ANFATEC PRESENT – THE IMAGE ANALYSIS

1 PROGRAM PHILOSOPHY

Anfatec file format provides the *.txt-file, where all simultaneously acquired images are referred. Opening this *.txt-file, all image open, each as one new "image window".

Each Window contains:

- ✗ picture data displayed as square
- ✗ name displayed in the caption of the form equals the *.int-file name and the meaning
- ✗ scaling and acquisition data
- ✗ independent scaling options
- ✗ display of vertical axis scale ("z Scaling")
- ✗ scale bar for lateral scaling ("XYScaling")

Click with the right mouse button into the image to reach the pop-up menu.

Image / Scan info – is a switch between display of the image and the acquisition data (*.txt file contents).

2 FILE HANDLING

Open   opens the Anfatec files and some other image formats

Close all   closes all opened files. This function is helpful, when too   many   data are open.

Save As   allows to save the picture

                  as 32 bit integer (*.int) or 32 bit real data (*.sin).

Export   as bitmap

3 IMAGE HANDLING

Copy   Copies   the   analysed   image   in   the   clipboard   to   make use of it in other windows applications (Power Point, CorelDraw, ...). The data

              are   copied   as   extended   *.wmf,
                  so   they   exist   as   vectors   and   can   be   un-grouped   and changed afterwards.

4 IMAGE PROCESSING [PROCESS/..]

Invers   inverts the data (sign) and thus the colour scale

Leveling   allows to subtract planes (0D, 1D), lines and rows (0D, 1D or 2D). 0D is just a constant and necessary for FFT. 1D is linear, 2D is quadratic fitted. Select "**points**" to subtract a plane, when certain parts of the image cannot be used or when the image data consist of plane which are not detected with the plane method.
When using **"points"**, you can set a certain number of points (left mouse button click on the "new picture") in the picture. The plane is calculated using only this points.

Noise   noise reduction. The procedure checks whether a pixel is a certain percentage too far away from its surrounding pixels. If yes, it is replaced by the average of its surrounding pixels.

Arithmetic   can calculate new images from scanned images

Sphere   is a special low pass filter, which simulates a tip with a diameter given by the user in physical units. This tip is "scanned over the surface" and the resulting picture is visualised as "low pass" result. In contrast to the low pass, a high pass result sharpens the picture with the action radius of the simulated spherical tip.

Rescale   allows to rescale an image, if necessary. When the image is saved as SIN or INT with the new scaling, this scaling is kept.

FFT   Fast Fourier transformation. Make sure, that a "0-order plane" (= constant value which equals the average image height) is subtracted before FFT. Otherwise,
the   central point of the transformed image is "over-illuminated".

***For options which are not explained here, please check on the following pages.***

GENERAL IMAGE PROCESSING WINDOW

All image processing windows use the scheme displayed here:

    ✗ original image on the left side
    ✗ filter options or possible selections under the original image
    ✗ new image enlarged on the right side
    ✗ **functions to give commands**

Functions:
    ✗ **UNDO**   restores the original image
    ✗ **DO**   calculates results and displays it in the "new image" (old data still kept in the back round)
    ✗ **CANCEL**   quit without changes
    ✗ **TAKE OVER**   uses "new image" data as valid data in the image window and closes filter window.
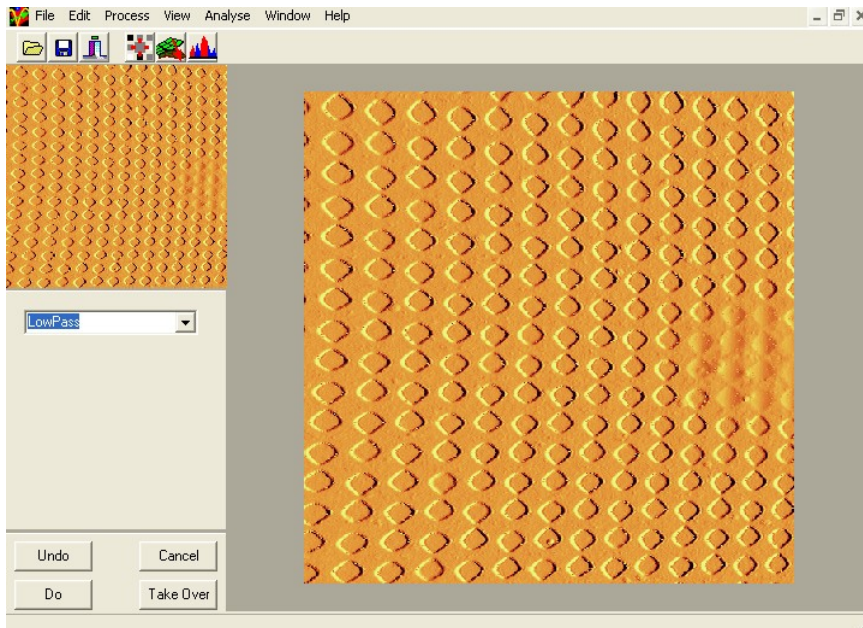
Simple Filter

Allows the basic filtering with the following selections:

Parameters for this filters are not adjustable.

Mean Filter

This filter takes the data of the surrounding pixels, sorts them by size and replaces the central data point by the mean value.

Noise Filter

This filter helps to reduce noise by replacing single pixels in the image by the average of their surrounding pixels. As criteria for replacement, the user can set a **border** on % in the left part of the filter image.

This filter takes all values around one pixel and calculates their average. If this average is more than this **border** different from the average, then the pixel is replaced by the average.
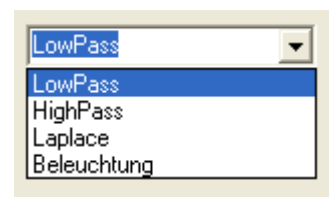
Leveling

This filter option can also be opened with the icon

In the options part of the levelling, one find a selection for the filter dimension and the type. In order to substract a plane from the image, one chooses 2Dim (x- and y-direction) and 1st order (only polynomials of 1st order are calculated).
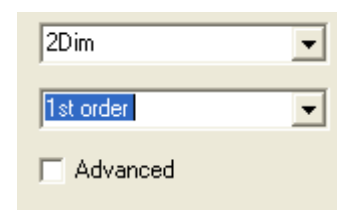
With **Advanced**, a histogram appears. One can select the grey scale values which are taken into account for the calculation. With a drag&drop with the left mouse button, new values are selected. With the right mouse button, values in the histogram can be deleted again. The Histogram shows the selected values in red, while in the picture green is added to the image colour for all selected values.

In the example, only parts of the top-layer will be recognized in the calculation, because the height values of the bottom layer are not selected.

The points-selection
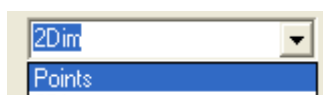
allows to set single points inside the picture. With this option, only these single points are taken into account for the slope correction.
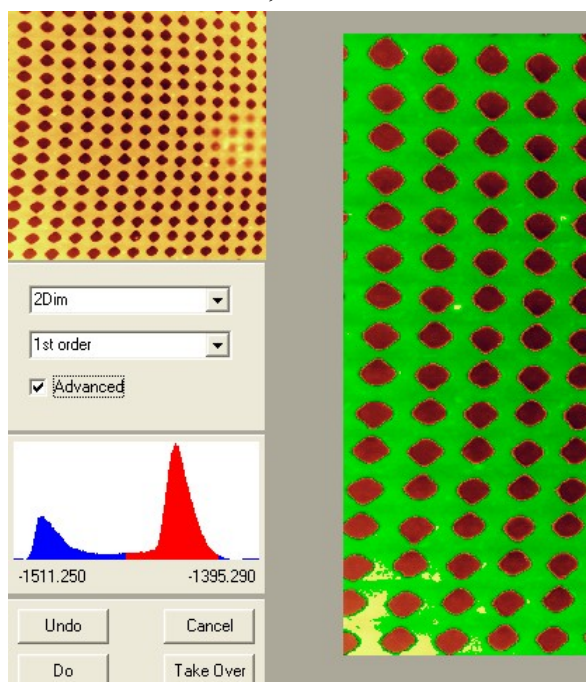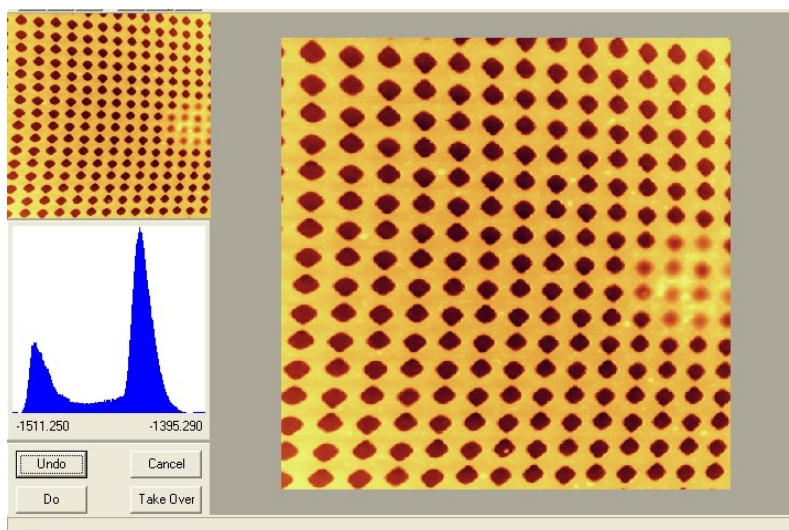
HISTOGRAM

changes the brightness and the contrast of the image.

In the selection area appears a histogram of the data. Drap & drop inside the histogram, in order to select an area. It appears in red in the histogram and green in the image.
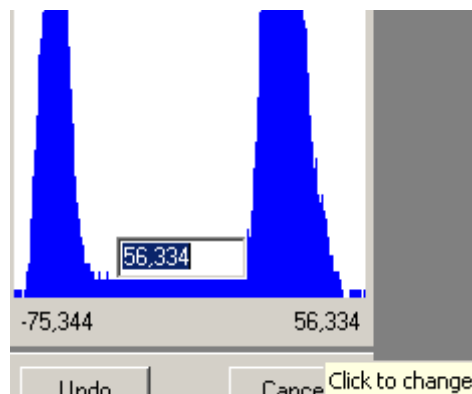
With DO, the image is scaled in a way, that the colour scale equals the red selected values.

If more than one region is selected, the range in between is taken as if selected.

In order to scale different images exactly in the same way, one can set the maximum and the minimum value, directly:
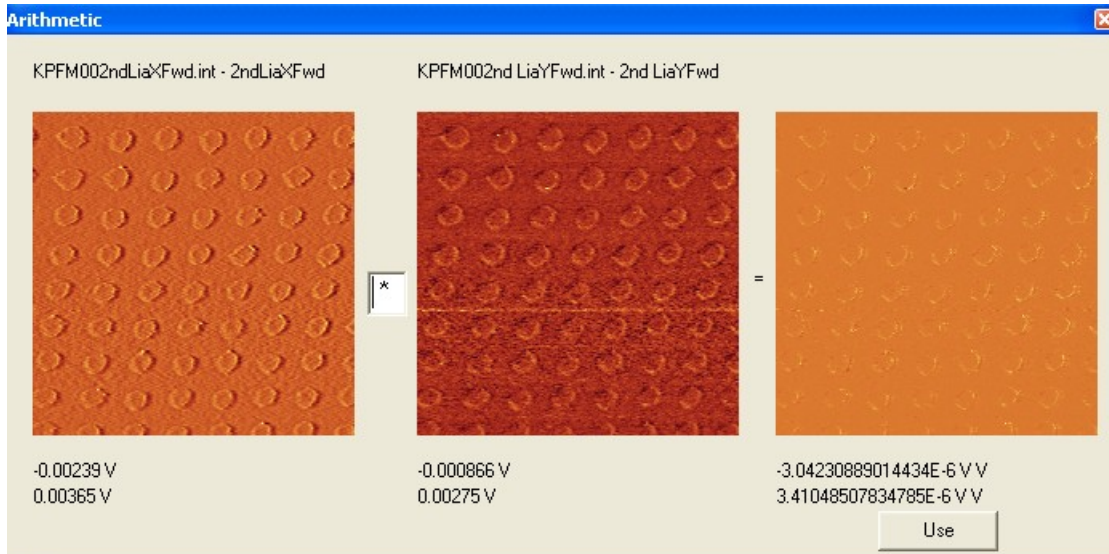
◆ click into one of the numbers displayed below the histogram

◆ enter a new value

ARITHMETIC

With this window, pictures can be subtracted from each other or divided by each other:


In order to get a certain picture into the original data parts, one drags the picture and drops it into Arithmetic. The operation can be printed into the related Edit-window between the two original pictures. With a double click in the right-most picture, one gets the result.

In this example, the X and Y of the 2nd lock-in have been multiplied.

ZOOM

In order to zoom into an image, click with the left mouse button in the "new image" and move with mouse button pressed to the second corner of the range, you like to zoom in. While moving the mouse, an colour inverted rectangle shows the image range. When leaving the mouse button, the zoom is done.
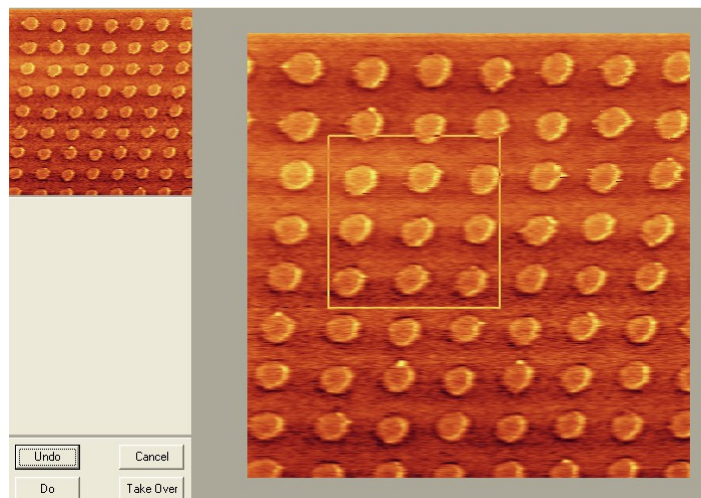

SPHERE

In this filter, one can try to estimate the maximum tip diameter used for the imaging of a surface.

The user gives a tip diameter estimation. The program draws the tip as half-circle inside the image.

Now, one can choose between low-pass filtering and high-pass filtering. A sphere with the suggested diameter is shifted over the surface as if it images the surface. A status bar shows the current calculation state, because this function might take some time.

In case of a low-pass, the virtual trace of the tip is drawn as new image. In case of a high-pass, the difference between the virtual image the original image is drawn.
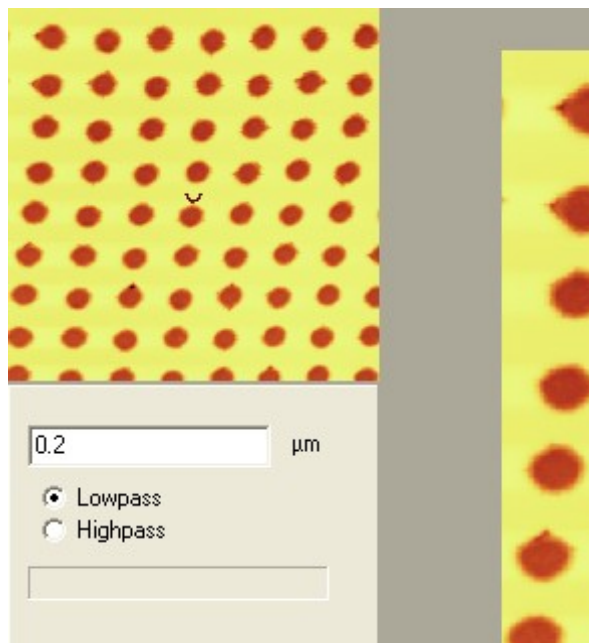
5 VIEW OPTIONS FOR THE IMAGES [VIEW/...]

Refresh   refreshes the image plot

Palette   is a tool to change the colour palette of the images. The palettes can be loaded and saved.

**Font (z-Bar)** changes the font settings for the vertical scale bar

Font (Label) changes the font settings for the XY scale bar.

ScaleBars   opens the same window as visible, when the right mouse button is used on an image and allows to change the scaling visualization for the active image window.
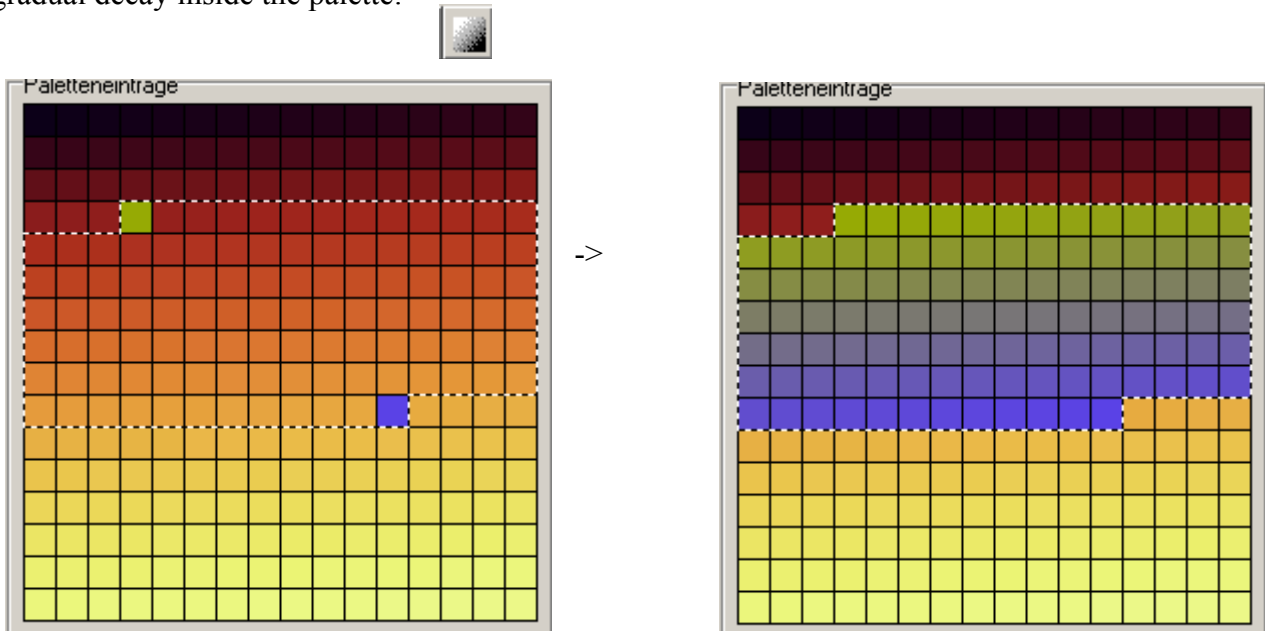
View3D   is a 3D plot of the data in the following window:

the z-gain allows to change the z-scaling of the plot.

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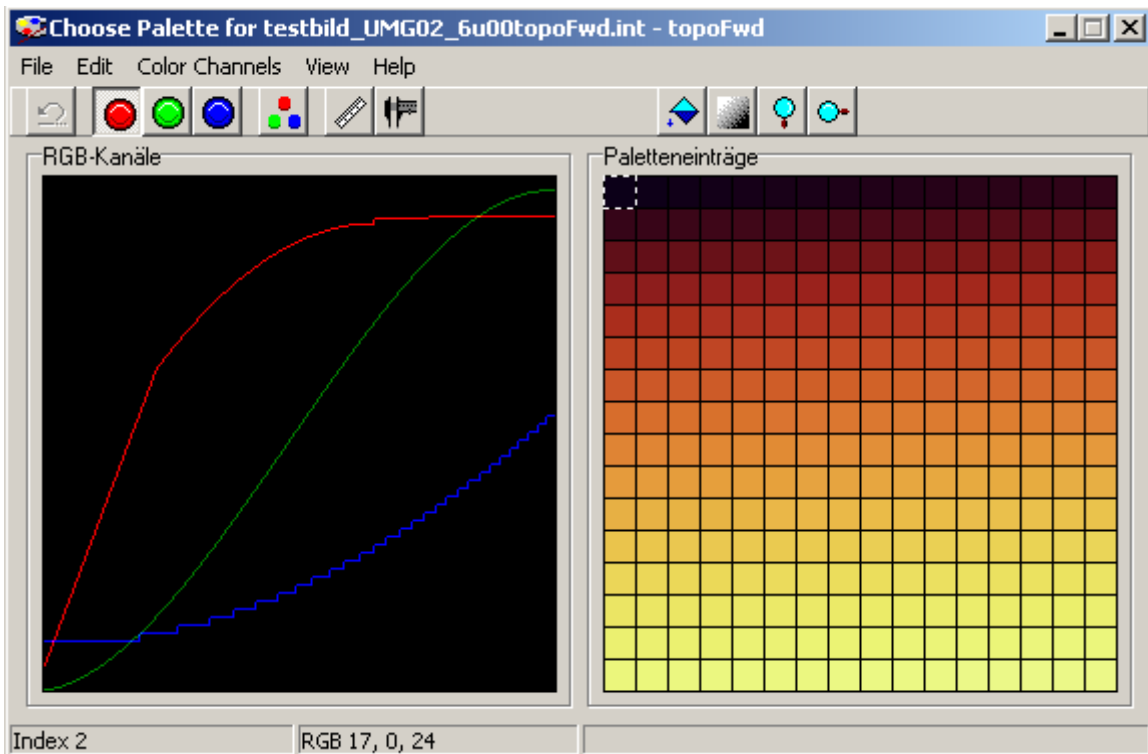
PALETTE

This part allows to load and to save user palettes for the images. One can change single colours in the image. Also, one can select a range in the colour palette and use the entry to generate a new gradual decay inside the palette:

If necessary, one can select a single colour with one of these knobs:

and move the mouse in the left image in order to change the intensity of the selected colour.

FONT (Z-BAR) AND FONT (LABEL)

These function equals the settings called with the right mouse button on an image. They open a standard Windows surface for the font settings. When a new file is opened in Present, the last font setting is kept and used on all newly opened windows.
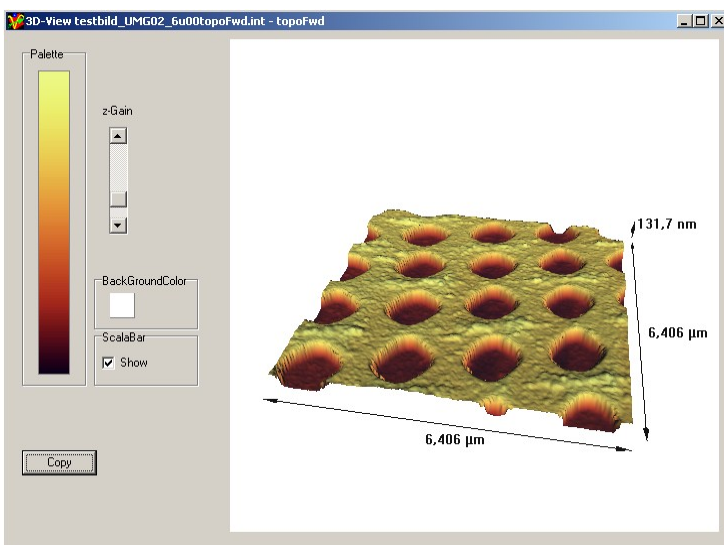
SCALEBARS

Opens the same window, which is opened with the right mouse button inside a picture:
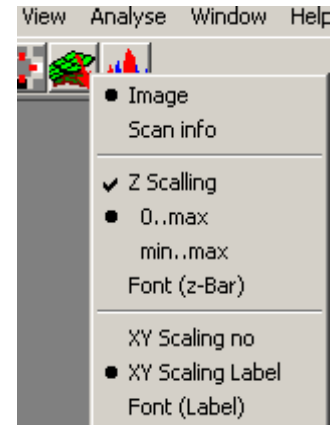
3D-VIEW

Allows to visualize a picture in 3D.

The slider allows to change the height of the image. One can enable or disable the visualisation of the axis description.

The image is rotated simply with the mouse.

Copy puts the image in the Clipboard of the PC.

6 ANALYSIS TOOLS [ANALYSE/...]

These tools are thought for the evaluation of the data.

LINE ANALYSIS

It works on the active window. The image is shown. The line selection can be done as

➢ **row** horizontal line through the whole image

➢ **column** vertical line through the whole image

➢ **any** line with start and end point. The point can be moved by a drag&drop function with the left mouse button.
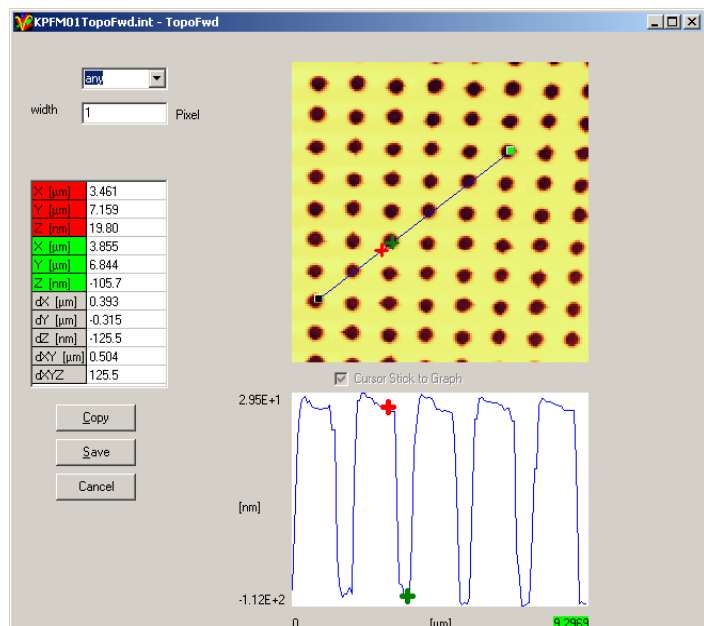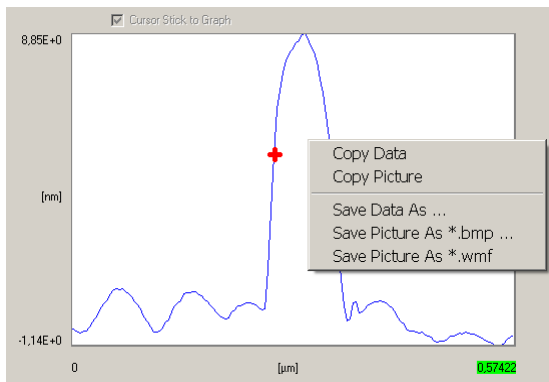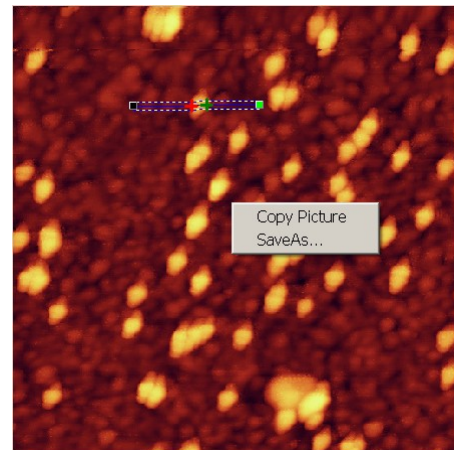
➢ **radial** line starts in the image center and ends at the edge.

➢ **width** is used to average over the here given number of lines for the "row" or "column" selection. For "any", it has no effect. For "radial"it is the angle in degree, over which the averaging is done.

➢ **number** is the line number (for row or column) or the angle in degree (for radial)

After selecting the line, this line is drawn (white window part). Click into this image to place crosses. When two crosses are placed, the crossed can be moved by a drag&drop function. Scaling numbers show the distance (horizontal) and height (vertical). Positions of and distances between the crosses are displayed left:

- dZ height difference between the crosses
- dXY distance in the XY-plane
- dXYZ distance in the 3-dimensional data

The data can be stored in different file formats. Click with the right mouse button into the upper image. An additional menu appears (as shown in the picture aside). It allows to chose between "Copy Picture" (copies the image with the blue line into the clip board) and "Save as..." (opens a save dialog box which allows to set a file name and saves the image as Bitmap.

Copy Picture
SaveAs...

☑ Cursor Stick to Graph

8,85E+0

[nm]

-1,14E+0

Copy Data
Copy Picture

Save Data As …
Save Picture As *.bmp …
Save Picture As *.wmf

0   [µm]   0,57422

If the right mouse button is used on the lower part

X [µm]	0,802
Y [µm]	0,446
Z [nm]	4,975
X [µm]	0,873
Y [µm]	0,442
Z [nm]	4,648
dX [µm]	0,0705
dY [µm]	-0,00391
dZ [nm]	-0,327
dXY [µm]	0,0706
dXYZ	0,335

OK

☑ Cursor Stick to Graph

8,85E+0

[nm]

-1,14E+0

0   [µm]   0,57422
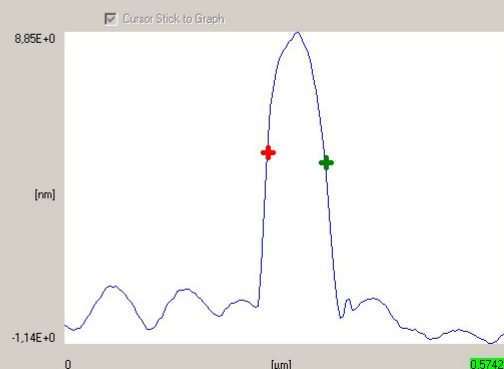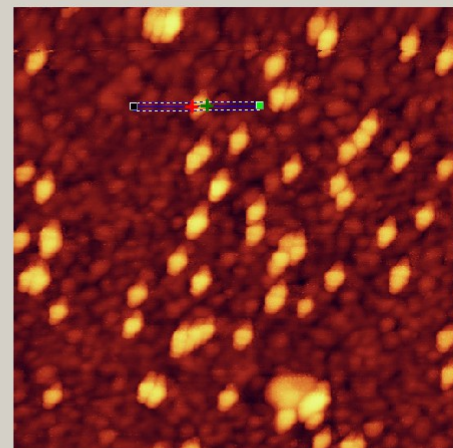
(line diagram), one can chose between two copy-functions and three save functions:

Copy Data: copies the ASCII data into the clipboard

Copy Picture: copies the Bitmap only

Save Data As... :   saves the line analysis data as ASCII file

Save Picture as *.bmp: saves the picture only as bitmap (without text)

Save Picture as *.wmf: saves the picture and the scaling text as wmf-file. The WMF can be broken into its parts later in order to move the text separately.

Hint: A left double-click with the mouse on one of the numbers allows to change the printing style of the numbers.
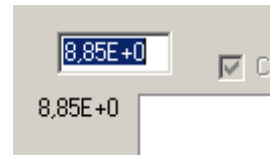
The text is exported in the standard text set with 'View/Font(Label)'.

Roughness

StD   is the rms roughness of the picture analyzed

Mean is the averaged height.

Unit Cell

This function allows to find a unit cell inside an image.

1) move the three green point to the corners of the unit cell you expect to be the correct one.

2) Press Cross-correlation. The system find all point in the picture with fit best to the user defined unit cell.

3) one can adjust the edge from which the found intensities are taken into account.

4) press 'find grid' to let the system calculates unit cell vectors.
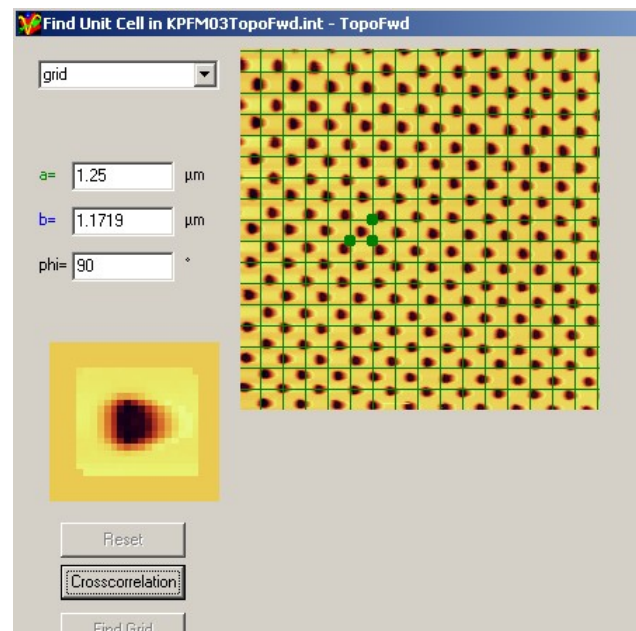
After this, the found intensity maxima in the cross correlation picture are marked with while spots. Between them, unit cell vectors are calculated in two directions. In the original picture, these vectors a and b are drawn in green and blue, respectively.
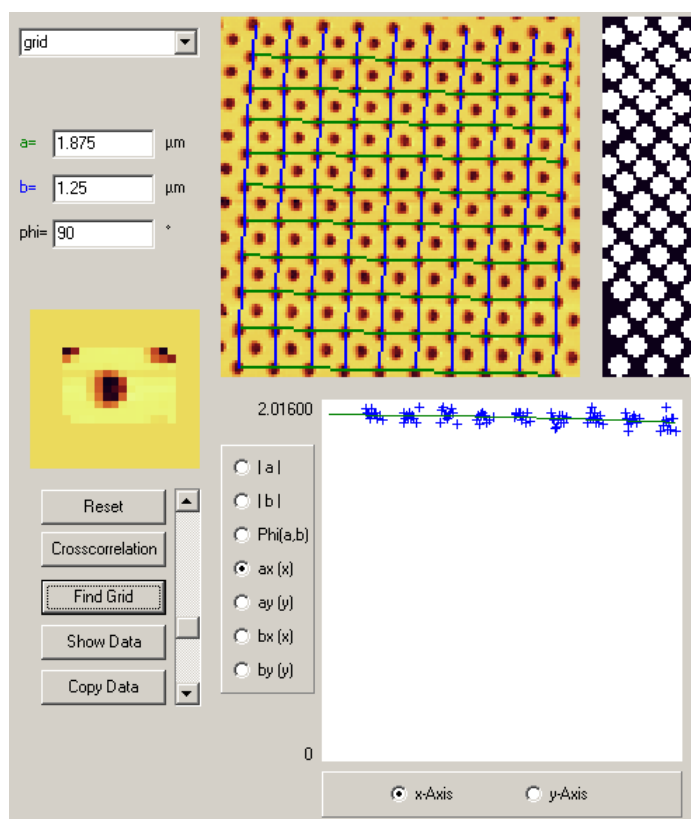
In the lower part of the window appears a drawing in which the components of the two unit vectors can be shown in dependence on their position in the image. Each vector is visible as one blue cross.

One can select single crosses (they get red) and delete them.

Inside the crosses, a green fit is drawn, whose parameters are given in the lower

Anfatec "Eddy" Level-AFM Description

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right part of the window. From these parameters, the lengths of the unit cell vectors can be obtained. For a completely linearised image, the vectors should not depend on the position in the image.