

FractalAnalyzer

A graphic rich application for multi-fractal analysis



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Table of Contents

Chapter 1 INTRODUCTION

- 1.1 Why Fractal Analyzer? The rationale and philosophy of this tool
- 1.2 Hardware/Software requirements
- 1.3 How to start Fractal Analyzer?

Chapter 2 A QUICK TOUR

- 2.1 A Glance of some Geophysical Terms
- 2.2 A Quick Tour of Fractal Analyzer

Chapter 3 DEMO RUN OF FRACTAL ANALYZER

- 3.1 Multi-fractal analysis of demo data
- 3.2 Generating logCr Vs logr plots
- 3.3 Generating Dq Vs Time plots
- 3.4 Generating Dq Vs q plots

APPENDICES

- A.1 Output Data file Organisation

1 INTRODUCTION

1.1 Why FractalAnalyzer? The rationale and philosophy of this program

FractalAnalyzer is intended both for publication-directed research and for practical application for earthquake hazard estimation, as well as other clustering aspect study of microseismicity .

Please see further details in the manuscript.

1.2 Hardware/software requirements

Windows Vista/7 OS

Note: This application has been successfully tested on Windows 7 OS, but can be run on the other OSs as mentioned above.

- **MATLAB Compiler Runtime (MCR) is required.**
- A monitor of at least 600 x 400 pixel resolution. A laptop screen (1024 x 768 pixels) is fine.
- A text editor to modify ascii input files, and a spreadsheet to read tab-delimited text files.

1.3 How to start Fractal Analyzer?

To start using Fractal Analyzer application, you don't need to be a programmer or a computer expert. All you need is the knowledge of fractal dimension analysis and its use in earthquake seismology. If you satisfy the above criteria, then you are ready to use this application.

1. Fractal Analyzer application is available in two forms:
 - Fractal Analyzer Matlab package
 - Fractal Analyzer executable file
2. **Fractal Analyzer Matlab Package** users need to set the current folder of Matlab as *FractalAnalyzer*. For running the **Fractal Analyzer Executable**, just double click on the *FractalAnalyzer.exe* file.
3. **Fractal Analyzer** application pops up on the screen and can now be used.

2 A QUICK TOUR

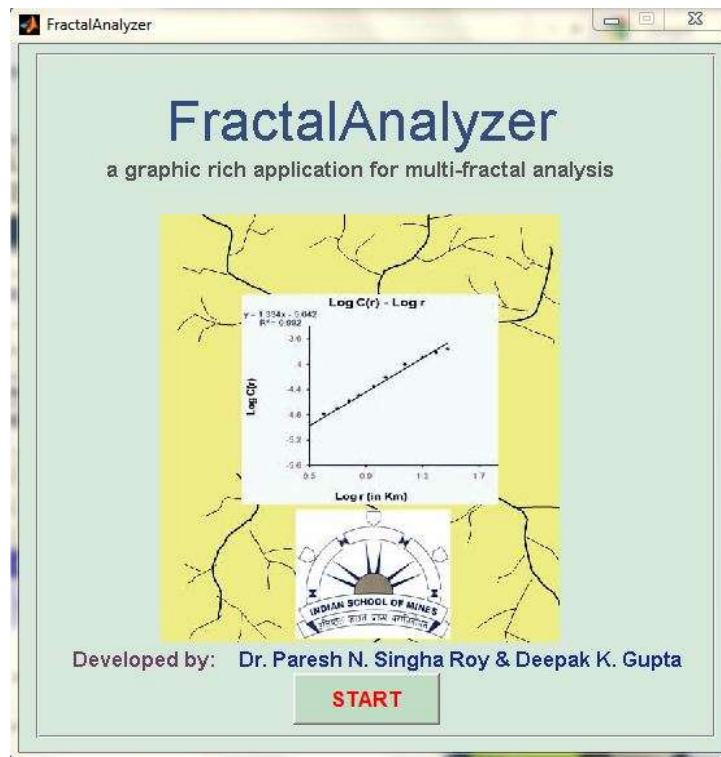
2.1 A Glance of some Geophysical Terms

Please see the details in the manuscript.

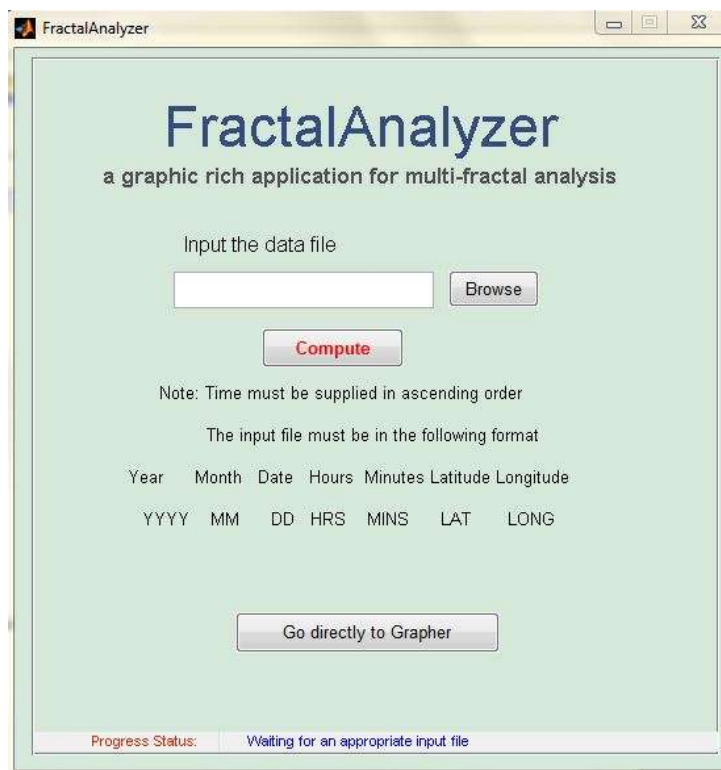
2.2 A Quick Tour of Fractal Analyzer

This section will help you understand the layout of the application. We always recommend that you save all your current working documents frequently to prevent lost of files in the event of program crashes.

In section 1.3 we have already discussed how to start the application. Once the application has been started, the user shall be seeing the cover page of the application as follows:



1. Press the **START** button of the application and wait. The application will be started and you will be directed to the **Multi-Fractal Dq** computation section.



2. If you want to compute Dq values and save the files in the current folder, then browse and supply the input file in the required format and press on **COMPUTE**. If you already have the the Dq values and want to go to the **Grapher** section, then press **Go directly to Grapher**.
3. The format of the input file for Dq computation is shown in the figure below. Note that the data must be arranged in ascending order of time.

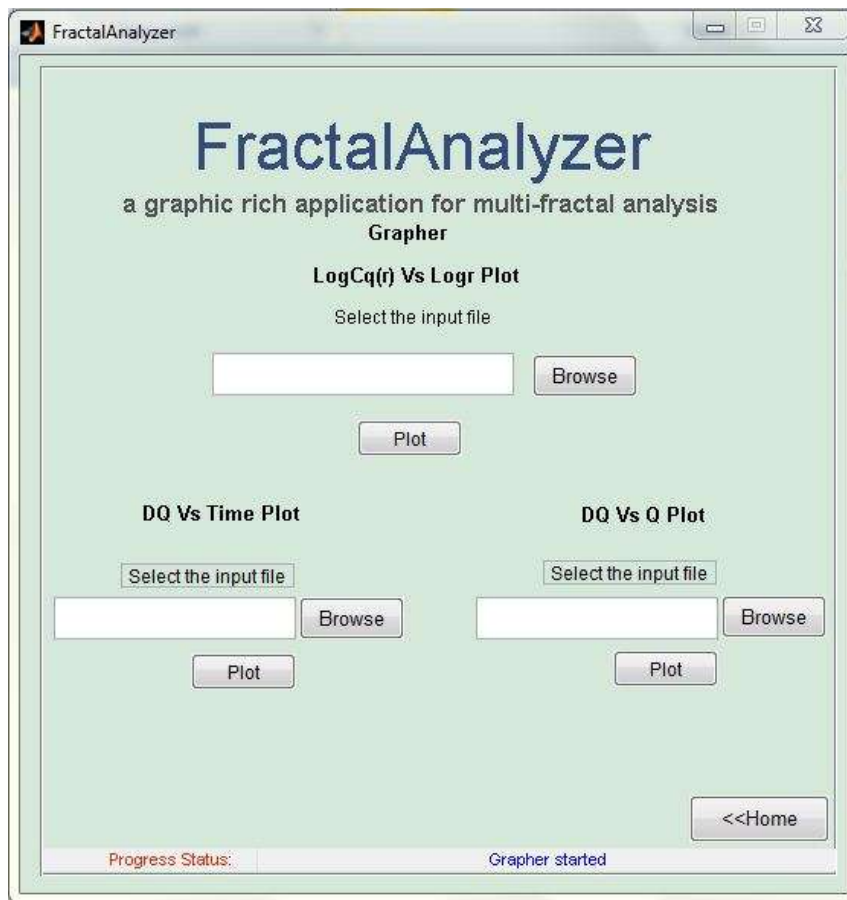
Note: Time must be supplied in ascending order

The input file must be in the following format

Year	Month	Date	Hours	Minutes	Latitude	Longitude
YYYY	MM	DD	HRS	MIN	LAT	LONG

4. Next figure shows the layout of the **Grapher** section of the application. This section allows following plots:
 - $\text{Log}(C(r))$ Vs $\text{Log}(r)$
 - Dq Vs Time
 - Dq Vs q

The meaning of these terms has been described in section 2.1. These plots are separately viewed in Matlab operations. Various Matlab figure operations such as save, edit etc. can be performed over these plots.

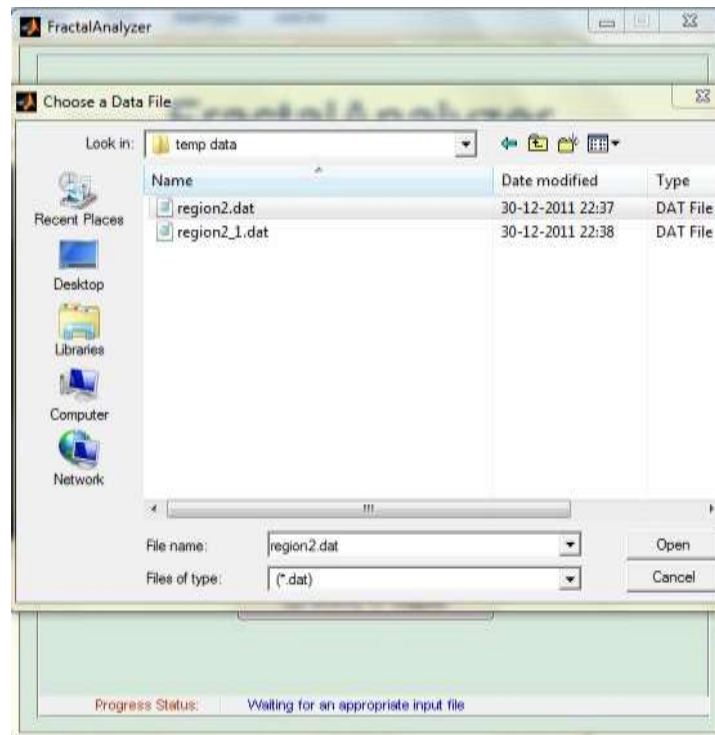


5. The **HOME** button at the right bottom allows to user to go back to the home page of the application.

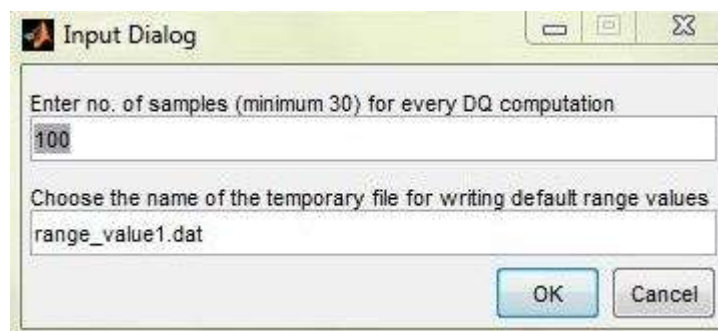
3 DEMO RUN OF FRACTAL ANALYZER

3.1 Multi-fractal analysis of demo data

- 1) To compute the logCr and Dq values for various fractal dimensions, choose a input file. For demo purpose, we are choosing **temp data\region2.dat** file existing in the current folder.

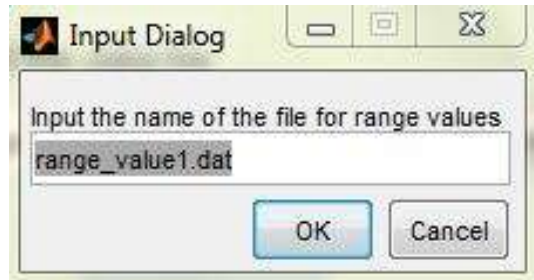


- 2) When the proper input file has been chosen, click on **COMPUTE**. An input dialog will pop up on the screen as shown in the figure below. It asks for two inputs
 - **No. of samples for every DQ computation:** It is the number of data values to be extracted from the input file for one Dq computation. If the input number is **k** and the number of data values in the file is **n**, then the total number of Dq values for a single q will be **floor (n/k) + 1**. This value should not be less than 30.
 - **Name of the temporary file for writing default range values:** It is the temporary file, where the range values for a particular q will be saved.

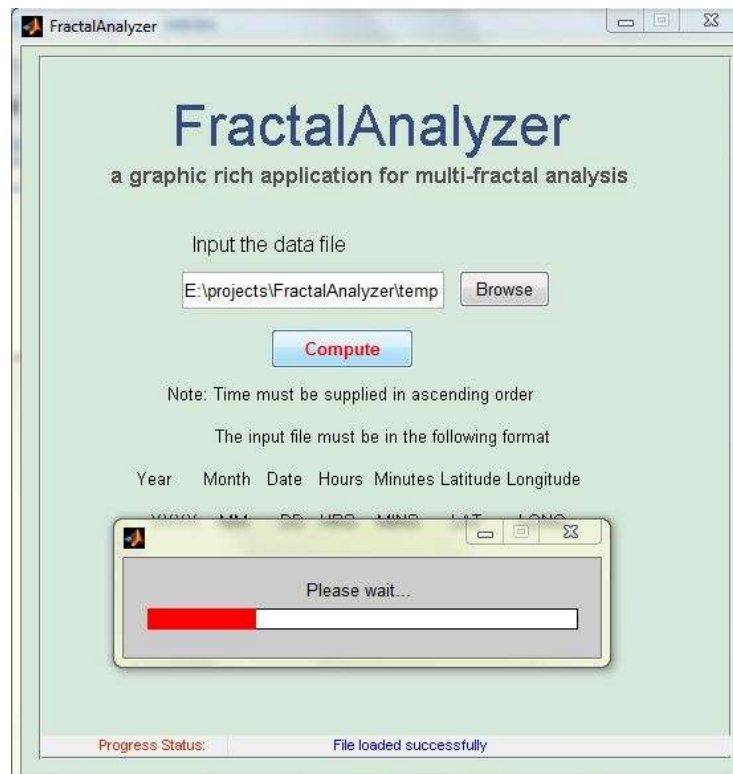


- 3) Once the above two inputs have been supplied, press **OK**. A new input dialog comes over the screen asking for name of the file for range values. Note that if you do not want to use the default range values, go to the temporary file created in the previous step, edit the values and

save it. When a final file with range values is ready, browse it in this dialog and press **OK**. Here, we use the same temporary file with no change.



- 4) The Dq computation starts with a progress bar denoting the status as shown in the figure below. Once the Dq computation is finished, the **Grapher** module will open on the screen.

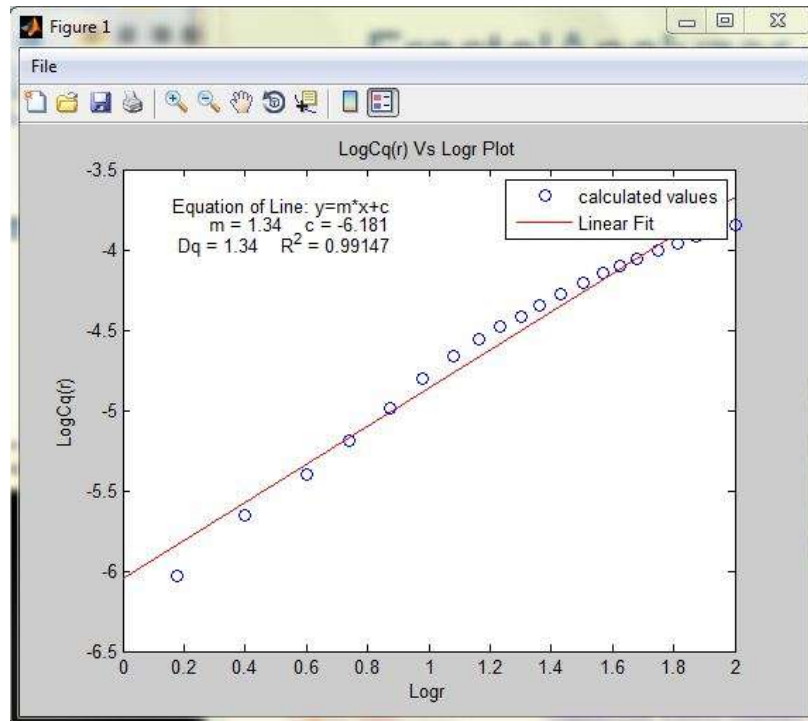


- 5) Though this module seems to run in a single flow, it has been creating the intermediate files at every step. For further details on the intermediate files and output data organization, refer to *Appendix A.1*.

3.2 Generating logCr Vs logr plots

- 1) For generating the plots, open the **Grapher** section of the application and go to the **Log(Cq(r)) Vs Log(r) Plot** section.

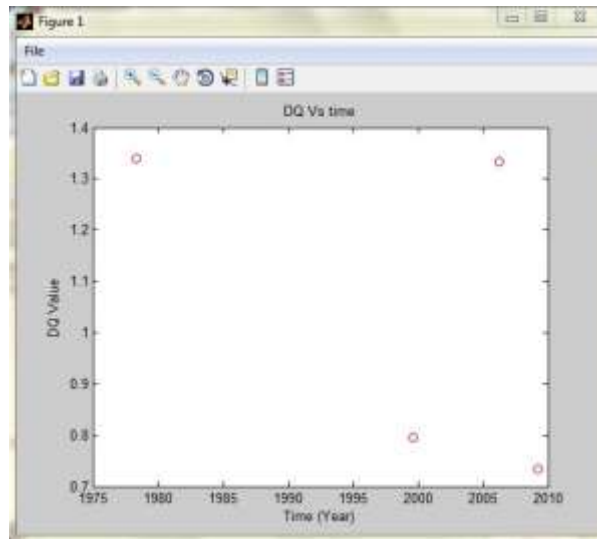
- 2) Choose the data file containing $\log(Cq(r))$ and $\log(r)$ values. If you have generated these files using the application, refer to the *Appendix A.1* to understand the output file organization for this application.
- 3) Once the proper file with .dat extension has been chosen, click on **Plot**. The required plot pops up in the new window as shown in figure below. This window shows the fitting value (R^2) and the slope of the fitted line i.e. Dq value.



- 4) As this plot uses a Matlab figure window, several Matlab operations such as edit, save (multiple formats) etc. can be applied over it.

3.3 Generating Dq Vs Time plots

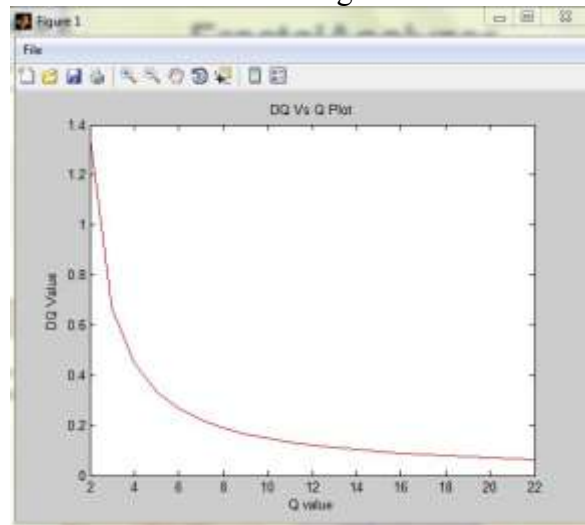
- 1) For generating the plots, open the **Grapher** section of the application and go to the **Dq Vs Time Plot** section.
- 2) Choose the data file containing Dq Vs Time values. If you have generated these files using the application, refer to the *Appendix A.1* to understand the output file organization for this application. Files of this type will be of .dqv extension.
- 3) Once the proper file with .dqv extension has been chosen, click on **Plot**. The required plot pops up in the new window as shown in figure below.



- 4) As this plot uses a Matlab figure window, several Matlab operations such as edit, save (multiple formats) etc. can be applied over it.

3.4 Generating Dq Vs Q plots

- 5) For generating the plots, open the **Grapher** section of the application and go to the **Dq Vs Q Plot** section.
- 6) Choose the data file containing Dq Vs Q values. If you have generated these files using the application, refer to the *Appendix A* to understand the output file organization for this application. Files of this type will be of .dqq extension.
- 7) Once the proper file with .dqq extension has been chosen, click on **Plot**. The required plot pops up in the new window as shown in figure below.



- 8) As this plot uses a Matlab figure window, several Matlab operations such as edit, save (multiple formats) etc. can be applied over it.

APPENDICES

A.1 Output Datafile Organization

This section deals with the organization and storage of the datafiles generated during the computation of Dq values for a given dataset. The application has been directed such a way that the path for the supplied input file for Dq computation will be treated as the current path for the entire output module.

The output files generated at several steps of computation are saved as follows with respect to the current folder:

1. Cropped catalogs: *current folder\log_files_n_1\inputfile_n_1*
current folder\log_files_n_2\inputfile_n_2 and so on.

For the demo data used above, we have assumed the current folder as **temp data** and the number of data values to be used for Dq computation as **100**.

2. Every **log_files** folder contains the various statistics computed for the corresponding dataset which are as follows:
 - I. **range_value1.dat**: Contains the range values to be used for calculating the Heaviside function values for the dataset of the corresponding **log_files** folder
 - II. **heavi.dat**: Stores the Heaviside values computed using the supplied range values.
 - III. **rdist.dat**: Stores the distribution values in ascending order.
 - IV. **DqVs.qdq**: Stores the Dq values for different fractal dimensions for the dataset of the corresponding log folder.
 - V. **correlation** folder: This folder contains the values of **logCq(r) Vs logr** for multiple fractal dimensions for the dataset of the corresponding **log_files** folder.
3. The current folder will also contain a folder named **DQ**, which contains the **Dq Vs Time**