1 OPD GUI and User's Guide

Here we present the main features of the developed GUI to interact with the method OPD for IR sequences of PT. The general user interface is shown in Figure 1. To run the application, it is necessary to pass the main program a 3D matrix corresponding to the IR sequence. That is GUI_OPD(mymatrix3D). If no matrix is given, a file containing a 3D matrix must be chosen. Here we show results applied to the flat sequence of CFRP, set as default if the program can find the file in the same path of the main .m file.

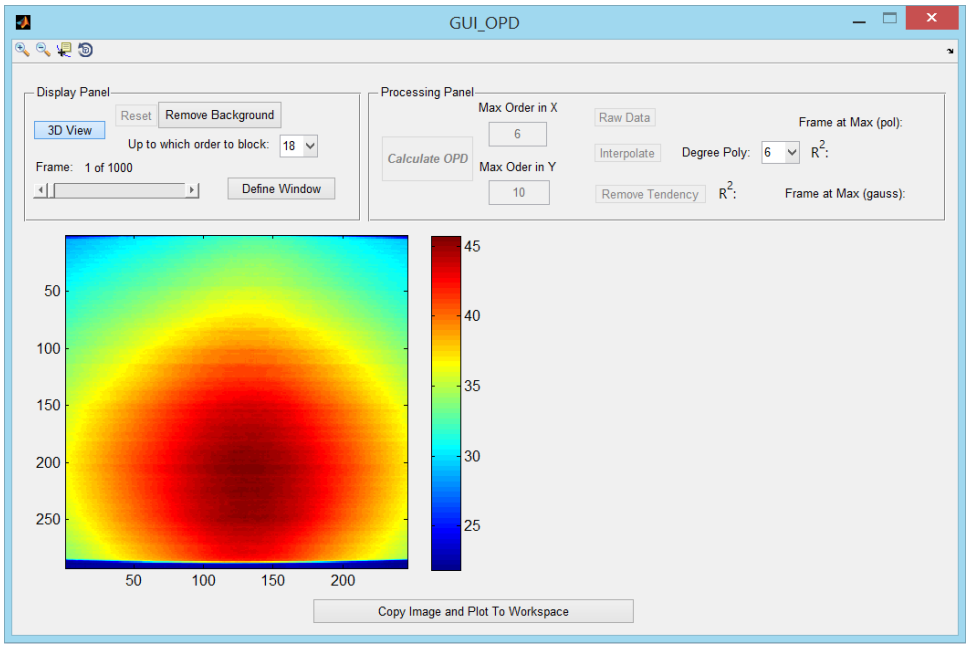

Figure 1: General user interface.

The interface shows the first thermogram and it can be varied along all the frames. We vary the frame until the defects become visible and then a window can be defined with the *Define Window* button. There are two methods to do that: by drawing it with the cursor or by giving the coordinates of two of the corners of a rectangle. Figure 2 shows the two options if they were executed at the same time (only is really executed at the time).

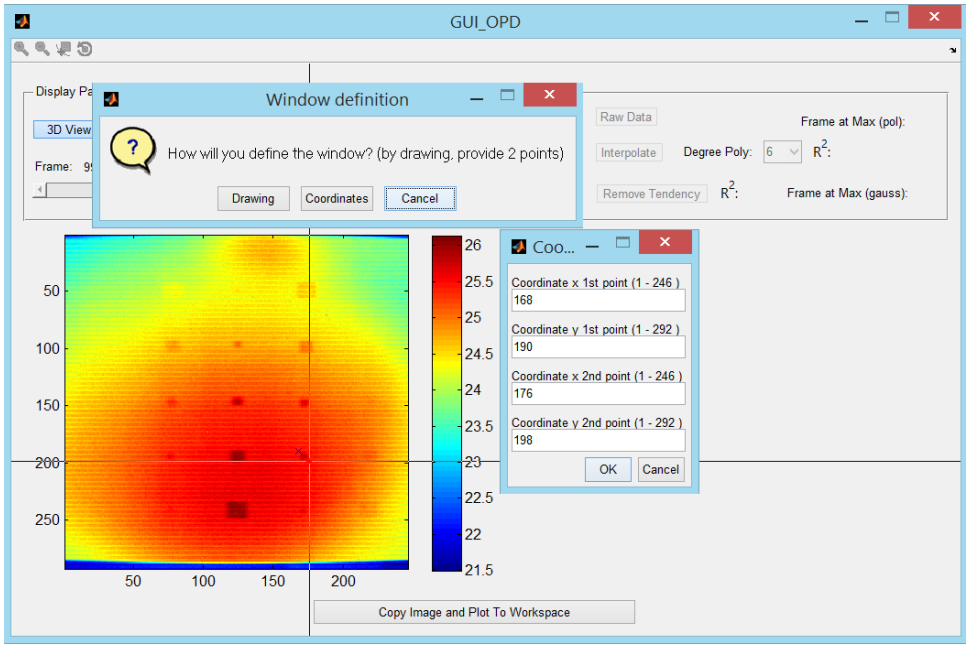

Figure 2: Image definition example.

After the window is defined, almost all buttons become available. The *Calculate OPD* button must be clicked

to begin the OPD of the window over all frames. It is possible to choose up to which order for each axis the decomposition is done. For example, in Figure 3, those values are 7 for the horizontal direction and 10 for the vertical direction. The default values are the size of the defined window. On the right side of the interface, it can be seen the resulting transient response of the OPD in the log-log format by default. Nonetheless, it is possible to change it to linear plot with the *Log Scale* check button. It is plotted by default the raw OPD. Two options are possible to process the curve: a polynomial fit using the *Interpolate* button and a automatic tendency removal and Gauss fitting process (*Remove Tendency* button). For the polynomial fit there are several polynomial degrees to choose from (Figure 3).

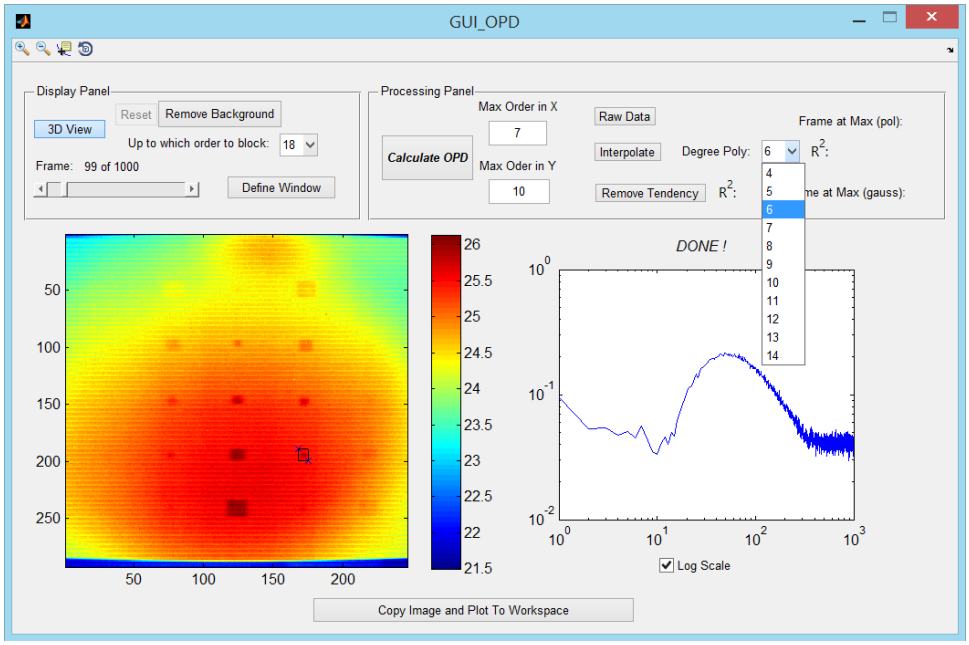

Figure 3: OPD transient response and fitting options.

After the polynomial regression is done, the R^2 value (coefficient of determination) appears right to the button. The frame where the first relative maximum occurs (if any) is shown as well. That can be observed in Figure 4. The frame is 57 and R^2 is 0.97. When the program is calculating something, all buttons are disabled (Figure 4). A message comes out, in the example while the Gaussian fitting is being made. The Gaussian result can be seen in the Figure 5 along with its R^2 and the frame where the maximum is. These values are 0.96 and frame 59.

Finally, the proposed method to remove the thermal background can take part of the action as well. With the *Remove Background* button that can be achieved. A pop-up menu below the button is used to set up the blocking degree for the reconstruction used in the algorithm to remove the thermal background. In the image that degree is set to 18. The processing is fast enough to run over the frames in this "background removed" view. The thermogram without the thermal background is shown in Figure 4. The *Reset* button is used to go back to the raw thermogram view. The view of those IR images can be in 3D by clicking the *3D View* button. If the image on the right of the GUI or the plot on the left need to be saved, the *Copy Image and Plot to Workspace* button serves to that purpose. Two variables are then generated in the Matlab environment.

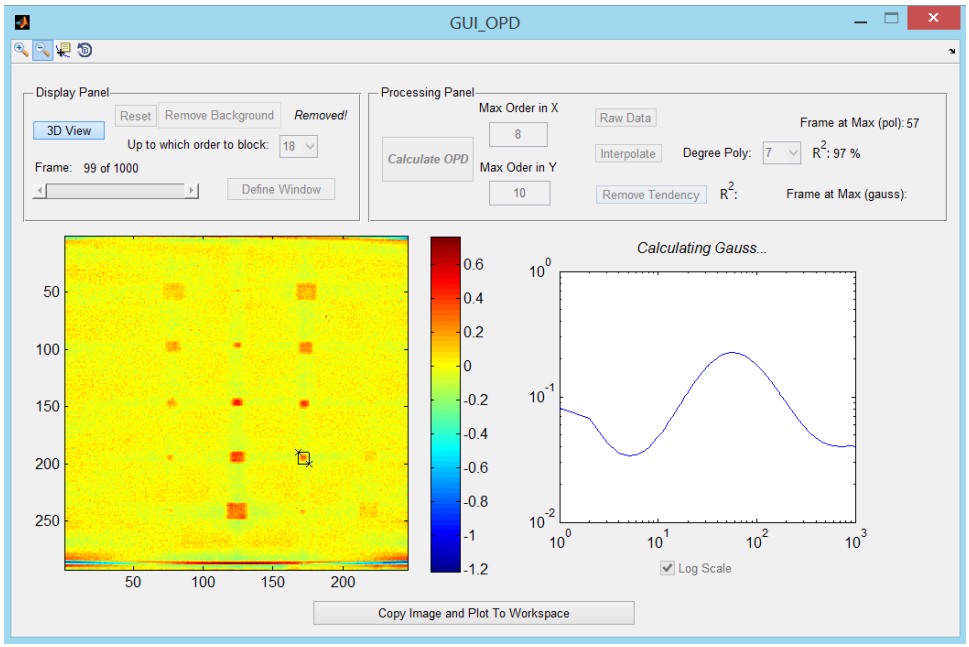

Figure 4: Fitting results and thermal background removal.

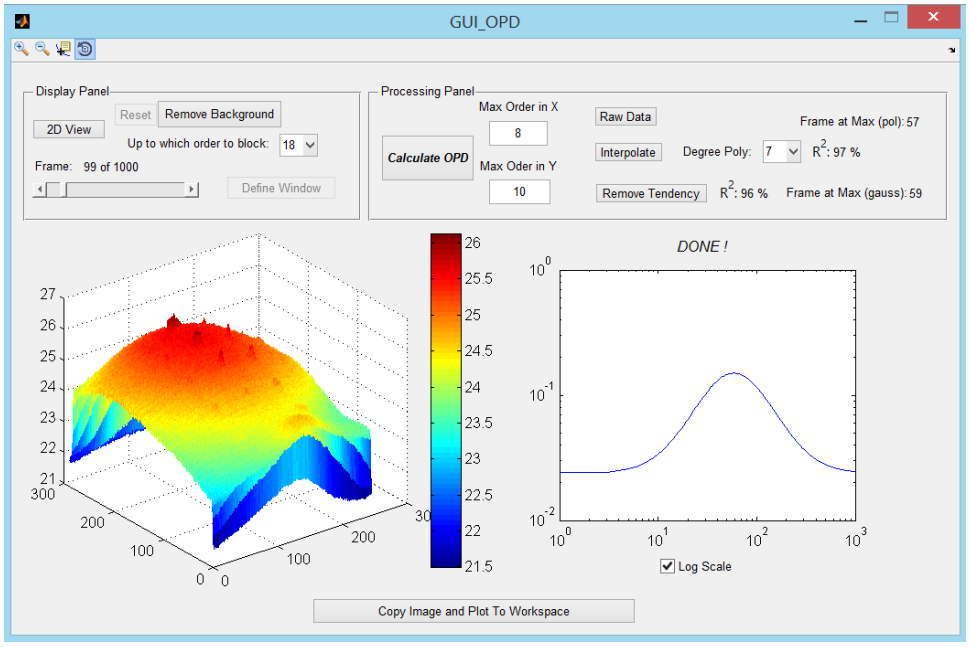

Figure 5: 3D view and Gaussian fitting results.