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The IDL Wavelet Workbench

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Abstract. Progress in the development of the 1996 release of the IDL Wavelet Workbench (WWB) is shown. The WWB is now improved in several ways, among them are: (1) a smarter GUI which easily directs the user to the possibilities of the WWB, (2) the inclusion of more wavelets, (3) the enhancement of the input and output modules to provide a better interface to the input and output data and (4) the addition of more analysis methods based on the wavelet transform.

1. Introduction

One of the most advanced packages for wavelet analysis is probably *Wavelab*[1] written for MATLAB. New insights have been gained in many other fields by applying wavelet data analysis, thus it was a reasonable task for us in astronomical research to translate most of the code from the *Wavelab* package into IDL (Interactive Data Language, by Research Systems, Inc.). IDL was chosen because of its wide-spread availability in the astronomical community and because of its development environment. The last official version of the so-called *IDL Wavelet Workbench* (WWB) was in the Spring of 1996. It has been made publicly available at the ftp site of Research Systems, Inc.[2].

2. The 1996 version of IDL

The 1996 version of the WWB consists of 111 different modules with approximately 10,000 lines of code in total. Approximately all modules have been written or translated from MATLAB code into IDL by AG. The 1996 version can be run either from the IDL command line or from a graphical user interface (GUI).

[1] http://stat.stanford.edu/~wavelab/

[2] ftp://ftp.rsinc.com/

The WWB is written in a highly modularized way to be easily maintained and improved. In the 1996 version, COMMON blocks are used to store important variables for the different routines. These COMMON blocks can be set also from the command line. Therefore, it is possible to use the WWB as a stand-alone package and also as a library to supplement ones own IDL routines.

The 1996 WWB provides simple input and output routines. Its analysis and plotting libraries are sophisticated and employ most of the typical methods used in wavelet analysis like the *Discrete Wavelet Transform*, *Multiresolution Analysis*, *Wavelet Packet Analysis*, *Scalegram*, and *Scalogram*. In addition, the 1996 WWB offers typical routines for de-noising and compression of one- and two-dimensional data. The available set of wavelets is restricted up to four important families: the Haar-wavelet and the families of the Daubechies-wavelets, Coiflets, and Symmlets.

3. Current Developments

The 1996 release the IDL WWB has been widely used for different tasks such as pattern detection, time-series analysis and de-noising of data. A lot of useful routines have been added to the WWB since 1996, or they are foreseen to be included.

- The current version makes use of the most recent changes to IDL (version 5.0.2); now WWB uses pointers to handle arbitrary data arrays. Also, the WWB command line interface and the GUI may be used at the same time.

- The GUI has been simplified; now it includes more possibilities, but with an easier interface and a less complicated dialog structure.

- All necessary variables are now kept in two IDL data structures, those variables also may be set from the command line.

- The data input portion of the WWB has been upgraded to handle FITS-files; the output portion of WWB has been upgraded so that one can use the GUI to set PostScript output.

- More analysis routines are now available. In additional to the forward DWT, now the backward DWT (*IWT*) has been included to show possible differences between the original and transformed data. A continuous wavelet transform using the Gauss, Sombrero, and Morlet wavelets has been added also.

- The capabilities for time-series analysis has been greatly enhanced by adding wavelets and routines which improve period detection. For example, a routine has been added for detecting periods in unevenly-sampled time-series, and eleven new wavelet filters are provided.

- The computations can now allow datasets more than 32767 points long.

- Plotting capabilities of the *Scalogram* have been improved.

- For a better understanding of the wavelet transform, a GUI for manipulating specific wavelet coefficients has been included. This greatly improves the learning and analyzing process.

4. Future Plans

There are some future plans for integrating capabilities to analyze multidimensional data and adding additional routines. Suggestions and contributions from the user community are greatly welcome.

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