

Graphical and analysis tools in M370/M470 software

I – INTRODUCTION

The aim of this application note is to present the numerous analysis and graphing tools available in the M370/M470 software for the line scans and area maps. These analyses can be useful to highlight specific features and ease the interpretation of data.

II – GRAPHS

II-1 Templates

When data is acquired, the different views available are shown on a toolbar at the top of the window showing the data (Fig. 1).



Figure 1: The configuration and templates toolbar.

Each type of data (ac-SECM, SVP, LEIS...) has its own predefined templates showing predefined values and data. In the toolbar shown in Fig. 1, the six first icons located on the right side of the “experiment configuration” shortcut are default templates whereas the three icons shown on the far right are empty. They can be referred to as a "scratch pad" for data analysis.

Empty templates can be filled by any data, either acquired or processed by the analysis tools. The choice of the data is made by right-clicking on the map (Fig. 2). This feature is available on any 3D map data, not just the empty/scratch-pad templates.

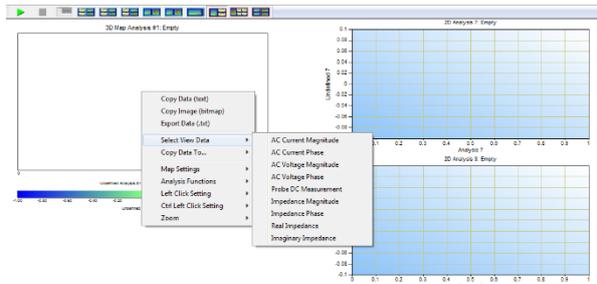


Figure 2: How to show data in any 3D object/template.

Figure 3 shows one template where the impedance magnitude is displayed. On the left side is the 3D graph window (area map) and on the right side the corresponding 2D graph window (line scan, cross-section, power spectrum, Fast Fourier Transform), the top one corresponding to the horizontal cross section and the bottom one to the vertical cross section.

The cross sections are chosen by clicking on the area map, which chooses the intersection point of the cross section. This is the default "left-click" action, but can be set to perform other actions as default.

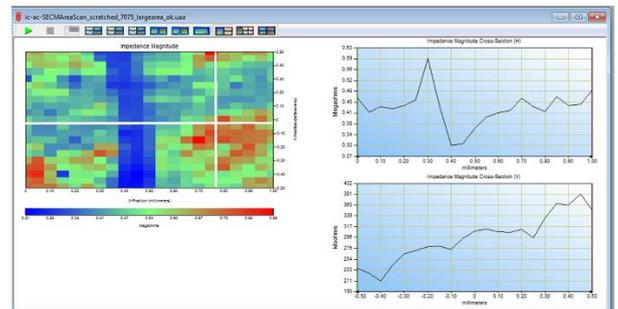


Figure 3: Template showing the area map and the two corresponding cross sections along x and y axis. (Nb : the crossmark was added by the author).

Two other empty templates are offered: one with one 3D maps and four 2D graphs. The specific use of this one will be shown in the next part.

The last empty template offers four 3D maps, dedicated to the comparison of maps on which different analyses were performed. Again, the specific use of this one will be explained later on.

It is also possible to create your own templates, which would then show the desired parameters and the desired graphs. To create a new template, the software has to be connected to the M470 workstation, so that a new file can be opened. On the “New”, the “New template” line needs to be selected

(Fig. 4). In our example a new “SECM Area Scan Template” will be created.

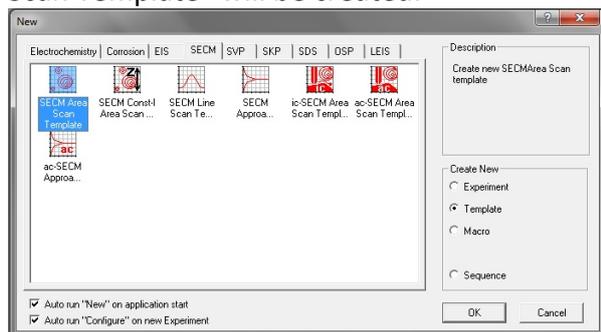


Figure 4: The “New Template” window.

Then an empty template will show up that you can populate with everything that is available in the default templates. This includes area maps, 2D line graphs, processed area maps, any controlled parameters, any experiment settings (Fig. 5). They are accessed by right-clicking in the empty window.

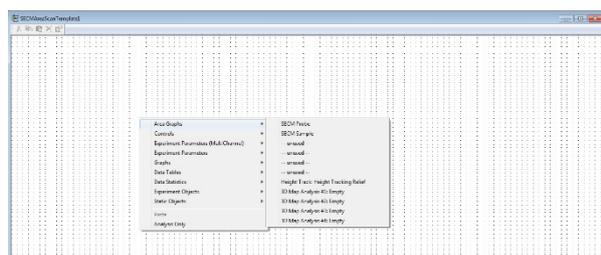


Figure 5: The empty template board and the available choices for template creation.

In our example, we choose to show the area map of the probe dc current response, the corresponding 2D line scan, the experiment time and duration (Fig. 6).

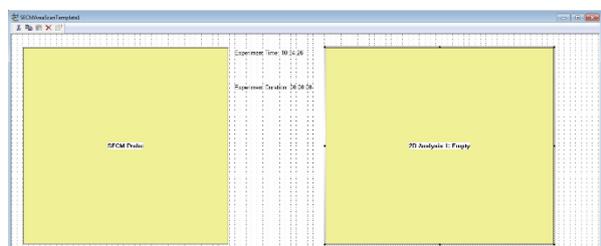


Figure 6: The chosen variables and constants displayed in the new template.

The new template must then be saved in the default location, closed to the default templates, which is C:\M370 or C:\M470. It will then appear in the Templates toolbar when an SECM experiment is opened as a white template (Fig. 7).

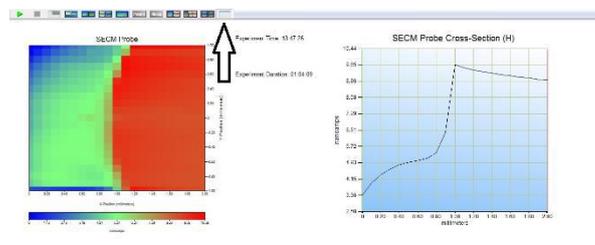


Figure 7: SECM data displayed using the newly created template.

Note that all the data available in the experiment can be plotted as a 3D map but only the cross section already available in the template can be added in the new template. Note that it is possible to change the parameters under which the new template icon appears in the toolbar by opening the “Associate Toolbar Icon” item in the “Template” menu (Fig. 8).

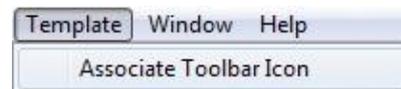


Figure 8: “Associate Toolbar Icon” item to change the parameters associated with the Template icon.

Figure 9a shows how to modify the parameters and Fig. 9b how it changes the way the icon appears. Note that “Tooltip Title” and the “Tooltip Description” appear when the mouse hovers over the icon. Note also that the “Status Message” appears in the bottom left corner of the window.

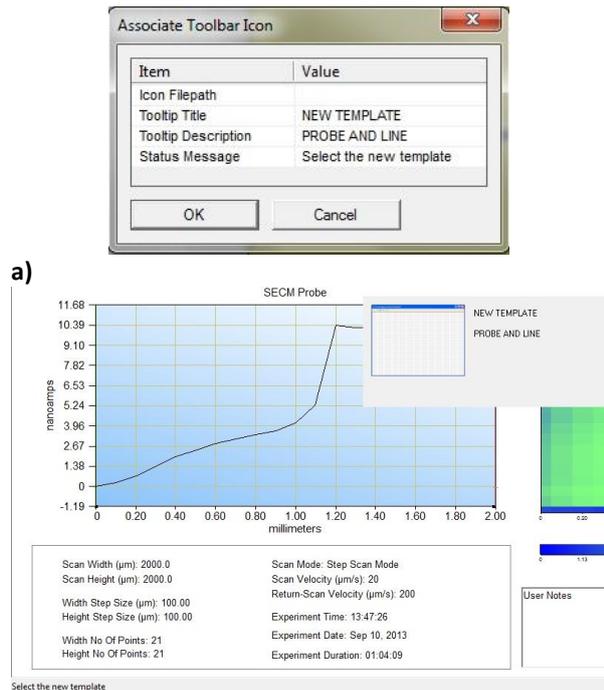


Figure 9: a) Modified icon parameters and b) how the modifications appear in the window.

II-2 Map settings

Map settings are available by right-clicking on the data window as shown in Fig. 2.

It is possible to change the contrast on the maps by adjusting the colour scale. By default the colour scale is adjusted relatively to the minimum or the maximum measured values but the user can manually set the values corresponding to the red and blue colours.

It can be helpful to reveal features that could not be seen otherwise.

Another interesting tool is the ability to resize the data. One can choose to show only a portion of the data, hence highlighting only the most interesting features. Fig. 8 shows two maps: a) is the raw map and b) is the same map centered on the features of interest with contrast adjustment.

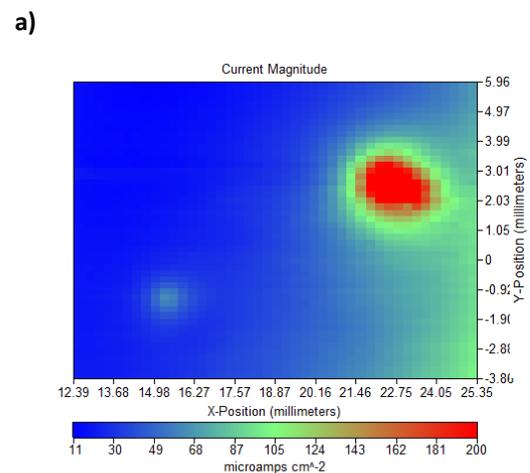
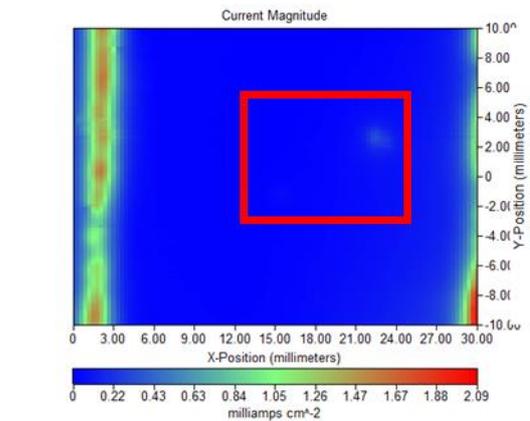


Figure 10: LEIS maps a) as acquired, b) with contrast adjustment and zoom on the interesting features outlined in red in a).

III – ANALYSES

Some of the tools available in the Analysis Menu are explained in the SCAN-Lab application note #4 [1]. The present note will cover the other analyses tools. The analysis menu is available by right-clicking on the data window of interest.

The purpose of these tools are not to provide additional data but to help the user improve and enhance the way the data appears in the case where the acquisition parameters were not optimized or if artefacts occurred during the acquisition of the data.

III-1 3D maps and templates

By 3D maps we consider any area map, which actually are displayed as 2D images with the 3rd dimension as a colour scale. For a pseudo 3D representation an additional software is required. We provide 2 software: MIRA and IsoPlot3D®. More details on the MIRA software are given in the application note #5 [2].

Most of the analysis tools consist in performing an operation on each point of the data.

Notable tools are “Tilt Correction”, which is a particular case of “Curve substraction”. “Curve Substraction” allows the user to remove from the data a polynomial fit of the data (up to order 5), previously selected by the user.

“Tilt Correction” is a particular case of “Curve Substraction” for which a polynom of order 1 is used and the tilt is calculated in both x and y axes.

For “Curve Substraction”, the user defines along which axis the best fit is performed.

For any analysis, the user defines an empty window which will be populated by the resulting data. This is what is being requested by the command “Select Destination for Result”. There are four empty analysis windows available. In order to actually display the data the user should select an analysis object.

When a window is populated with data it will then appear in the “Select View Data” line (accessed by right-clicking in the data and selecting the "Select View Data" option or by selecting an appropriate analysis template that will display the data.) with a reminder of the operation performed. In Fig. 11, one can see that two operations were performed in the data located in the empty window #2.

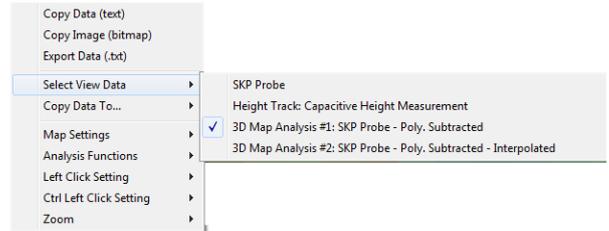


Figure 11: How to display the analysed data.

Another available template displays one area map and four different line scans. This template is specifically dedicated to the 2D Fast Fourier Transform (FFT) analysis. As a 3D map displays data along the x and y axis, FFT can be performed to determine the spatial frequency of features.

As the Fourier function transforms real data into complex values, both the real and the imaginary parts of the data can be shown on each x and y axis as it can be seen in Fig. 12. The data chosen for the FFT are the horizontal and vertical lines intersecting where the cursor is located, as the Analysis function is accessed (right-click).

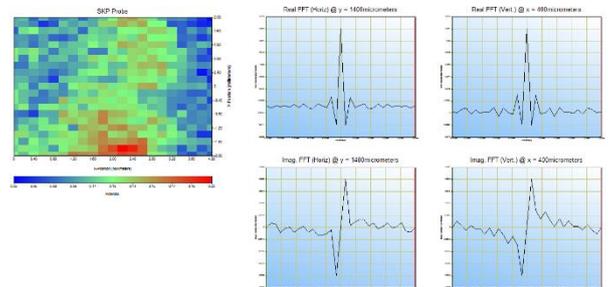


Figure 12: 2D FFT displayed in the 2nd default template.

The default templates can be populated with the analyzed data, for example the data obtained after each analysis can be displayed simultaneously and compared (Fig. 13).

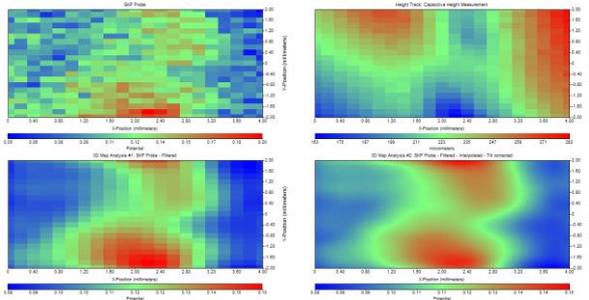


Figure 13: The four 3D maps displayed simultaneously.

III-2 2D Maps

Additional tools are available when right-clicking on the 2D map (also called Line Scan) (Fig. 14).

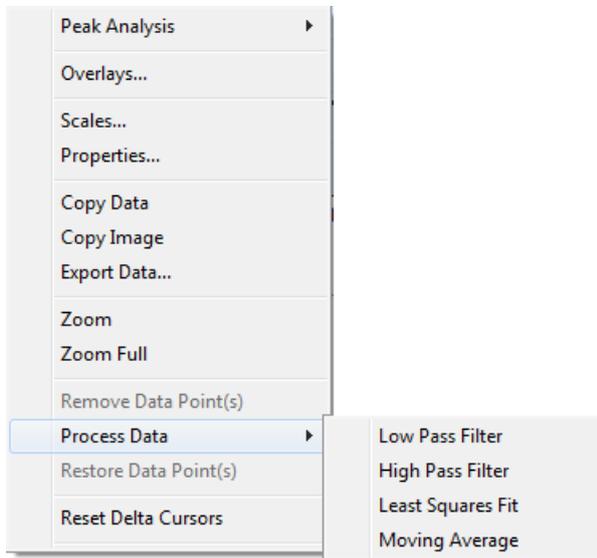


Figure 14: Analysis tools available for the 2D graph.

It is possible to overlay two different curves by choosing the “Overlays” command.

It is also possible to smooth the data or filter the data using the “Process Data” command.

An example of the “Moving Average” tool is demonstrated in Fig. 15.

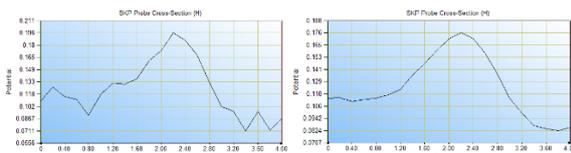


Figure 15: Left : raw data; Right : After moving average with a 5 point window.

IV – CONCLUSIONS

Some of the advanced analysis and graphing tools available in the M370/M470 software were introduced in this document. These tools can be used to ease the interpretation of data and help extracting the most useful features of the data. Formatting the data also helps in presenting the most interesting aspects of the results.

REFERENCES

1. [SCAN-Lab application note #4: Post-treatment and optimization of area scan experiments.](#)
2. [SCAN-Lab application note #5: Introducing the Microscopic Image Rapid Analysis \(MIRA\) software.](#)