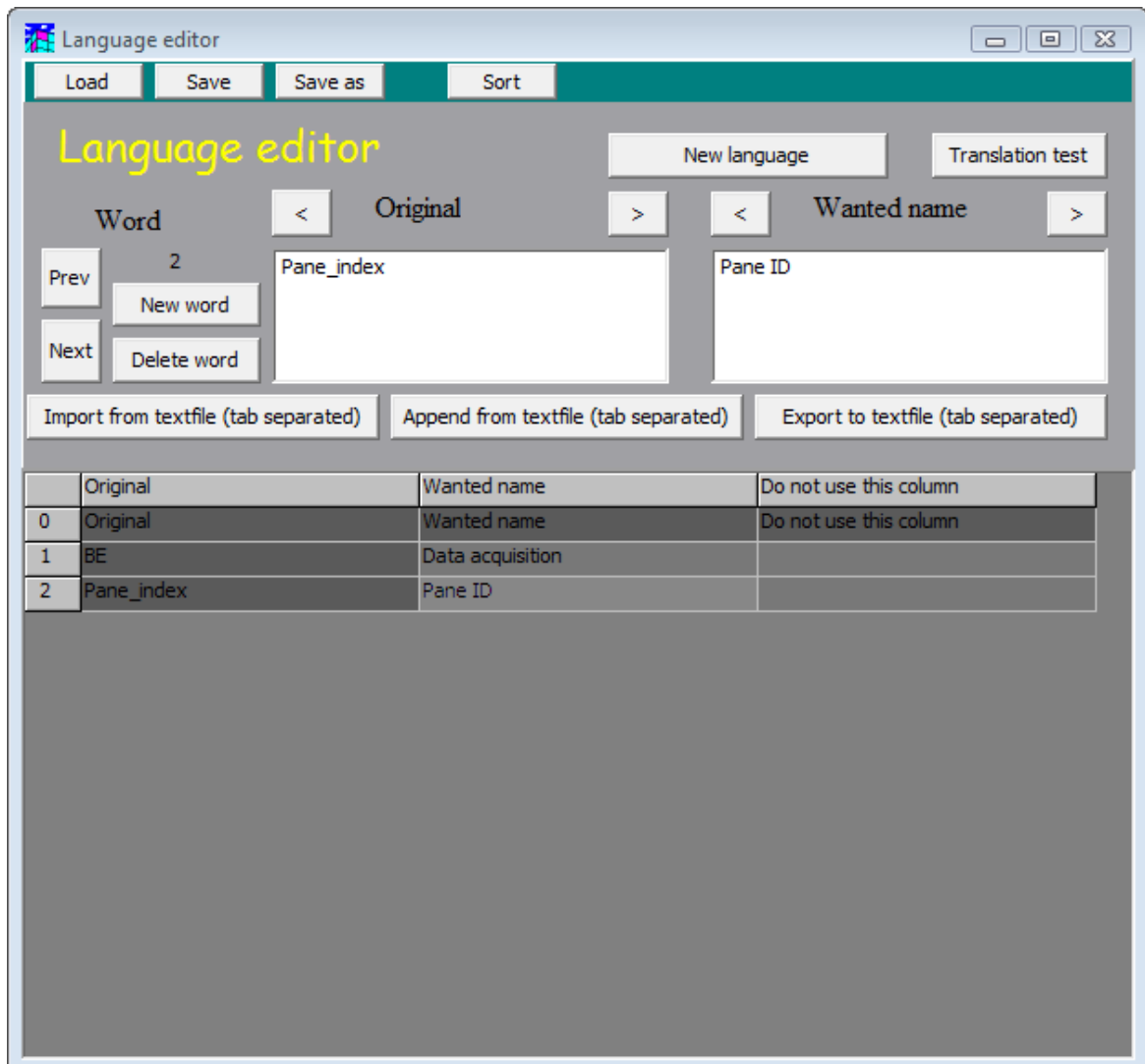
Select the color of the online button when BREIN is online.

Settings/Offline color

Select the color of the offline button when BREIN is offline.

4.1.3.18 Settings/Change lyrics

If you do not like the names of BREIN items and parameters you can overwrite the names by defining a 'translation' in the following list of vocabularies:



The example above re-defines the term 'BE' as 'Data acquisition' and 'Pane_index' as 'Pane ID'.

4.2 Settings in the program folder

Here you can set the path to the central storage folder by writing it to the first line of the file **brein_path.ini**. If **brein_path.ini** does not exist in the program folder, BREIN modules expect their program folder to be the central storage folder.

4.3 Bright_eye_traverse.exe: Configuration for highest speed

In most BREIN applications **bright_eye_traverse** is the most heavily used component, usually analyzing 3 spectra (transmittance and reflectance from both sides) for several positions across the panes. In order to speed up the analysis the program can run several fits in parallel if it is working on a PC with several cores. In addition, you can run several instances of

bright_eye_traverse on different PCs in parallel, all working on the same BREIN problem.

4.3.1 Using multiple cores on one PC

Parallel processing on one PC with multiple cores is achieved by operating several instances of the OLE server code_be.exe. For highest speed we recommend to have as many code_be instances running as the PC has cores (i.e. 2 instances on a dual core machine, 4 on a quad core, ...).

Bright_eye_traverse starts all instances of code_be automatically. The number of instances to start is defined in the text file brein_cores.ini in the central storage folder. The content of this file is 2 lines only, like the following:

Number of cores to be used by BREIN

4

In this example bright_eye_traverse.exe will start 4 instances of code_be.

The code_be.exe OLE server

This program is a special version of our CODE thin film analysis and design software. Code_be is delivered as part of a BREIN system. It must be registered as OLE server. Normally this is done during BREIN installation. In case of problems you can manually register the program as OLE server the following way: Start a 'command box' in the accessories folder of the Windows start menu with a right-click, and select the option 'as administrator'. In the command box, type in the following command (the path of the program has to be adjusted, of course):

```
c:\brein_demo\code_be.exe /regserver
```

4.3.2 Working with several PCs in parallel

The analytical work of bright_eye_traverse.exe can be splitted up in several parts, each of which is taken care of by a different PC. This mechanism can be used only in the case of the pre-processing of measured spectra by a scanner program like the Zeiss scanner (see above). The scanner program must generate as many scan files as you want to use different PCs. In the case of 2 PCs working in parallel, scan files with the extensions *.sc1 and *.sc2 must be generated by the scanner.

On each PC which is going to participate you must install bright_eye_traverse.exe. This can be done as part of the BREIN installation or as a stand-alone application. In the case of a BREIN installation bright_eye_traverse.exe is located in the BREIN program directory, sharing several files with other BREIN modules. The installation of a stand-alone bright_eye_traverse program is described below. Once the bright_eye_traverse modules are installed the only thing to do is to tell them which type of scan files they should analyze. This is done by generating a text file called bright_eye_traverse_instance.ini. The file has a single line which defines the instance of this bright_eye_traverse module as an integer number. The file must be stored in the bright_eye_traverse.exe program directory. Instance 1 takes care of *.sc1 files, instance 2 handles *.sc2 files, and so on.

Installing bright_eye_traverse.exe as stand-alone program

In order to run bright_eye_traverse.exe on a PC as a stand-alone program, i.e. independent of a BREIN installation, you can download the zip-file bright_eye_traverse_stand_alone.zip from our website. This file is available in the support section on the page 'Download BREIN'.

To install the software on the target PC you have to copy the content of the zip-file to the wanted directory. Then copy your passport file `brein_passport.wtp` to this folder. Finally, run the program `setup.exe` and click the button 'Re-register components of current directory'.

Once the stand-alone version is installed, you have to connect it to the BREIN system it should support. In order to do so, please enter the path to the central storage folder in the first line of the text file `brein_path.ini` in the folder of the stand-alone `bright_eye_traverse.exe`. Make sure that the path to the BREIN system is available as a network folder with read and write permission.

4.4 Central storage folder

The central storage folder holds all files which make up a BREIN solution. The following items are located in the central storage folder.

4.4.1 Brein.ini

This is a configuration file for BREIN.EXE. Most of its content is for internal use only or is set by men commands which are explained in the description of the graphical user interface.

Example of a `brein.ini` file:

```
Last product ID
1
Shift x
750
Shift y
150
Zoom factor
1.20000004768372
Color scheme
2
Online color R
255
Online color G
0
Online color B
0
Offline color R
120
Offline color G
120
Offline color B
120
Start online
0
Operator page only
0
Automatic database backup
2
```

Maximum number of database records
10000
Database backup format
2
Index start display
0
Number of monitors
1
Show profiles reverse
0
Show history reverse
0
Automatic tick selection
0
Archive using date of measurement
0
BREIN OLE server
code.colors
Use always global averaging
0
Ignore remote path
1
SQL time format string
dd.mm.yyyy hh:mm:ss

4.4.2 Brein_autostart.ini

This is a text file with a list of program modules that should be run parallel to BREIN. When you enter the name of a module in the brein_autostart.ini file, brein.exe will check if this program is running already. If not, the module will be started. All listed programs must be present in the BREIN program folder.

The mechanism to check if a module is running is this: Brein.exe looks up in the folder live_signals (located in the brein program directory) if there is a certain file present. The file named to be looked for is the module name with extension *.alv – in the case of brein_cleaner.exe the expected filename is brein_cleaner.avg. If the file is missing, Brein.exe will start the missing module. In any case the

*.alv file is deleted. All the BREIN modules write after regular time intervals their *.alv file to the live_signals directory. This way Brein can check if a module is active and need not to be started. Please note that BREIN does not close the programs listed in autostart.ini when it is shutdown. You have to close these program manually if you want to stop them.

4.4.3 Brein_cores.ini

This text file defines how many cores should be used for data analysis in bright_eye_traverse.exe. The structure of the file is simple: The first line is just a comment (that will be ignored) and the second line contains the number of cores to be used.

Here is an example:

Number of cores to be used by BREIN
4

4.4.4 Archive folder

The bright eye modules will store measured spectra and results of the analysis to an archive directory if a folder named 'archive' exists. For each product a subfolder is created. Within the product folder, subfolders specifying the current year, month and day are created.

4.4.5 Database folder

This folder holds the BREIN database, i.e. all information about the products produced with the deposition devices and all measured data and results.

Subfolder 'Current product'

This folder is used to synchronize various BREIN modules. When the operator changes the current product in BREIN (by pressing the **Select product** button on the **Results** page) brein.exe writes a file with the name of the current product to this folder in the database. This must be the only file in the folder.

Some BREIN modules scan this folder and notice a change of the filename. They will then adjust their configuration to match the newly selected product.

Subfolder 'factory'

Used for internal purposes.

Subfolder 'object_images'

Used for internal purposes.

Subfolder products

This folder contains all settings and results for the individual coating products. See the next section about defining products.

The following files are contained in this folder:

- brein_settings.ini
- products.ini

Brein_settings.ini contains internal information only, you should not change it. Products.ini contains the list of products that can be selected by the operator. Each item in this list must have a corresponding subfolder with product specifications, measured data and results database.

4.5 Defining products

Each coating product in BREIN must be defined in the products folder of the Central storage folder. The product folder must have a name which is contained in the products.ini file as well. Only the products that are listed in products.ini can be selected in BREIN.

BREIN is delivered with a demo product which is defined in the Demo subfolder. You can inspect this folder in order to identify the files and subfolders which are discussed in the following. It is a good idea to completely copy a working subfolder for a product as the basis for a new product.

4.5.1 Info.txt

This file contains the position and dimensions (in m) of the coating line which is used to produce this product. These numbers are used when the production of the coating product is simulated. The speed of the panes as well as the distance between the panes can be entered as well.

The simulation of coating production is used internally for testing purposes only. It is not part of the public BREIN system. Please do not change the info.txt file unless you really know what you are doing.

4.5.2 Objects.txt

This file contains the logical sequence of deposition devices and bright eye stations. The demo product has the following settings:

DD0
BE1
DD1
BE2
DD2
BE3
DD3
BE4
DD4
BE5
DD5
BE6
DD6
BE7
DD7
BE8
BE9

This means we start with deposition device DD0, followed by bright eye BE1. Then DD1 does the next deposition step which is monitored by BE2, and so on. For each object in this list there must be a corresponding subfolder with exactly the same name.

4.5.3 Bright_eye_inline.ini

Usually several Bright Eye problems are handled by a single analysis program. In many cases, for example, all spectra recorded inline in the deposition vacuum can be analyzed by a single instance of the bright_eye_inline.exe program. In such a case the analysis program reads (when it is started) the file code.wcd (see below in the section about Bright Eyes) which contains the optical model. To prepare the analysis for the individual Bright Eye stations, a fit parameter set specific to the individual bright eye is loaded (it must have the name fit_parameters.fps, see below). This is much faster than to load a new CODE configuration each time an analysis for a different bright eye is to be started.

The bright_eye_inline.ini file tells the bright_eye_inline.exe program which Bright Eyes are to be

watched and analyzed, and how this should be done. Here is an example:

Window title

Inline analysis

Product

Demo

Number of bright eyes

8

Name 1

BE1

Previous 1

Time limit 1

2.5

Name 2

BE2

Previous 2

BE1

Time limit 2

2.5

Name 3

BE3

Previous 3

BE2

Time limit 3

2.5

Name 4

BE4

Previous 4

BE3

Time limit 4

2.5

Name 5

BE5

Previous 5

BE4

Time limit 5

1.5

Name 6

BE6

Previous 6

BE5

Time limit 6

2.5

Name 7

BE7

Previous 7

BE6

Time limit 7
2.5
Name 8
BE8
Previous 8
BE7
Time limit 8
2.5

Comments:

- The **window title** appears in the caption of the bright_eye_inline.exe program
- The **number of bright eyes** defines the number of bright eyes.
- For each bright eye you have to define its **name**, the name of the **previous** bright eye and the maximum time (**Time limit**) for the analysis. If you specify a previous bright eye, the program will look up results obtained by the previous station for the current pane and use these values for the fit to be performed. This way partial results obtained by the individual stations are transferred through the system.

Bright_eye_inline.exe will read the ini-file and use the information for its configuration.

4.5.4 Bright_eye_traverse.ini

This file has a similar function than the file bright_eye_inline.ini discussed above. It is read by the bright_eye_traverse.exe program which is typically used to analyse spectra recorded after the deposition, outside the vacuum chamber, scanning profiles of the optical properties across the width of the panes. In most case the scan generates a lot of spectra, and the analysis program handles only one bright eye station. Here is an example:

Window title
Traverse
Product
Demo
Number of bright eyes
1
Name 1
BE9
Previous 1
BE8
Time limit 1
2.5

The time limit is used for a single fit action, not for the whole scan of the pane.

4.5.5 Bright_eye_instance1.ini

Some BREIN systems do not work with the analysis programs bright_eye_inline.exe and bright_eye_traverse.exe, but use one or more instances of bright_eye.exe. The latter reads the configuration file bright_eye_instance1.ini which has exactly the same function as

bright_eye_inline.ini.

4.5.6 Deposition devices

Each deposition devices is described by a file **info.txt** in its subfolder. For the DD0 device in the demo product the content of this file is this:

```
Left
5
Top
29
width
3
height
12
Number of parameters
3
Parameter 1
BE1 L*
80
90
100
Parameter 2
BE1 a*
-2
0
2
Parameter 3
BE1 b*
-2
0
2
My BE
BE1
```

The structure is the following:

The parameter Left, Top, Width and Height define the position of the device in the coating line and its size (all in m). These values are for production simulation only, please do not change.

Very important are the item 'Number of parameters' (which defines the number of parameters, of course) **as well as the parameters themselves**. If the deposition device produces a layer that contributes to the coating product, the layer thickness would be a parameter to be defined here. A composition parameter of the layer (e.g. its oxygen content) could be another parameter.

The parameters defined in all the deposition device definitions are to be determined by BREIN. They are collected in a list which is used to generate the database of results.

In the demo product we do not specify layer thicknesses but rather generally color parameters.

For each deposition device three color coordinates L^* , a^* and b^* are defined as parameters which are to be determined by BREIN. The names of these numbers in DD0 are 'BE1 L^* ', 'BE1 a^* ' and 'BE1 b^* '.

For each parameter you have to type in 4 lines in the file which must contain the

- name in the first line
- the tolerated minimum of the parameter in the 2nd line
- the target value of the parameter in the 3rd line
- the tolerated maximum of the parameter in line 4

After the parameter section the last 2 lines of the file contain the identifier 'My BE' (do not change it) and the name of the bright eye that monitors this deposition device.

4.5.7 Bright eyes

The handling of bright eye stations is defined by several files.

Info.txt

The first 8 lines of this text file contains the size and position of the Bright Eye station in the production line. This is important for a simulated production only and you should not change these numbers.

The rest of the file tells BREIN the number of spectra that are used by this Bright Eye station to do the analysis (**Number of spectra**). In the example below 3 spectra are used.

For each spectrum the **name of the spectrum** has to be specified. This name must agree with a spectrum object in the CODE configuration that is used for the analysis work at the Bright Eye station. The next item to be specified is the **spectrum option** which defines the file format to be used to import the data. Use the following table when setting the spectrum option for a spectrum:

- 1: Standard format
- 2: xy-format
- 3: JCAMP format
- 4: SpectraCalc format
- 5: Perkin-Elmer format (binary)
- 6: Zeiss format
- 7: OPUS format
- 8: Custom format 1
- 9: Perkin-Elmer (ASCII)
- 10: NanoSpec format
- 11: Custom format 2
- 12: Custom format 3
- 13: NanoCalc format
- 14: Ultrascan format
- 15: Custom format 4
- 16: Jasco format
- 17: ---
- 18: Hitachi format
- 19: Custom format 5

20: Minolta format

Next the the spectrum option you can enter a **remote path**. If you specify a network folder as remote path the Bright Eye will look for new files in this folder. If you leave this item empty the subfolder measurements\BE name\New is scanned for new files to be processed.

The last item to be defined is the **default extension**. If you specify a default extension (like 'xy', 'dat' or 'spc') the Bright Eye will look for files with this extension only and ignore other files in the directory.

Here is an example of a info.txt file:

```
Left
90
Top
36
width
3
height
3
Number of spectra
3
Spectrum 1
T
Spectrum option 1
2
Remote path 1

Default extension 1
xy
Spectrum 2
RF
Spectrum option 2
2
Remote path 2

Default extension 2
xy
Spectrum 3
RG
Spectrum option 3
2
Remote path 3

Default extension 3
xy
```

code.wcd

This file is a CODE configuration (CODE is our main software product for analyzing and designing thin film stacks) which contains the method to analyze measured data – in most cases

an optical model and a fit routine adapted to the problem to be solved. The names of the fit parameters must agree with the names of the quantities that BREIN is going to determine at this station. Usually the fit parameters obtained by a Bright Eye agree with the parameters which appear in the definition of the deposition device before the Bright Eye (see above).

fit_parameters.fps

This is the fit parameter set that should be used to do the fit for this station. Please read the section about the file `bright_eye_inline.ini` above.

4.5.8 Configuring standard displays in BREIN

The standard pages of BREIN showing results are configured in the files

- `results_history.ini`
- `profiles.ini`
- `spectra.ini`

Although the structure of the ini-files is described below, it is recommended to use the graphical user interface shown above to control the appearance of the various pages of BREIN. It is much easier, and the probability of faulty settings is much lower!

Results_history.ini

This file controls the appearance of the time development of parameters on the page 'History'. When you make changes to this file, be careful and do not enter empty lines which may screw up the file structure. The content of the file for the demo product is used here in order to explain the different sections of the file. File content is shown in **blue**, explanations in **red**.

There are four different groups of parameters which are shown on 4 subpages of the Insitu page:

Number of groups

4

Every group has a name and three RGB parameters for the background color of the subpage (the colored background is not implemented yet, though):

Name group 1

Colors I

Background color group 1 R

200

Background color group 1 G

200

Background color group 1 B

200

This group displays 9 channels, i.e. It shows results of 9 parameters:

Number of channels group 1

9

Groups are separated by a dashed line

BE 1

Specify the name of the bright eye which has determined this parameter

BE1

Parameter 1

Specify the name of the parameter

BE1 L*

Target value 1

Specify the target value for this parameter. It is recommended to use the term **Get original** here which means that the target value and the tolerated minimum and maximum value for this parameter are taken from the definition in the corresponding deposition device.

Get original

Min warning value 1

If you have used **Get original** above, this minimum value is ignored

10

Max warning value 1

If you have used **Get original** above, this maximum value is ignored

26

BE 2

BE1

Parameter 2

.
.
.

profiles.ini

This file controls the appearance of the operator display page 'Profiles'. It can consist of several subpages showing selections of profile results.

After the **version**, you define the number of subpages called **number of groups**. For each group the **background color**, the number of result **channels** (displayed from left to right) and the number of **samples** (displayed from top to bottom) has to be specified. In the example below there are 3 groups, showing color results for the last 6 panes for transmittance and reflection from both sides. The range of the traverse motion is specified by the settings for **Position x min** and **Position x max**. Like described in the last section (results_history.ini) it is recommended to use the term **Get original** below the line Target value 1. This means that the settings for the target value and the tolerance range for this parameter are taken from the original definition in the deposition device part. The **direction** parameter set to 1 in the example below means that the scan is across the pane, perpendicular to the motion of the substrates.

Version

1

Number of groups

3

Name group 1

Profiles T

Background color group 1 R

200

Background color group 1 G
200
Background color group 1 B
255
Number of channels group 1
3
Number of samples group 1
6

BE 1
BE9
Parameter 1
BE9 T L*
Target value 1
Get original
Min warning value 1
80
Max warning value 1
100
Position minimum 1
500
Position maximum 1
2500
Direction 1
1

BE 2
BE9
Parameter 2
BE9 T a*
Target value 2
Get original
Min warning value 2
80
Max warning value 2
100
Position minimum 2
500
Position maximum 2
2500
Direction 2
1

BE 3
BE9
Parameter 3
BE9 T b*
Target value 3

Get original
Min warning value 3
80
Max warning value 3
100
Position minimum 3
500
Position maximum 3
2500
Direction 3
1
Name group 2
Profiles RF
Background color group 2 R
255
Background color group 2 G
255
Background color group 2 B
50
Number of channels group 2
3
Number of samples group 2
6

BE 1
BE9
Parameter 1
BE9 RF L*
Target value 1
Get original
Min warning value 1
80
Max warning value 1
100
Position minimum 1
500
Position maximum 1
2500
Direction 1
1

BE 2
BE9
Parameter 2
BE9 RF a*
Target value 2
Get original
Min warning value 2

80
Max warning value 2
100
Position minimum 2
500
Position maximum 2
2500
Direction 2
1

BE 3
BE9
Parameter 3
BE9 RF b*
Target value 3
Get original
Min warning value 3
80
Max warning value 3
100
Position minimum 3
500
Position maximum 3
2500
Direction 3
1
Name group 3
Profiles RG
Background color group 3 R
50
Background color group 3 G
255
Background color group 3 B
200
Number of channels group 3
3
Number of samples group 3
6

BE 1
BE9
Parameter 1
BE9 RG L*
Target value 1
Get original
Min warning value 1
80
Max warning value 1

100
Position minimum 1
500
Position maximum 1
2500
Direction 1
1

BE 2
BE9
Parameter 2
BE9 RG a*
Target value 2
Get original
Min warning value 2
80
Max warning value 2
100
Position minimum 2
500
Position maximum 2
2500
Direction 2
1

BE 3
BE9
Parameter 3
BE9 RG b*
Target value 3
Get original
Min warning value 3
80
Max warning value 3
100
Position minimum 3
500
Position maximum 3
2500
Direction 3
1

spectra.ini

This file controls the appearance of the operator display page 'Spectra'. You define the **number of groups** (i.e. subpages of this display) and for each group its **background color**. Each spectrum is defined by 2 items, the **Bright Eye name** and the **spectrum name**.

Version

1
Number of groups
2
Name group 1
Inline spectra
Background color group 1 R
200
Background color group 1 G
200
Background color group 1 B
255
Number of spectra group 1
8

BE 1
BE1
Spectrum name 1
T

BE 2
BE2
Spectrum name 2
T

BE 3
BE3
Spectrum name 3
T

BE 4
BE4
Spectrum name 4
T

BE 5
BE5
Spectrum name 5
T

BE 6
BE6
Spectrum name 6
T

BE 7
BE7
Spectrum name 7
T

```
-----  
BE 8  
BE8  
Spectrum name 8  
T  
-----  
Name group 2  
Exsitu spectra  
Background color group 2 R  
255  
Background color group 2 G  
255  
Background color group 2 B  
0  
Number of spectra group 2  
3  
-----  
BE 1  
BE9  
Spectrum name 1  
T  
-----  
BE 2  
BE9  
Spectrum name 2  
RF  
-----  
BE 3  
BE9  
Spectrum name 3  
RG  
-----
```

4.6 Guidelines for preparing new product definitions

In order to introduce a new product to an existing BREIN system, the following hints may be useful.

Since there are many configuration files to be generated, it is recommended to start with a working product and make a copy in the database folder products. Here we show the required steps for the product 'Demo' which is shipped with BREIN.

1. Copy the Demo folder and rename the copy to Demo2.
2. Enter Demo2 as a new line in the file products.ini
3. Open the Demo2 folder and delete the database file brein_results.cds. When you later select the new product for the first time in BREIN.exe (don't do that now) the program

- generates a new database file.
4. Open the file objects.txt and verify the sequence of deposition devices and bright eyes. If the new product does not use the same objects as the one that was copied you have to delete objects or enter new ones in the list object sequence. If you have to enter new ones, make sure that you also generate new object folders. To do so, the best way is to copy an existing one and modify the copy as required.
 5. Start brein.exe and click on the 'Select product' button. Select the new product. A new database file is created automatically at this time.
 6. Use the command 'Actions/Log-in to modify product' to enter BREIN interior where you can make modifications to the configuration.
 7. Click on the page 'Overview' to see a graph of the factory. A mouse click on the individual objects (deposition devices and bright eyes) opens dialogs to change the object properties. Go through all deposition devices and inspect the number, the names and the specifications of the parameters to be determined by the BREIN analysis.
 8. Now use the menu command 'Settings/History' and set in the dialog how the modified parameters should appear in the 'History' page.
 9. Use the menu command 'Settings/Profiles' and set in the dialog how the modified parameters should appear on the page 'Profiles'.
 10. Use the menu command 'Settings/Spectra' and set in the dialog how the modified spectra should appear on the page 'Spectra'.
 11. If you have used the graphical user interface of brein.exe to change the number of parameters of a deposition device or one of the parameter names, you have to close the program now and delete (once more!) the database file brein_results.cds in the product directory. Using the new parameter settings, brein.exe has to generate a new database file.

The settings in BREIN itself are now done. What remains to be done are the modifications of the optical analysis. In the case of glass coatings, this means to adapt the analysis of the inline spectra (done by bright_eye_inline.exe) and the exsitu data (bright_eye_traverse.exe).

Bright_eye_inline:

1. Check the file bright_eye_inline.ini for necessary modifications concerning the number of bright eyes and their names.
2. Start Bright_eye_line.exe and click on 'Show CODE' to open the CODE window which does the actual analysis. In CODE, use the menu command 'Fit parameter set/Load' and search for the file fit_parameters.fps in the BE1 folder. Then press F7 to enter CODE's treeview level and right-click on 'Fit parameters' in the treeview on the left side. Check if the names of the fit parameters match your expectations for BE1. You should not make any changes in CODE unless you are a CODE expert and you know what you are doing. If you made changes and you are really sure that they are OK, save the fit parameter selecton using the menu command 'Fit parameter set/Store'.
3. Repeat the inspection of the selected fit parameters by loading the fit parameter sets for all BEs that are analyzed by bright_eye_inline.exe (BE2, BE3, ...).

Bright_eye_traverse:

1. Check the file bright_eye_traverse.ini for necessary modifications concerning the number of bright eyes and their names.
2. Start bright_eye_traverse.exe and open the CODE window. Press F7 and right-click 'Fit

parameters' in the treeview. You do not have to load a fit parameter set in this case because usually bright_eye_traverse.exe is not used with fit parameter sets.

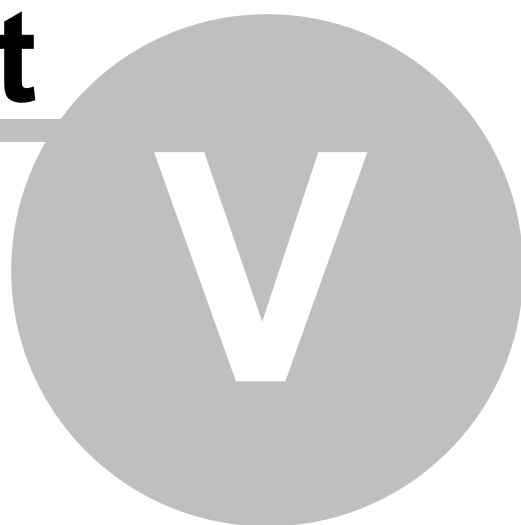
3. You should not make any changes in CODE unless you are a CODE expert and you know what you are doing.

4.7 Configuration files

The table below lists important files for the configuration of BREIN:

<i>Filename</i>	<i>Path</i>	<i>Meaning</i>
Brein_path.ini	Program directory	Text file which contains the path of the central storage folder in first line
Brein.ini	Central storage folder	Contains BREIN settings, e.g. the color scheme
Brein_autostart.ini	Central storage folder	List of programs that BREIN starts when brein.exe is executed
Brein_settings.ini	Central storage folder: Subfolder products	Internal settings for brein.exe, do not change
Products.ini	Central storage folder: Subfolder products	List of products that can be selected by the operator. Be sure that all relevant products are listed here.
Info.txt	Deposition device folders for a product	Definition of the parameters which are to be determined by BREIN (like color coordinates, layer thicknesses, ...) and their tolerated range
Info.txt	Bright Eye folder for a product	Definition of the spectra used by this bright eye, file import format, location of remote path, file extension
Code.wcd	Bright Eye folder for a product	CODE configuration to be used by this bright eye analysis
fit_parameters.fps	Bright Eye folder for a product	Fit parameter set to be used at this bright eye station
Results_history.ini	Product folder	Definition of the appearance of the 'History' operator display
Profiles.ini	Product folder	Definition of the appearance of the 'Profiles' operator display
Spectra.ini	Product folder	Definition of the appearance of the 'Spectra' operator display

Part



5 BREIN as seen by operators

Operators see the main module brein.exe only. They can inspect the results of the analysis, modify some display options and extract data for external storage. They can also set temporary target values if this feature is activated in the configuration of the BREIN product.

5.1 Modifying displays

The appearance of BREIN displays is configured by the BREIN administrator, leaving only a few properties accessible for operators:

- In history graphs operators can change the zoom level
- In profile graphs operators can change the zoom level
- Operators can activate 'Global averaging' for profiles: In this case all quantities which are profile averages are obtained by taking the average for the specified global position range of y-values
- Operators can activate 'Autoscale graphs' for displays of profile data. If activated, the center of the y-axis is the profile average and not the target value. This is useful if you want to see details of profiles when you are far away from the target: You can zoom the y-axis around the average value to the desired level. The disadvantage is, of course, that the absolute level of the values is not visualized.

5.2 Exporting results

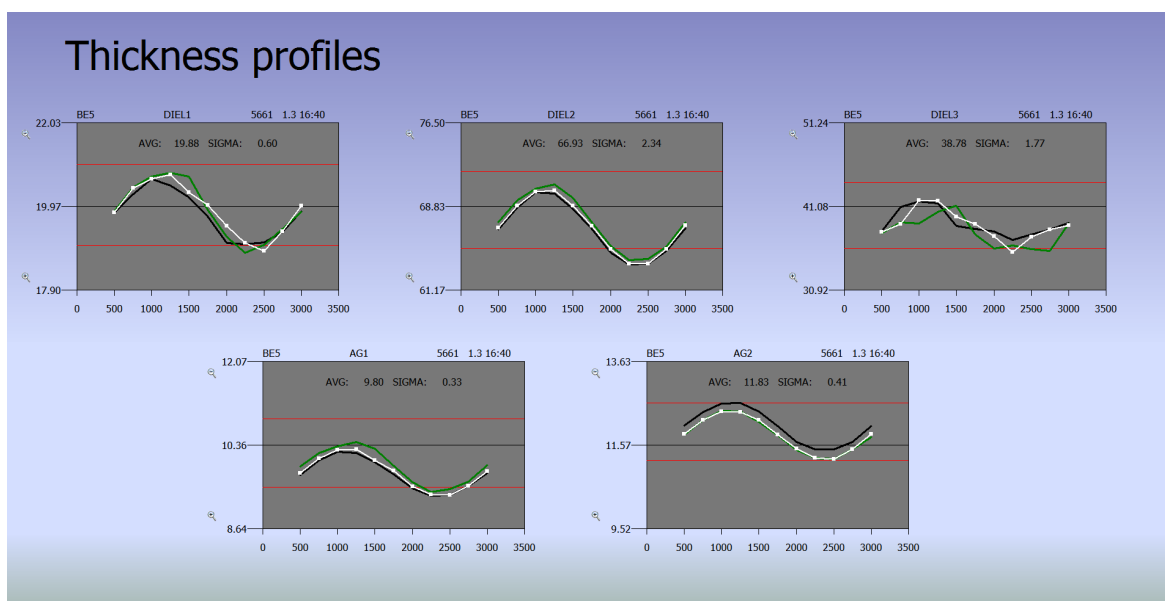
Exporting numbers

The results of the BREIN analysis can be exported automatically to an external SQL database. If this feature is activated no manual operator action is needed to externally save the data. However, a manual data export is possible clicking the button 'Data export' on the 'Results' tab. You can write the data (as they appear in the results table) to CSV (text file with comma separated values) or Excel files (in Excel 2007 or Excel 97 format).

Exporting pictures

The menu command **Copy graph** copies the selected display as bitmap to the clipboard. From there you can paste it where you want it to be.

The **Print** command prints the display to a printer.



5.3 Switching between temporary and permanent target values

BREIN products can be configured to allow that operators decide to work with temporary target values. This option should be used with extreme care - it gives the operators the freedom to produce coatings with target properties that differ from the original design.

The button 'Temporary targets' sets the current values as target values, but only for those parameters for which a 'source bright eye' including position range has been defined.

The button 'Permanent targets' replace the temporary target values by the target values that have been set in the original product definition.

Part

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6 Backing up a running BREIN system

6.1 Overview

If the running BREIN system turned out to be useful for your production you might want to generate a backup. In addition to the usual wish to have a copy of all the obtained data, a BREIN backup may also be generated to have a backup system that can quickly replace the active BREIN system in case of emergency, i.e. after a failure of the production system. This part of the documentation describes how you can backup a BREIN system and what is needed to make it run on a different machine. The first section shortly summarizes what is needed to run a BREIN system. This is good to know in order to decide which backup strategy you want to use for your system - a complete backup of the whole Windows system or a backup of the relevant BREIN program folders.

6.2 What is needed to run BREIN

BREIN needs all files contained in the BREIN program folder with the exception of the archive subfolder which is optional. The archive folder contains historic results which are not needed to start BREIN on a new machine. It is a good strategy to copy the archive folder to a different location from time to time (like every month) and then delete it completely. The folder may contain many small files which makes generating backups slow.

In addition to the BREIN program folder you need the CODE software being installed on the BREIN machine. CODE is needed as OLE automation server in most BREIN solutions.

If you use the automatic data export to an external SQL database the database driver for this connection must be installed on the new BREIN machine as well if you migrate to a new PC. The required driver depends on the SQL system and not so much on BREIN. In case of emergency and doubt about the correct driver you can install and run BREIN on the new system without the SQL export. Copy the SQL connection string (you find this using the BREIN menu command **Settings/SQL export of results**) to a safe place and then delete it to make BREIN run without trying to access the external SQL database.

6.3 Complete Windows backup

The fastest way to get BREIN running in a case of emergency is to have a clone of the complete Windows system. You can use one of the many tools to backup and restore complete partitions. Just make sure that the new machine has at least as many cores as the previous PC had, and that its computational speed is equal or higher than that of the original BREIN computer.

The most elegant way to work with BREIN is to have it running on a virtual machine (VM). With tools like VMware you can migrate existing Windows installations to virtual machines, including all installed software packages and drivers. Virtual machines are single (huge) files which contain the complete system. In most cases, migrating means to copy the virtual machine file to the destination PC and start the virtual machine there. This is the fastest way to get a replacement for a failing computer.

6.4 Manual backup

You can also backup only those files of the BREIN PC that are needed to run the software on a new Windows machine. You need to save the complete BREIN program directory and the installed CODE software. If your BREIN system uses the optional external SQL connection you have to install the required database drivers on the new system as well.

Backup BREIN

In order to backup BREIN and CODE as easy as possible we have equipped the latest version of our installer program live.exe with a backup feature (you can get the program at http://www.mtheiss.com/?c=4&content=support_download_tools). Copy the new version to the BREIN directory (very likely c:\brein) and start it. At the bottom you will find a backup button that starts the backup action. The installer program copies itself, together with all other files in the folder, to the backup location.

To restore BREIN on the new PC, run the installer live.exe in the backup folder and follow the instructions for the normal installation of the software.

Backup CODE

The CODE backup can be done the same way as the BREIN backup: Copy the latest version of live.exe to the CODE program folder (very likely c:\code) and use its backup feature.

Note, however, that the main application code.exe needs to be registered as OLE automation server on the new BREIN computer. In order to make this work you need to start the installer as administrator (Right-click on the program icon, select the option 'Run as administrator'). Alternatively, you can do the OLE server registration anytime afterwards running a command line as administrator and typing in the command 'c:\code\code.exe /regserver'.

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