



Physics MRI Research Centre

WinDXP Wrapper

VERSION 1.00

User's Guide

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Table of Contents

Introduction	3
Scope.....	3
Functionality Summary	3
Running WinDXP Wrapper	4
Using IDL Workbench	4
Using IDL Virtual Machine	4
Using Wrapper.exe (Recommended).....	4
The Wrapper Interface.....	5
Processing Tab.....	5
Weight Tab	6
Pruning Tab	7
Time Constants Tab	8
Advanced Tab	9
How to use WinDXP Wrapper	10
WinDXP Parameter Strategy	16
Weight Parameters Strategy	17
Pruning Parameters Strategy.....	17
Time Constants Parameters Strategy	18
Advanced Parameters Strategy	18

Introduction

Scope

The wrapper is designed to facilitate the process of determining T_2 distributions from a spatially resolved 1D image. It surrounds the Oxford Instruments WinDXP engine so that the engine can be used to process each pixel independently, and automates the process so that the user is not required to process each pixel manually. It is also capable of performing the same bulk T_2 analysis that WinDXP offers using ASCII as input.

Functionality Summary

Wrapper is currently capable of the following:

- ✓ Read .RIImage file encoded by Oleg Petrov's SE-SPI pulse sequence for echo amplitude data
- ✓ Read 1 column ASCII file containing delay list times in micro seconds
- ✓ Select a range of pixels the user wishes to process
- ✓ Modify all parameters WinDXP uses to run the engine
- ✓ Select an output folder for all distribution files to be written
- ✓ Bulk Measurement Option to facilitate input for bulk T_2 analysis

Running WinDXP Wrapper

WinDXP Wrapper is developed using ITT's IDL Workbench 7.1. Wrapper is only compatible with the Windows operating system, and can be initialized in 3 ways.

Using IDL Workbench

If you have access to IDL development environment workbench, here are the steps to running Wrapper:

1. Start the IDL environment in the proper working directory (preferably where the Wrapper installation is placed) or add the Wrapper path to the IDL path variables (under Preferences).
2. Type "Wrapper" in the IDL Command Line and press Enter.

Using IDL Virtual Machine

If you have the IDL Virtual Machine installed on your operating system, here are the steps to running the Wrapper:

1. Start the IDL Virtual Machine.
2. Go into the Wrapper installation directory and load the wrapper.sav file.
3. Once the IDL VM splash window appears, click the bottom left button "Wrapper".
When the second IDL BM splash window appears, click "Continue".

Using Wrapper.exe (Recommended)

The WinDXP Wrapper installation provides an executable file Wrapper.exe. Here are the steps to running the Wrapper using the executable:

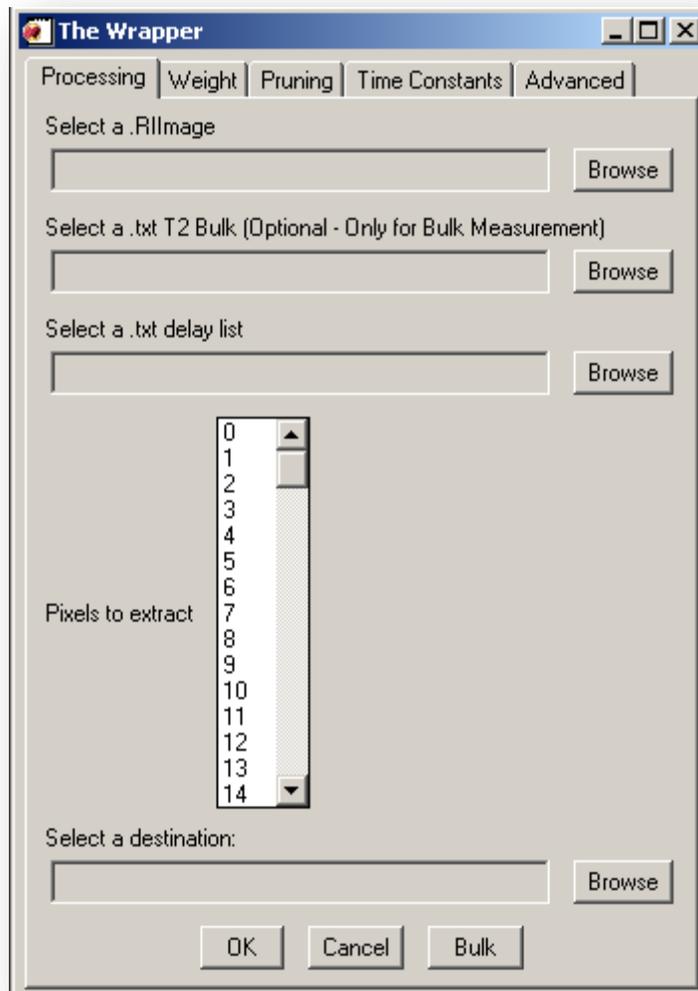
1. Go into the Wrapper installation directory and located the Wrapper.exe file. You may want to create a shortcut on your desktop by right-clicking, selecting "Send To" in the pop-down menu, and pressing "Send to Desktop (create a shortcut)".
2. Double-click the Wrapper.exe file, and follow step 3 of the IDL Virtual Machine instructions.

The Wrapper Interface

This section describes the functionality of each of the WinDXP Wrapper's tabs, which the user can select at the top of the application's window. The first tab is the main tab where the processing takes place. The remaining four tabs control parameters that affect the output file which mirror the parameter modification tabs that WinDXP offers. For further information about the parameters, see the WinDXP User's Guide.

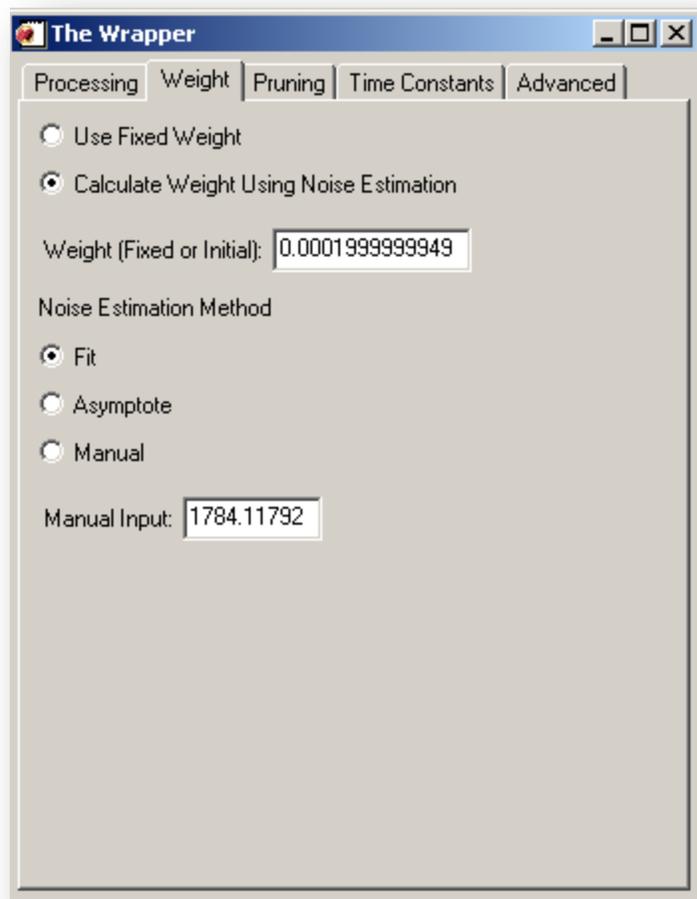
Processing Tab

This tab controls the inputs and outputs of the program. The processing has 3 loading functions, 1 pixel selection grid and an output destination function. At the bottom of the tab, you'll find the "OK" button that initiates the processing, the "Cancel" button that closes the application and the "Bulk" button that initiates the bulk T2 measurement process.



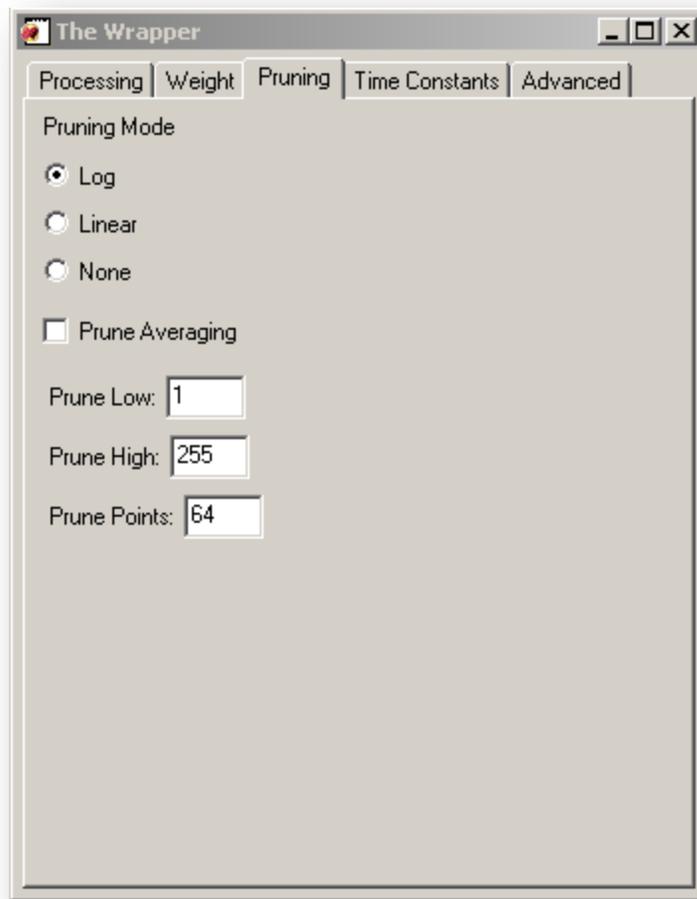
Weight Tab

This tab controls the weight parameter employed by the WinDXP program. The Wrapper will provide a choice between using fixed weight (which you can specify) and using WinDXP to calculate the weight using a noise estimation method. For this later option, you must specify the noise estimation method and the initial weight it will use. If “Manual” is selected for noise estimation, you must specify a signal to noise value (baseline value).



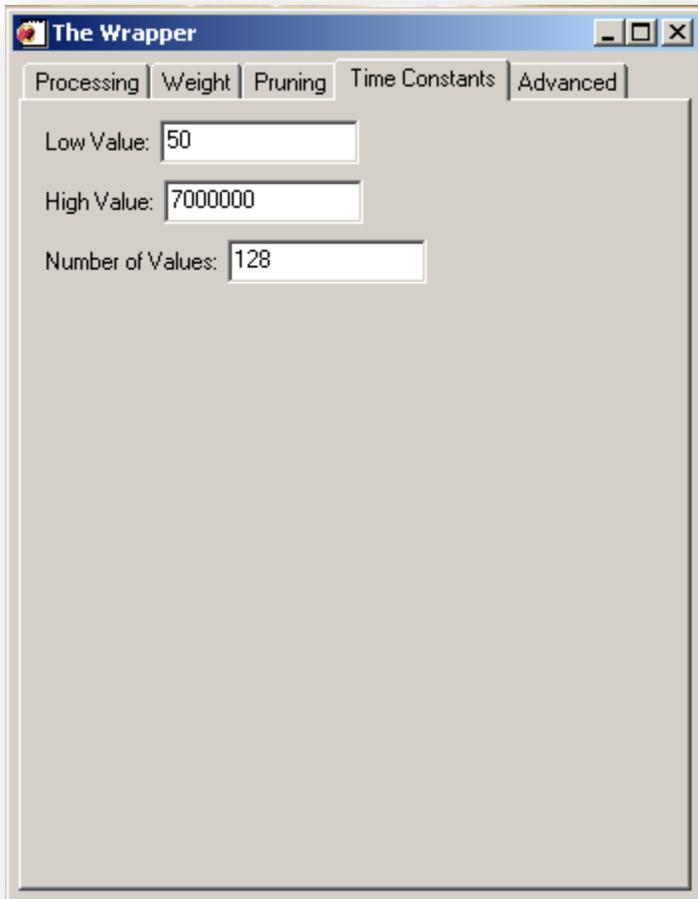
Pruning Tab

The WinDXP engine uses point pruning to accelerate the processing of the distributed exponential. If no pruning mode is selected, it will use every point in the decay data set (every echo peak) to a maximum of 512. When selecting the number of pruning points, keep in mind that the processing time is proportional to the amount of prune points. Refer to the strategy guide for further description of the pruning options.



Time Constants Tab

The Time Constants tab provides the inputs to generate the logarithmic time scale for the distribution. Refer to the strategy guide for a better description of these parameters.

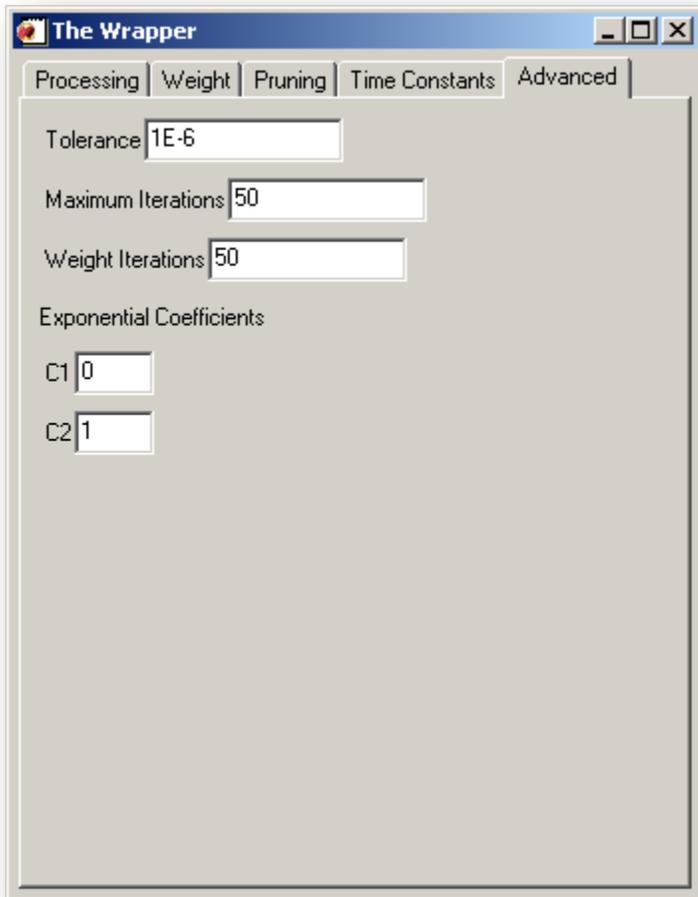


The image shows a screenshot of a software window titled "The Wrapper". The window has a blue title bar with standard Windows window controls (minimize, maximize, close). Below the title bar, there are five tabs: "Processing", "Weight", "Pruning", "Time Constants", and "Advanced". The "Time Constants" tab is currently selected and active. Inside this tab, there are three input fields with labels to their left:

- "Low Value:" followed by a text box containing the number "50".
- "High Value:" followed by a text box containing the number "7000000".
- "Number of Values:" followed by a text box containing the number "128".

Advanced Tab

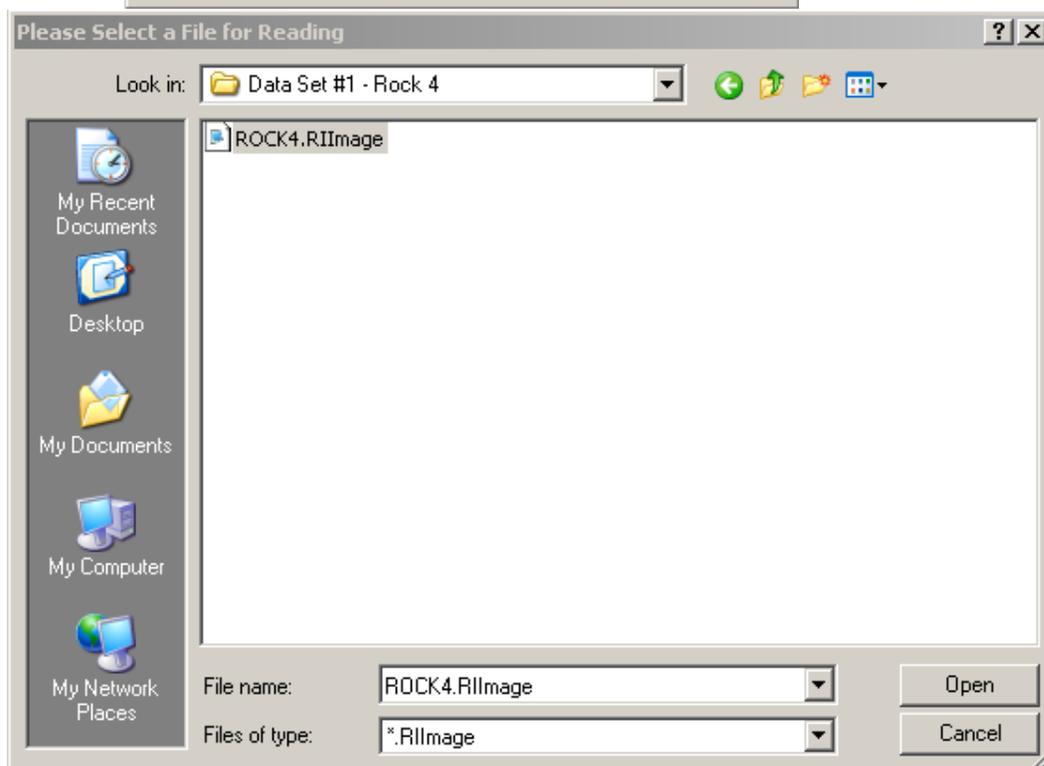
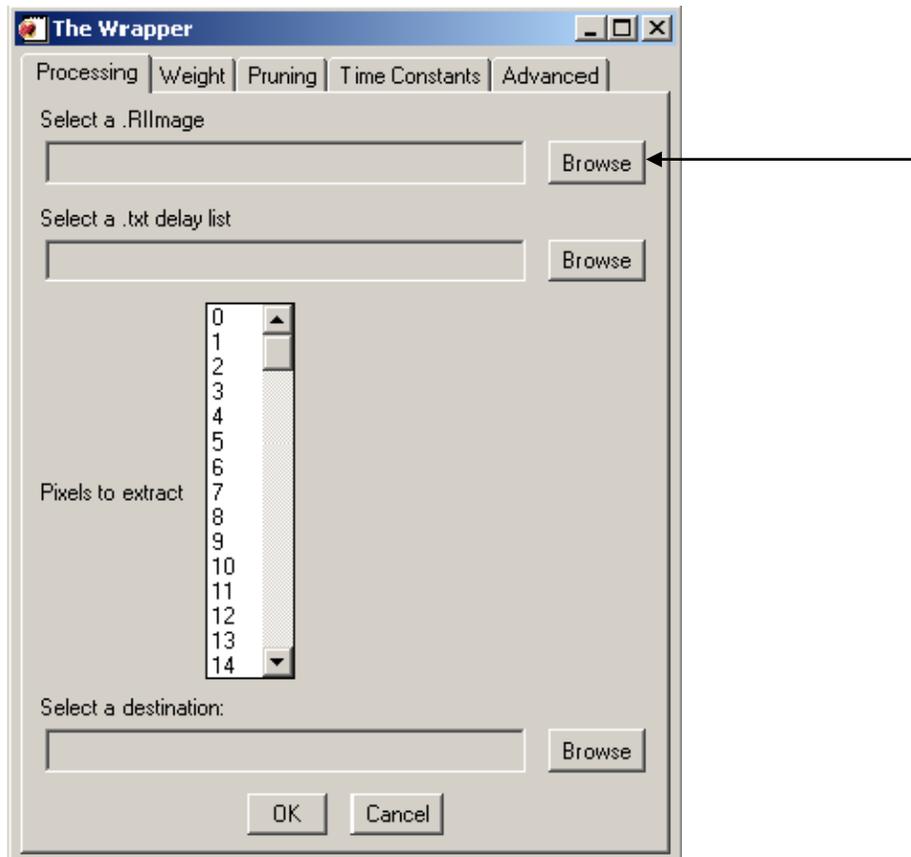
The advance tab provides supporting factors that do not affect the distribution output directly. The default values match the ones from WinDXP.



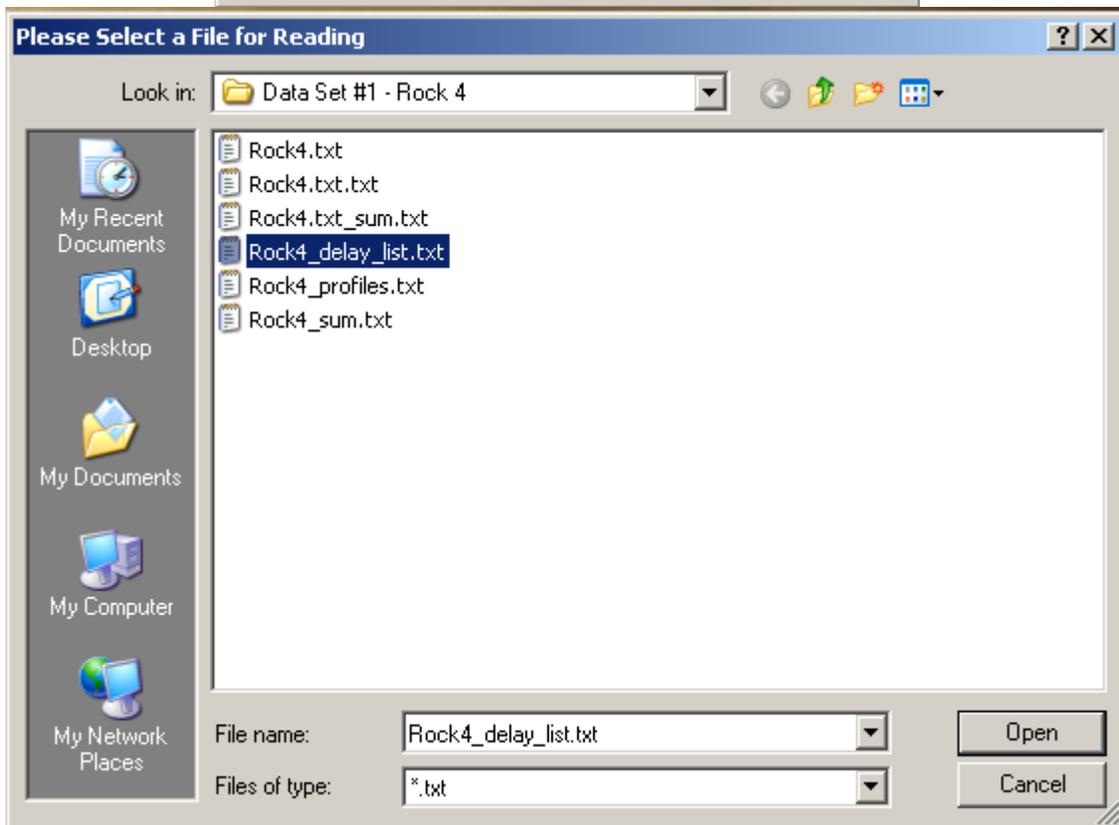
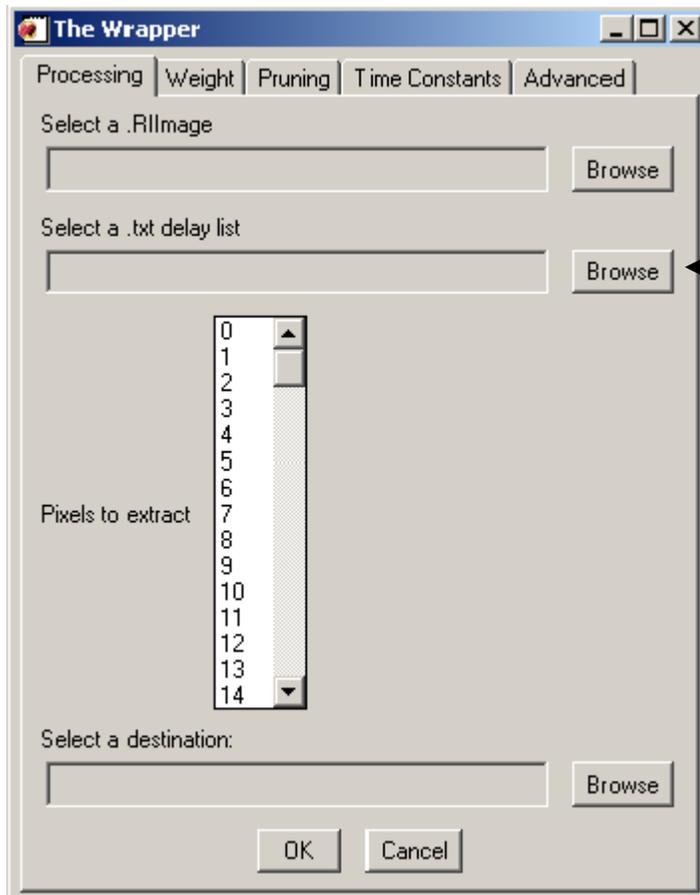
How to use WinDXP Wrapper

Here are the general steps you should follow to use the WinDXP Wrapper.

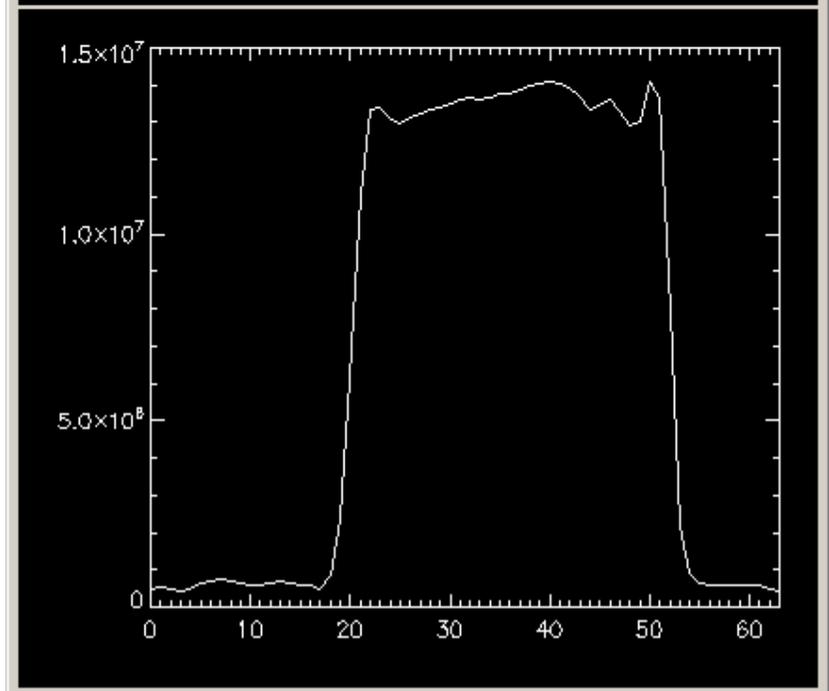
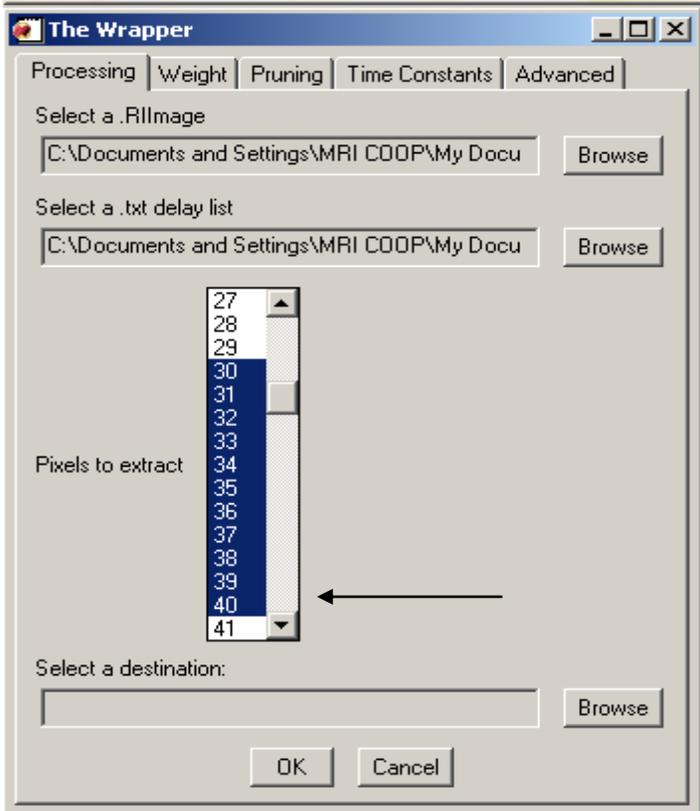
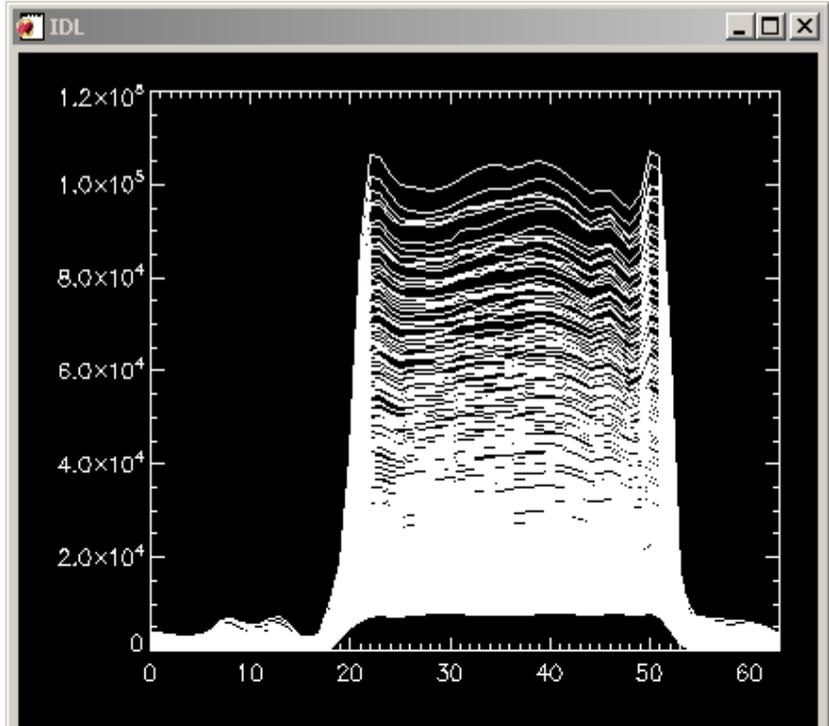
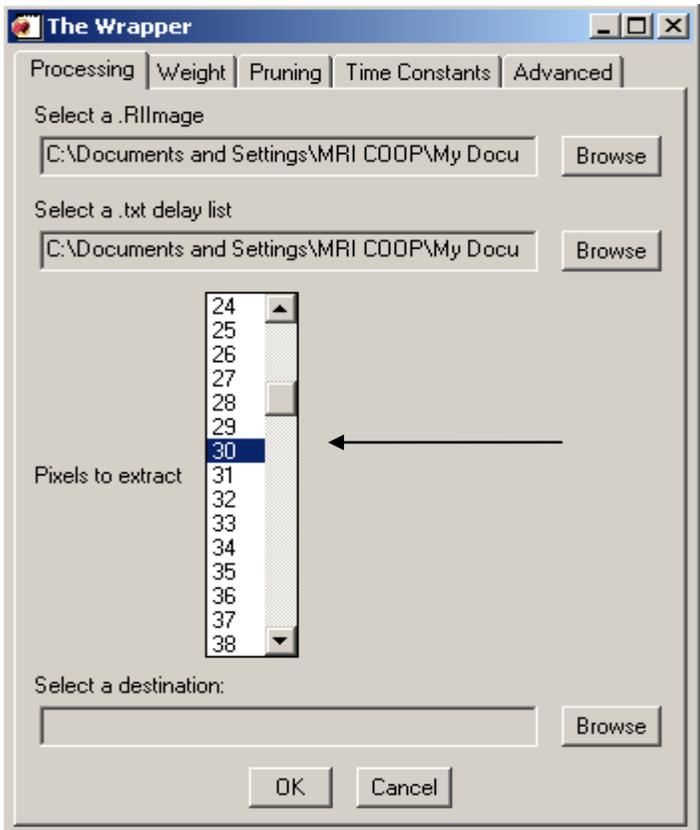
1. From the processing tab, click “Browse” to select a RIImage file.



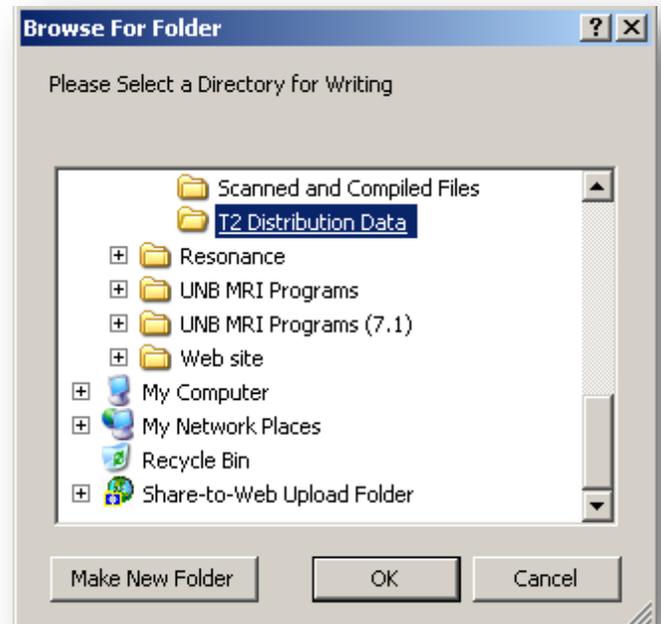
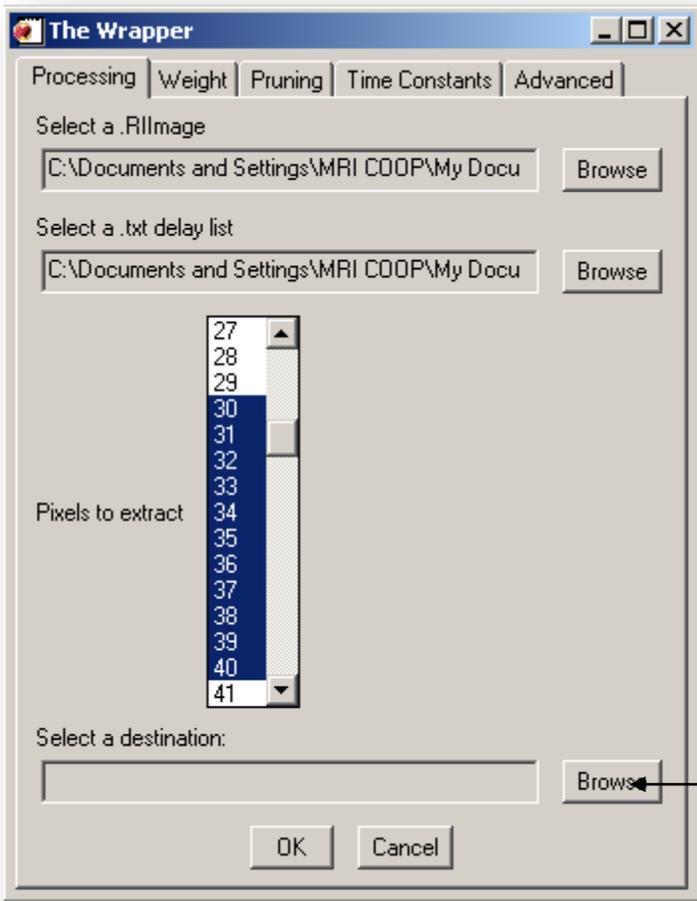
- From the processing tab, click “Browse” to select the corresponding delay list. Make sure that the delay list matches the RImage file; as a rule, it has the same name with “_delay_list” suffix.



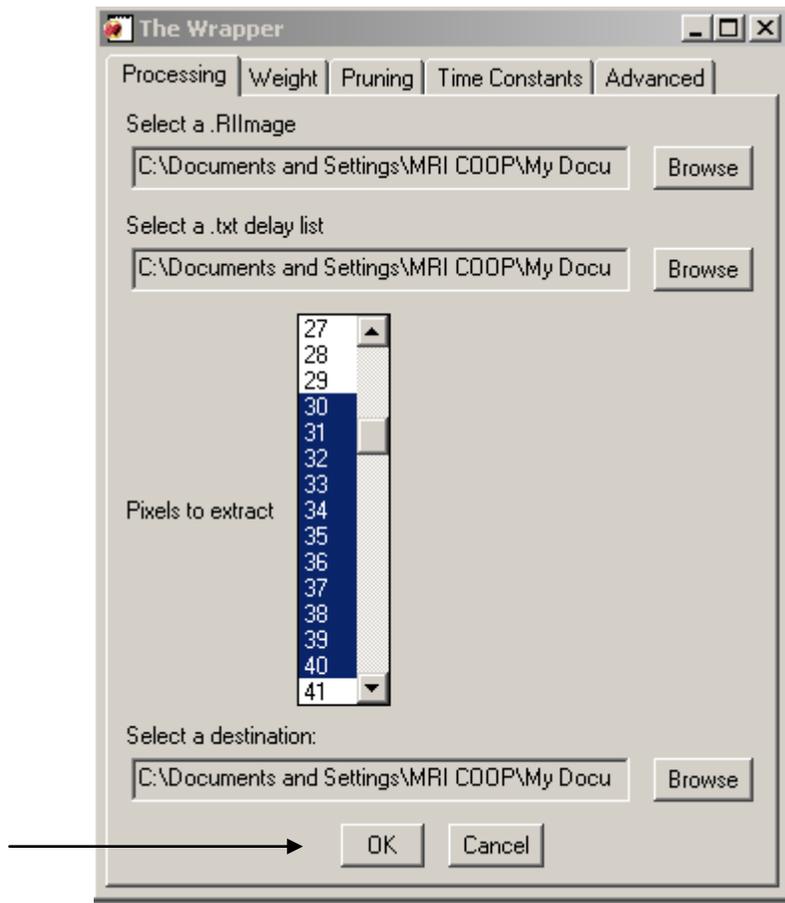
3. After loading the RllImage, a plot of T₂-weighted 1D images is generated. Use this plot to choose which range of pixels is fit for processing. In the pixel selection grid, click the first pixel in the range, hold shift and click the last pixel in the range.



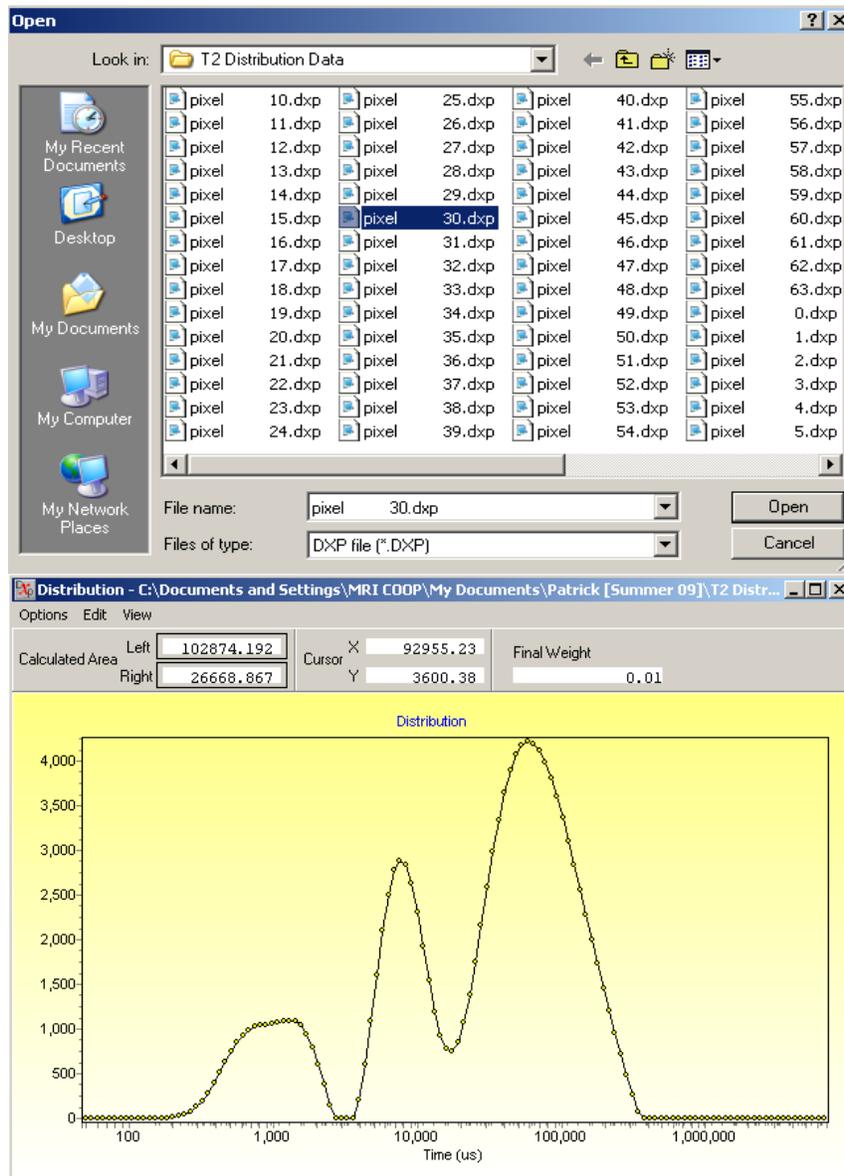
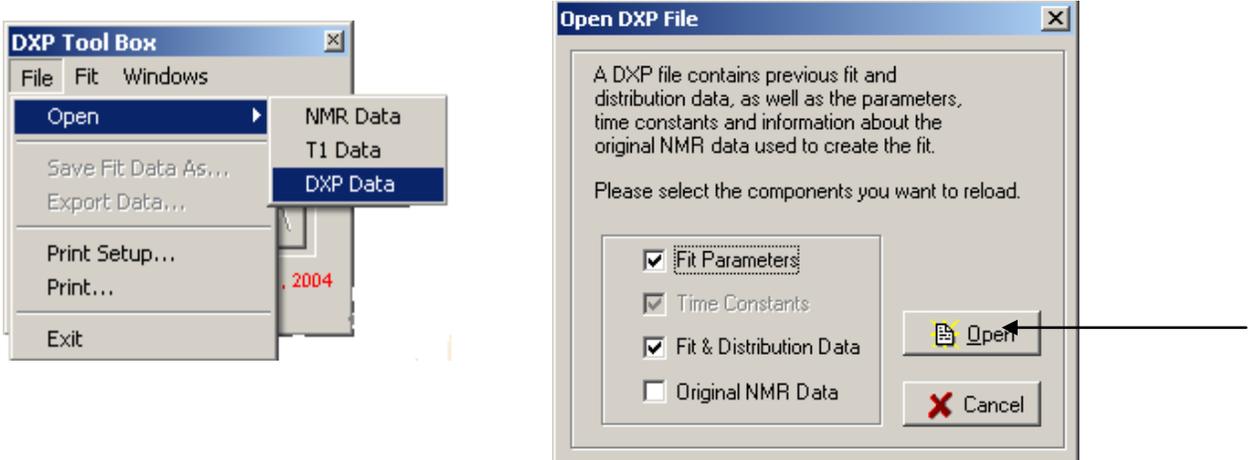
- From the processing tab, click “Browse” to select a destination folder. The output files are .dpx and are read by the WinDXP program (not engine).



5. Finally, make all desired parameter modifications and press “Ok” at the bottom of the processing tab. You will see the DOS command prompt appear in the taskbar, the process is finished when the command prompts stop appearing. After processing, you can go back and change any parameter, click “Ok” and the Wrapper will re-process the pixels using the new parameters.



- To view the distributions, open WinDXP. From the top menu, select "File", then "Open" and click "DXP Data". In the "Open DXP File" dialog, click "Open" without modifying the selection. Select one of the pixels in the destination folder you chose. Repeat this process for each distribution.



How to use the bulk T2 measurement

These are the steps to follow to use the bulk T2 measurement option in the WinDXP Wrapper. This option was desired to bypass the need for an .RIDat file as input for the bulk T2 measurement analysis of WinDXP. The WinDXP Wrapper provides the exact same analysis using an ASCII text file as input. The text file should contain T2 bulk data in a simple column of text. The format is identical to that of the delay list input (<value>\n<value>\n...).

1. In the processing tab, click “Browse to select a bulk T2 text file.

WinDXP Parameter Strategy

This section will provide some helpful information on choosing the proper values or modes for the parameters available in the WinDXP Wrapper. The successful choice of parameters is dependent on the sample data. Remember that these are general strategies and are to be considered only as an initial guide. If this information is insufficient, please refer to the Oxford Instruments WinDXP RAID manual provided with the installation.

Weight Parameters Strategy

The weight parameter represents the constant required for the inverse Laplace transform's convergence. The larger the weight, the more your distribution will look like one large peak. The smaller the weight, the greater the chance your distribution will have many smaller peaks.

The default value is $\sim 2 \times 10^{-4}$, which is considered small. Most distributions do not react very well to weight factors greater than 1. If the weight factor is too small, the data may not converge. You may consider increasing the "Maximum Iterations" parameter if you believe that the weight is appropriate. This will increase the number of iterations the engine will perform to converge the data.

An effective strategy is to begin with a large weight, which gives a broad distribution. Reduce the weight incrementally (try factors of 10) and the width of the distribution should decrease proportionally. At some point the distribution will not change with further changes in weight, while remaining free of spikes and small peaks. This value of the weight can be considered as most appropriate for your sample.

Pruning Parameters Strategy

The pruning parameter is relatively simple to use, as long as it is understood. The prune points parameter can be described in an example. If you have 2048 echoes, and choose 256 prune points using the linear pruning mode, WinDXP will use every 8th decay data point for processing. The logarithmic pruning mode will use equivalently spaced points along the logarithmic scale using the same factor of 8.

Prune averaging will average successive points (in this case 8) into 1 point. Since all the data are used, prune averaging will increase the signal to noise ratio, but may distort the distribution. It is advised to use this only when the signal to noise ratio is low.

No pruning will attempt to use every decay data point (echo peaks) up to a maximum of 512.. It is not advisable to choose this option if you have more than 512 points, as it will "cut-off" at 512 and distort the distribution.

Time Constants Parameters Strategy

The time constants represent the logarithmic time scale of the distribution. The low value is the first point on the scale. The high value is the last point on the scale. The number of values represents the number of points used to create the scale. Changing the high and low values allows you to change how the distribution is displayed (field of view).

Advanced Parameters Strategy

The advance parameters include tolerance, maximum iterations, weight iterations and two exponential coefficients. The maximum iterations parameter controls the maximum number of iterations the engine will perform to achieve convergence with the inverse Laplace transform. The weight iterations parameter controls the maximum number of iterations the engine will perform while calculating the weight factor using noise estimation. The default values are typically unchanged.