## STEM CELL  Quick reference (manual version 1.01)

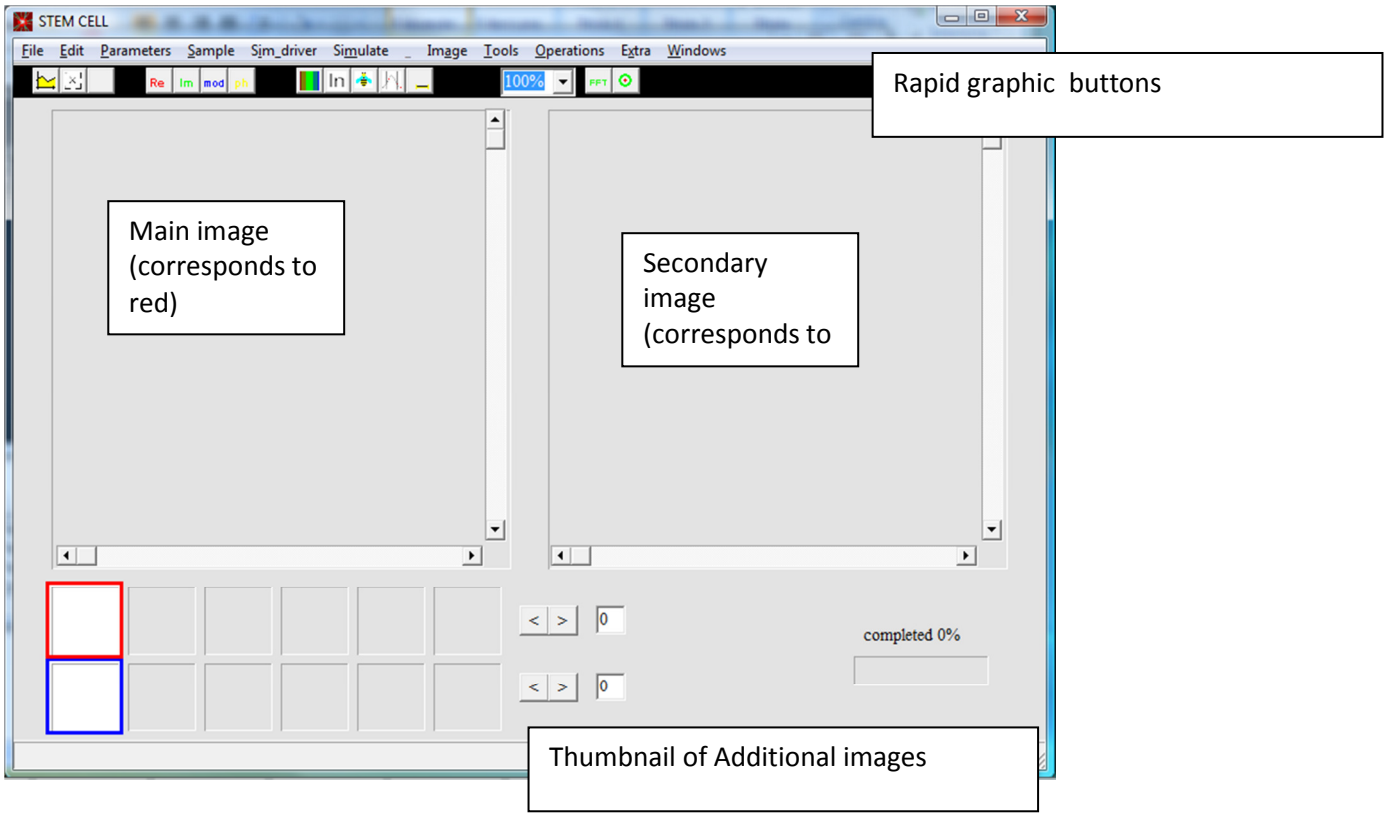
This is a quick guide to get started with STEM_CELL … more documentation is in progress

### General philosophy of the program

This program is meant to handle both experimental and simulated images, profiles and graphics.

When you start the program  the main windows appears as in fig1 plus a debug (dos-like ) windows.

NEVER CLOSE THE DEBUG WINDOWS !!!




This main windows is meant to select and analyze images. Both real and complex images are supported.

When more images are produced or uploaded a thumbnail of the image is visible in the 12 windows in the down left corner divided in two rows. Whereas not strictly obeyed as a rule of thumb the first row is for real space images the second row is for fourier space images.

You can select an image (it will be shown on the main screen (left)) from the thumbnail by double clicking on the thumbnail  or right clicking on the same thumbnail and selecting “set as arg1” the “set as arg 2” permits to select the image for presentation on screen two (right ).

When the space on the 6 thumbnail is over the image are stored internally , you can retrieve them by changing the offset value on the side of the thumbnail section , at every click you navigate to a

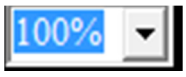
new image. If the number in this command is for example 3 you are seeing in the thumbnail the images from 3 to 9.

When the stored image are too many you can use a list of the images to navigate trough them. The list is available under Windows->Images in the main menu.

The images are internally stored with 4 byte float precision whereas the graphical representation is limited by the screen dynamic and eye sensibility to 255 grey /colour levels.

Part of the command only affect the way the image is represented on screen while other alter the image internal representation.

The rapid graphic button can be used to switch to different rendering on the image without altering the internal representation of it. They permit to select the real /imaginary part / phase and modulus ( 

). To set the image equalization (  ) to switch between BW/Colour (  ), to change the zoom factor ( 

) or to use logaritmic scale ( 

).

The equalization can be switched from FULL mode where the equalization is performed from the absolute minimum to the absolute maximum of the image and the AUTO mode where the level is chosen on the basis of the mean and standard deviation in a zone that you can select by the selection rectangle.

The selection rectangle can be regulated by using drag and drop on an image using the right button of the mouse: if you are in auto mode changing the selection automatically changes the equalization of the image.

**Additional information**

If you navigate trough the image by moving the mouse you should be able to read the corresponding value changing in real time on the bottom border of the main windows.

If you leave the mouse of an image the name of the image should appear automatically.

**Image I/O**

It is possible to open different image format. For all experimental images like dm3, bmp, raw, tietz just go to File->OpenExpImage and select the file.

You can also save your results. I strongly suggest to use the 32 bit tif that embeds all the information about the file, calibration and so on. After selecting the appropriate image you can save it in this format by File->"Save Image as t32" always specify the tif extension.

Needless to say the same image can be opened again by using File->"open Image T32".

Occasionally you may want to save the graphic representation of the images (alas calibration and embedded data will be lost). In this case use File->"Save image" the file format is specified by typin the correct extension (bmp, jpg …).

So far no dm3 writing is supported

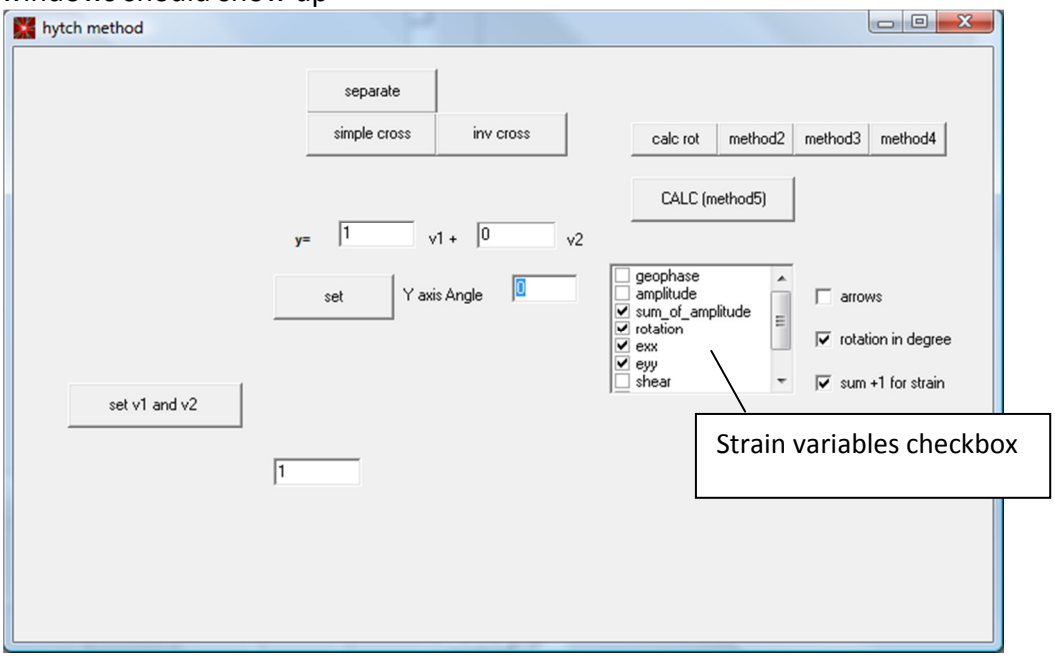
**A usefull application: the geophase algorithm**

Geometric phase algorithm is very useful to evaluate the strain in nanostructures: a comprensive reference is (M.J. Hytch, E. Snoeck, R. Kilaas Ultramicroscopy 74 (1998) 131-146).

Here a quick guide on the analysis is explained in a few step.

1) Select the HRTEM image to be analyised (double click)
2) Perform where necessary a wiener filtering by selecting
   Operation->Fourier->wiener-filter->wien+low pass
   (eventually you can try it twice )
3) Perform the FFT (use e.g. the 

button)
4) Select with the selection rectangle (right buttom or shift and left button) the first fft spot
5) Create a filtered image by clicking 
6) Select with the selection rectangle (right buttom or shift and left button) the second fft spot
7) Create a filtered image by clicking 
8) Make sure to select one filtered image as arg1 and a second image as arg2 ( a red and blue rectangle should appear around the thumbnails of the two bragg filtered images )
9) Open the GPA windows selecting in the main menu under Windows->GPA: the following windows should show up




10) Click “set v1 and v2” . A plot of the two selected directions should appear. If you encounter a failure here it could be that you have not selected the arg1 and arg2 images
11) In the two boxes select a combination of the two v1 and v2 vectors , this will be the y axis orientation. For example if you want the y axis along v1 select [ 1 ] [ 0 ] if you want it along v2 select [ 0 ][ 1 ] if you want it along a direction being the vectorial sum of v1 and v2 select [ 1 ][ 1 ].
12) Press set , this will show the new x and y axes. UIf you are not satisfied change the setting as in point 10

13) In the “strain variables checkbox” select the variables you want to visualize
14) Press CALC(method 5). After a time depending on the size of the images (up to 30 sec in extreme cases). The new graphics should appear in the thumbnail menu.
15) If necessary the strain can be normalized to a reference zone to be set as 1:
    - Select by the selection rectangle a region of the map that you want to select as reference.
    - Press Tool->normalize->to ref area
16) You can also add a colourscale inside your strain map. To do this
    - Select by the selection rectangle a region of the map where you want to put the scale.
    - Image ->add->color scale

SUGGESTIONS

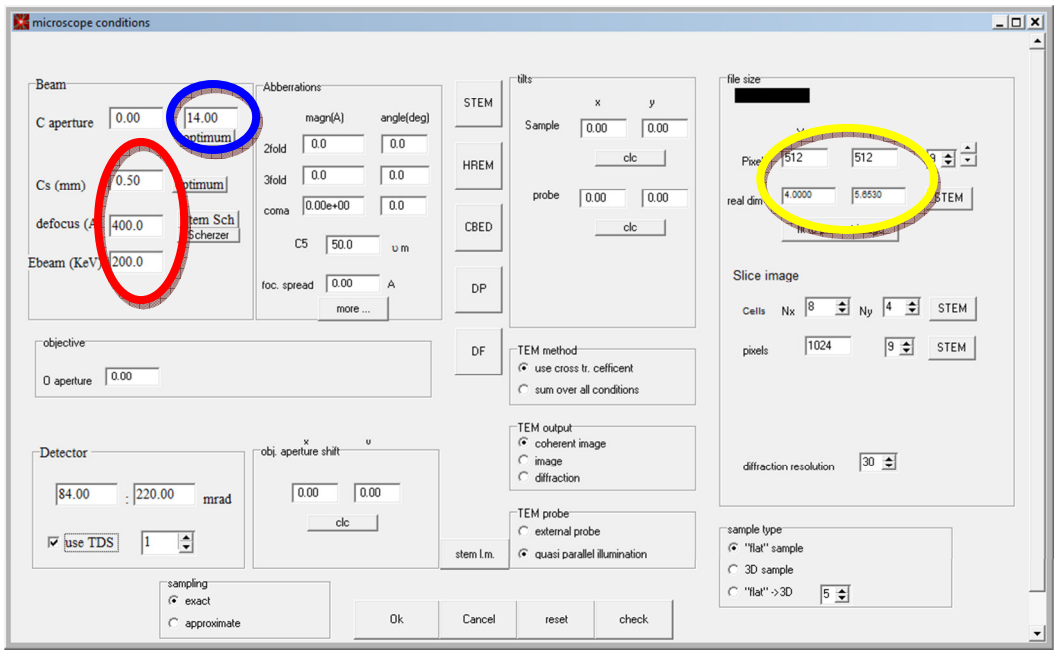
- The graphics will look better by using a colourscale and appropriate equalization as explained in the previous section.
- It is possible to smoothen the results: in the main menu select Tools->Transform-> Gaussian blur and select the appropriate factor.
- I strongly suggest not to use forbidden or chemical sensitive reflection like the 200 in spherelite. Moreover low frequency periodicity are usually to be preferred.

**An example of simulation: The stem probe**

It is possible to simulate the stem probe for different microscope settings.

The first step is to setup the probe parameters: to do this use

Parameters->beam/det and a large parameter windows should appear.



Select the condenser aperture in mrad in the figure in blue, the Cs(mm), defocus and voltage h(in the figure highlighted in red). And the size in real space dimensions and pixels(in the figure in yellow) . A reasonable choice could be for example

[ 512 ][ 512 ]

[ 20. ][ 20. ]

Press OK

If you now go to Simulate->beam probe1 you should be able to see the complex probe on your main window.

The final result can be represented in false colours and should look like in the following figure