Difwrap Documentation

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Chapter 1

Introduction

Difwrap is a program written in Perl to provide a Graphical User Interface (GUI) to *Difmap*. The software currently provides a means to estimate errors in source models generated by the `modelfit` function in *Difmap*. Future releases of *Difwrap* will contain additional features to allow for configuration and operation of *Difmap* through a GUI.

1.1 Requirements

Difwrap uses the Perl module `Expect` to communicate with a *Difmap* session. The `Tk` and `PGPLOT` modules are used to provide the GUI. *Difwrap* requires the following versions (or later) of these modules:

Module	**Version**	**Location**
Expect	1.04	`http://perl.com/CPAN/authors/id/AUSCHUTZ/`
Tk	800.010	`http://perl.com/CPAN/modules/by-module/Tk/`
PGPLOT	2.09	`http://perl.com/CPAN/modules/by-module/PGPLOT/`

Difwrap has been tested on Sparc Ultras running Solaris 2.5.1 and 2.6 with Perl version 5.004_04.

1.2 Where to get it

Difwrap may be obtained via anonymous FTP to `ftp.vsop.isas.ac.jp`. The distribution is in the `pub/difwrap` directory and is called `difwrap.tar.gz`. Installation instructions are provided in the accompanying `README` file.

Chapter 2

Using Difwrap

2.1 Running Difwrap

To start difwrap, first change to the directory where your data is, then type `difwrap`. *Difwrap* will start up the GUI, and then start a *Difmap* session. When this is complete, the main menu window will appear:

Figure 2.1: the *Difwrap* main menu.

Choosing "Interactive session" will allow you to interact with *Difmap* as normal. To return to *Difwrap*, type `<Control>-W` (*i.e.* hold down the `[Control]` key and press the W key).

Choosing "Model error estimates" will start up the error analysis GUI as described in Section 2.2 while choosing "Exit DifWrap" will exit the program.

2.2 Model Error Analysis

This function allows for the determination of errors in source models obtained using the `modelfit` command in *Difmap*. It is based on the process first described by Tzioumis *et al.* (AJ **98**, p36, 1989) thus:

> The parameter of interest was stepped by small increments near the best-fitted value. At each step, this parameter was kept fixed, while all the other parameters were allowed to relax during model fitting. The resultant model was compared with the data. When the *visual* fit to the data became unacceptable, the limits of the acceptable range of values had been determined. Even though this method is subjective, it is thought to give a conservative estimate of the model-parameter range allowed by the data.

This method has the advantage that it allows for the inter-dependency of model components to be taken into account during model fitting. For example, if the (u, v) coverage is limited, there can be a strong inter-dependency between the size and flux density of the model component.

The main problem with this method is many trial models may be needed before a good understanding of the errors can be obtained. Carrying out this task by hand is tedious and time-consuming as it requires the generation of many model files, followed by a visual comparison of every model with the data. The model error analysis function of *Difwrap* removes much of this drudgery. It works in the following way:

1. The model components are presented to the user who decides which parameter (flux density, position or component size/shape) requires an error estimate.

2. The user then decides what range of parameter values require trialing and how many points to sample within that range.

3. Lastly, the user selects which error fitting method is appropriate. There are three to choose from:

   (a) **No Modelfit or Selfcal.** For each parameter value that is trialed, the goodness of fit of the trial model is measured without running `modelfit` to allow the other parameters to relax. This method is less conservative than that described by Tzioumis *et al.* as it does not provide an error estimate that accounts for the inter-dependedness of model components. If you believe your model component parameters are reasonable independent of each other, you might decide to use this over the other methods as it is significantly faster. Because it it fast, this method is also useful to provide an estimate of the minimum errors before starting on one of the other (slower) methods.

   (b) **Modelfit only.** For each parameter value that is trialed, the goodness of fit of the trial model is measured after executing the `modelfit` task with the number of specified iterations. This is the method described by Tzioumis *et al.*

   (c) **Modelfit and Selfcal.** For each parameter value that is trialed, the goodness of fit of the trial model is measured after repeatedly executing the `modelfit` task with the number of specified iterations followed by phase self-cal until there is no improvement in the goodness of fit. This method provides an even more conservative estimate of errors than the second.

   Difwrap will then create a test model for each grid point, carry out the requested method and store the final model and goodness of fit values.

4. When this is complete, the user can select how the goodness of fit values are to be presented.

5. After inspection, the estimated error values are presented and the user may carry out another error analysis if required.

2.2.1 How to use the error analysis GUI

Below are step-by-step instructions for carrying out a model component error analysis.

1. After starting *Difwrap*, choose "Interactive session" from the main menu and carry obtain the best fit model to your data as normal.

2. Type `<Control>-W` to return to the main menu and select "Model error estimates". You will be presented with window (Figure 2.2) which you can use to choose the model component of interest, the range of values to test and the error fitting method.

3. **Model Components.** Near the top of the window is a list of your model components. Those parameters with a green background you have selected as variable while those with a red background are non-variable. You can alter the variability state by clicking on the square buttons in the columns marked by a "v". Select the model component of interest by clicking on a button in the left-hand column. Select the parameter of interest (either flux density, Position or Size) from the buttons above the list of model components. In figure 2.3, the size of component number 1 has been selected.

4. **Gridding.** For each value that describes a parameter, the range and number of values you wish to test must be selected. This is done through the Gridding section of the window. The number of grid points to be sampled for each range of values is selected

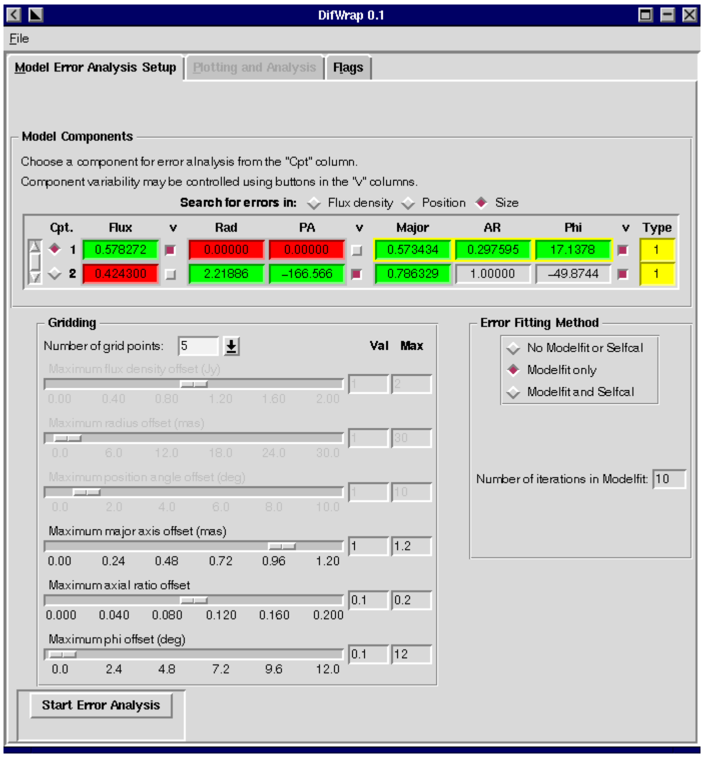

Figure 2.2: Model error analysis setup window.

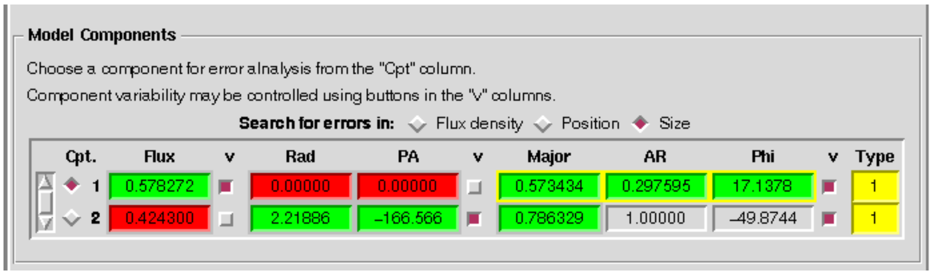

Figure 2.3: Model component selection.

together with the maximum offset of each parameter. This can be done by moving the horizontal sliders to the desired position or by typing in the desired values manually in the boxes in the Val column. For example, in Figure 2.4 5 grid points have been requested in each dimension[1] and the range of values ± 1 mas in major axis, ± 0.1 in axial ratio and $\pm 0.1°$ in major axis position angle from the best fit will be trialed.

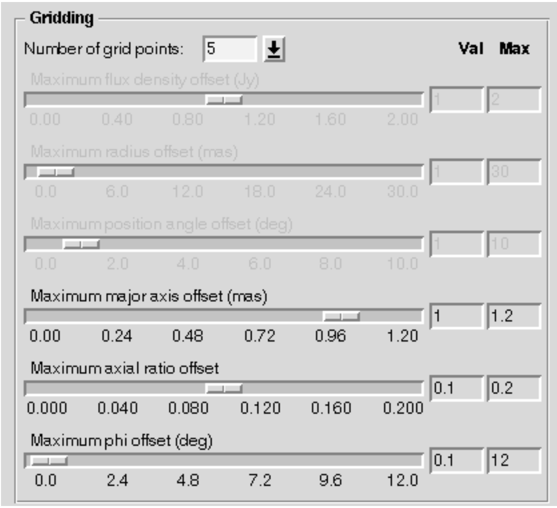

Figure 2.4: Gridding selection.

5. **Error Fitting Method.** Lastly, the error fitting method (as described above) must be selected together with the number of modelfit iterations. For example, in Figure 2.5 the "Modelfit only" method has been chosen with 10 iterations in `modelfit`.[2]

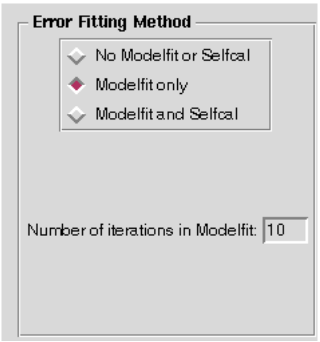

Figure 2.5: Error fitting method selection.

6. Once this setup page has been configured, the analysis is started by pressing the **Start Error Analysis** button.

7. A Status window will appear providing an indication of the progress of the modelfitting (Figure 2.6).

8. When *Difwrap* has finished sending commands to *Difmap*, a new window will appear from which you can choose how the results are to be presented (Figure 2.7). The goodness of fit (either rms or Chi-squared) of each trial model can be plotted as a function of the trial values. The user can select a grid point and *Difwrap* will ask *Difmap* to display the corresponding model with the data using `vplot`, `radplot` or

[1] *i.e.* In this case there are three dimensions to be sampled: major axis, axial ratio and major axis position angle. There are 5 grid points to be sampled per dimension, resulting in $5 \times 5 \times 5 = 125$ points to be sampled.
[2] *i.e.* The command `modelfit 10` will be executed in *Difmap*.

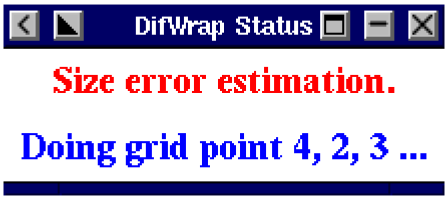

Figure 2.6: Error fitting method selection.

projplot. Select the *Difmap* command you would like executed from the “inspect data using” box and how the goodness of fit results are to be shown from the “plotting” box.

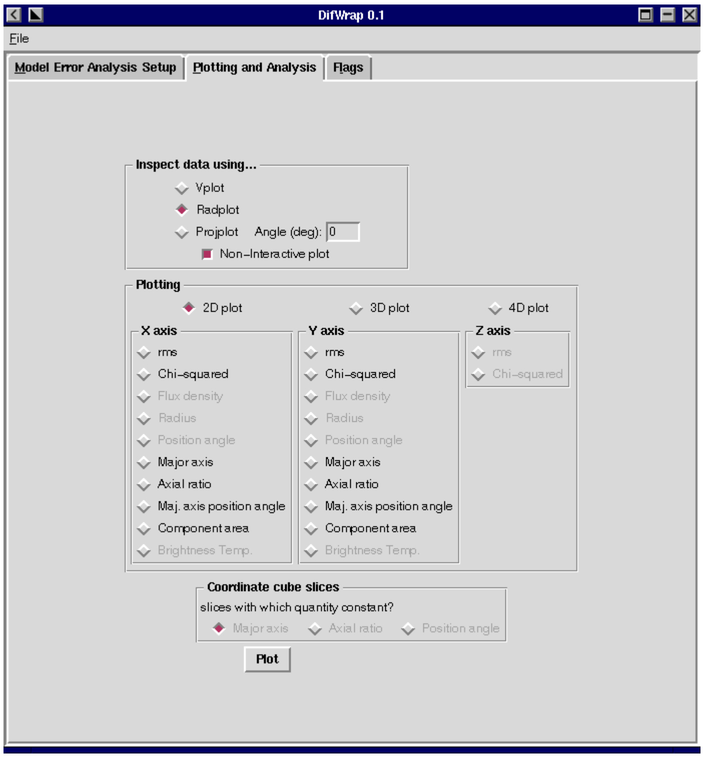

Figure 2.7: Plotting and Analysis window.

9. Figure 2.8 shows Chi-squared as a function of Flux density for a 9-point grid analysis to estimate the error in flux density of a model component. Clicking on a point with the left mouse button will result in the corresponding model to be displayed with the data. That point will then be surrounded by an orange circle to indicate that the point has been inspected. If the user decides that the model corresponding to that point is a good representation of the data, clicking the middle mouse button over it will change its colour from red to green, indicating acceptance. In this example, the central three grid points have been deemed acceptable while the others are unacceptable. Clicking the right mouse button in the window returns the user to the plotting window (Figure 2.7) and the estimated flux density errors are displayed in the message window (Figure 2.9). *Difwrap* estimates the errors by taking the most extreme accepted points. The contents of this window can be edited and saved or printed out using the “Save as” and “Print” commands respectively under the “File” menu.

10. Further plotting may be done, or a new error analysis session may be started.

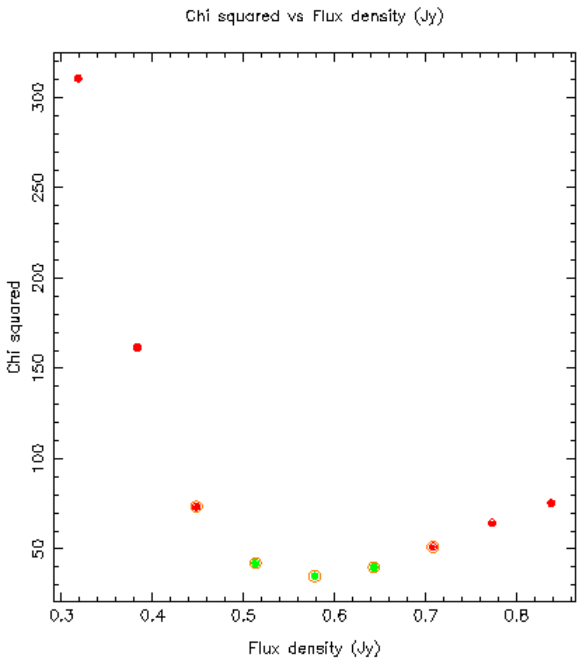

Figure 2.8: A plot of modelfitting results.

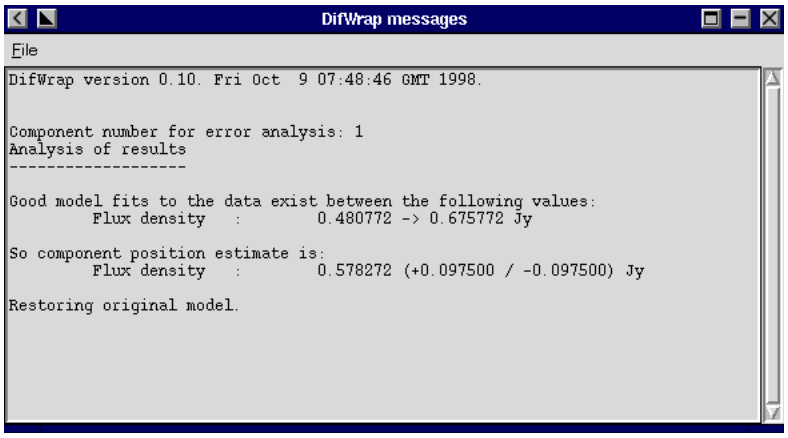

Figure 2.9: The messages window showing results of a flux density error analysis.

Chapter 3

Problems? Bugs?

If you notice any bugs or have any suggestions, please send them to `jlovell@vsop.isas.ac.jp`.