REDFIT-X - USER MANUAL

Cross-spectral analysis of unevenly spaced paleoclimate time series

Version 1.1 (August 2016)

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Olafsdottir, K. B., Schulz, M. and Mudelsee, M. (2016): REDFIT-X: Cross-spectral analysis of unevenly spaced paleoclimate time series. Computers and Geosciences, 91, 11-18.

Installation

The REDFIT-X program can be downloaded from http://www.geo.uni-bremen.de/geomod/staff/mschulz or the Computers & Geosciences site (https://github.com/cageo). The installation requires copying the ZIP-archive into an empty directory and make sure to keep the directory structure when unzipping. The zip file contains the following directories:

`.\bin`	Executable files
`.\src`	Fortran 90 source code
`.\doc`	Documentation
`.\example`	Examples and configuration file

Running REDFIT-X

The software is command line driven and can be run from the Windows command prompt or simply just by double clicking the executable file. After starting REDFIT-X the program asks for a name and path of a configuration file. The simplest way is to have the configuration file in the same directory as the executable file, then there is enough to put in the name of the configuration file. All program options and parameters are set in a configuration file and passed to the REDFIT-X program. An example configuration file redfit-x.cfg can be found in `.\bin`.

Configuration file

The configuration file is in plain text file and can be opened and edited with any text editor. The configuration file contains a Fortran 90 namelist of the form:

```
&cfg
        fnin(1) =  'c:\mydata\x.dat',
        fnin(2) =  'c:\mydata\y.dat',
          fnout =  'REDFIT-X-result',
         x_sign =  F,
         y_sign =  F,
           nsim =  1000,
         mctest =  T,
       mctest_phi=  T,
       rhopre(1) =  -999.0,
       rhopre(2) =  -999.0,
            ofac =  4.0,
           hifac =  1.0,
             n50 =  8,
           alpha =  0.05,
            iwin =  1
\
```

The namelist has to begin with `&cfg` in the first line and end with single slash in the last line. Each line ends with comma (except the first and last lines) and filenames must be enclosed by ' ··· ' or "··· ". The parameters in the namelist are explained below:

`fnin(1)`	Input file name for the 1st time series data
`fnin(2)`	Input file for the 2nd time series data
`fnout`	The results are written to files with this name (plain text files with various file extensions)
`x_sign`	Change the sign of the first time series: if `T`: The sign of the data is changed if `F`: The sign of the data is not changed (default)
`y_sign`	Change the sign of the second time series: if `T`: The sign of the data is changed if `F`: The sign of the data is not changed (default)
`nsim`	Number of Monte Carlo simulations (1000-2000 is recommended)
`mctest`	Estimate the significance of auto and coherency spectrum with Monte Carlo simulations if `T`: perform Monte Carlo simulations if `F` : do not perform Monte Carlo simulations
`mctest_phi`	Estimate Monte Carlo confidence interval for the phase spectrum if `T`: perform Monte Carlo simulations (mctest needs to be true as well) if `F`: do not perform Monte Carlo simulations

`rhopre(1)`	Prescribed value for ρ for the first time series, not used if $\rho < 0$ (default = -999.0)
`rhopre(2)`	Prescribed value for ρ for the second time series, not used if $\rho < 0$ (default = -999.0)
`ofac`	Oversampling value for Lomb-Scargle Fourier transform (typical values: 2.0-4.0)
`hifac`	Maximum frequency to analyse is set to hifac $* f_{\mathrm{Nyq}}$ (default = 1.0)
`n50`	Number of segments with 50% overlap
`alpha`	Significance level (Note: only 0.01, 0.05 [default], or 0.1 are allowed)
`iwin`	Window type used to avoid spectral leakage: 0. Rectangular 1. Welch 2. Hanning 3. Triangular 4. Blackman-Harris

Input Data

The two time series data need to be in two separated data files. The name of the data files are set into the configuration file as `fnin(1)` and `fnin(2)`. The data files should be a plain text file and in the format:

$$\begin{array}{cc} \mathrm{t(1)} & \mathrm{x(1)} \\ \mathrm{t(2)} & \mathrm{x(2)} \\ \vdots & \vdots \\ \mathrm{t(n)} & \mathrm{x(n)} \end{array}$$

The first column contains the sampling times and the second the time-dependent data. The times are geological ages, where t(n) is the highest geological age. If the ages are not in increasing order the program will stop. Comment lines are allowed at the beginning of the data file and should be marked with #.

Output files

The results are written in five different output files `fnout` with various filename extensions:

`fnout.gxx`	Autospectrum for the 1st time series
`fnout.gyy`	Autospectrum for the 2nd time series
`fnout.gxy`	Cross-spectrum
`fnout.cxy`	Coherency spectrum
`fnout.phxy`	Phase spectrum

The output files are saved as plain ASCII files in the same directory as the executable file REDFIT-X.exe. The output files include estimated spectra and estimated uncertainty measurements, both theoretical and Monte Carlo (only if `mctest = T`). The output files do also include the input parameters and estimated parameters used in the spectral estimation, like the τ values and degrees of freedom. The files should be largely self explanatory.