COMPUTER PROGRAM FOR TIME SERIES REDUCTION AND ANALYSIS

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ABSTRACT. The program package is elaborated which allows to view the whole data set and its parts, to scale, edit and partially reduce. The external programs are connected which allow to compute "running parabolae" fit (Andronov, 1990) and determine the individual extrema. Contrary to majority of similar programs, all determined characteristics are followed by corresponding accuracy estimates. The program is much more faster than the existing more complicated graphic editors.

Key words: Methods – statistical, data reduction

Although exist some scientific graphical programs likewise Sigma Plot, Origin, Grapher and others, for our specific problems often we need rather simple programs for visualization and data reduction. Besides correct mathematical algorithm, the contemporary programming style requests the user–friendly interface either for DOS or for Windows. The demands of fast computing and comfortable interface are satisfied by the programming languages such as Borland Pascal, C++ and Delphi.

Pascal and C++ for DOS simplify the manipulation with memory and other personal computer resources, but have less beautiful interface.

Here we introduce the program, written in the Borland Pascal 7.0 language with using the object–oriented library Turbo Vision 2.0.

The package "Remove&Reduce" is a simple program for time series analysis. Here we can scale and scroll time series image along abscissa or ordinate axes. Also used "cutting of image" options for quick zooming of curves (F3, Alt-F3 keys) for both axes. Zooming by the time axis allows us to see shorter timescale variations, and zooming by Y axis allows us to hide bad points (for which the absolute values of deviations from the "mean" curve are much larger than the values for other points). Such keys as "arrow left" and "arrow right" allow to show the properties of the individual points and to remove the points or reduce them. The interpolating formula to reduce the points is the following:

$$S_{\rm I} = (4 * (S_{\rm I-1} + S_{\rm I+1}) - S_{\rm I-2} - S_{\rm I+2})/6 \qquad (1)$$

which corresponds to a 3–rd order interpolating polynomial.

Also we can smooth the data by using the "running parabolae" fit (Andronov, 1990), and to save results to a file. The "Space" bar calls a "smoothing parameters" dialog, from which we can change the filter half–width and the number of steps of trial times for approximation. After this we fix the changes by pressing "Enter". The example of the results of smoothing are shown in Fig.1 ("F5" key).

For the objects with variations at short time scales (from seconds to minutes) we use the correction of times not to the center of the Sun, but to the barycenter of the Solar system. For computation of the value of correction we have use the spherical trigonometry formulae and the barycentric position expressions for the Earth in the Cartesian coordinates (Soma et al., 1988).

The last requirement which should be satisfied by our program, is the storing to the file the results of processing in an easily readable form. Also the package should support an opportunity of reading any file of results for their visualization and, if it is necessary, must contain some service – transforming work, for example, "cuttings" of parts of a file on time, calculation of various statistical characteristics etc. Now this program is used as a basic one for making other packages for other types of observations.

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Appendix

Operating procedure with the program for processing the ZTSh observations

Part 1. "Simple calculations"

After the loading "ZTSH.EXE" one should choose "Simple calculations".

- Choose the time correction from the current time to U.T.

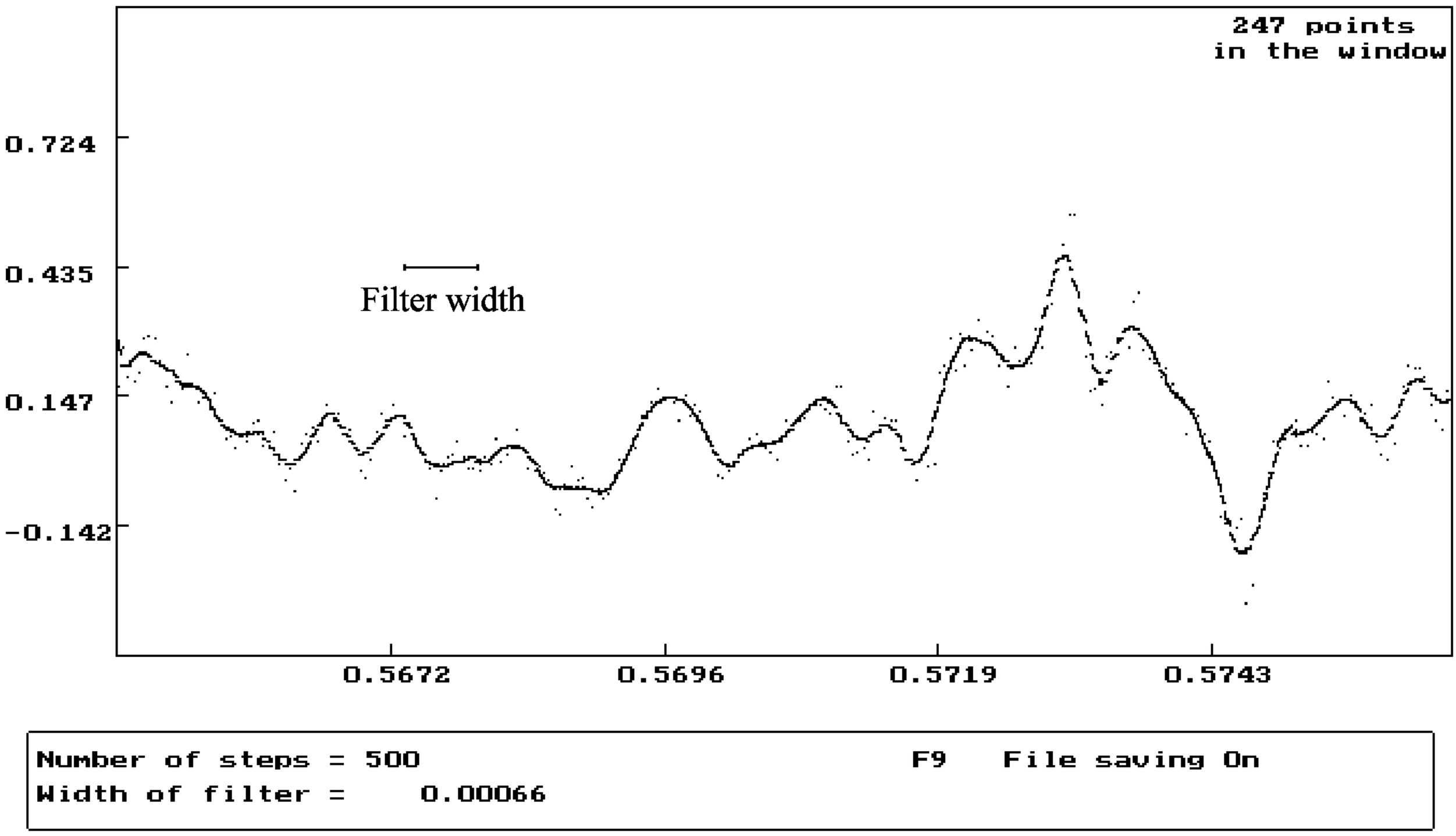

Figure 1: The light curve of AM Herculis obtained on 20.10.1993 by N.M.Shakhovskoy and S.V.Kolesnikov (1993) at the 2.6 Shain telescope at the Crimean Astrophysical Observatory fitted by the "running parabolae" in "Remove & Reduce" package. The abscissa is t=HJD-2449281, the ordinate is $\Delta m = m_{var} - m_{comp}$

- Load files: $(F3)$
- Enter types of objects (background, comparison star, variable star, standard star)
- Bad points:
- Removing of bad points: $(F8)$
- Reduction of a dropping out point \ groups of points: (Insert), then: $(Alt) + (R) \backslash (Alt) + (E)$
  Cancel marking of points: "+" on grey keyboard
- Reduce a background: $(F9)$
- Interpolate a background:
  $("blank"), (F1) \backslash (F2), (Enter), (Alt) + (-)$
- Interpolate a comparison star – " –
- Interpolate calibration – " –
- *Repeat* for the second pair of channels, starting with *reduction* of a *background*.

! Degrees of polynomial are desirable to be the SAME as in the first pair.

- Save the file of the results *.k*: $(F2), (F2)$

Part 2. "Calculations of mean polarization and viewer"

- Establish mode of operations
- Load beforehand calculated files of the standards *.S*: $(F3)$
- For the *linear polarization* indicate "Zero–polarized standard" or "Large–polarized standard" for each of entered standards
- Calculate the corrections P_x, P_y: $(F5)$
- Enter a name of object and it's coordinates from the list: $(F7)$
- Load *.K*: $(F3)$
- Delete superfluous points $(F8)$, so that the number of points in each series was divisible to number of points, on which will be calculated average.
- Calculate the individual mean value:
  $("blank"), (F1) \backslash (F2), (Enter)$
- Determination of the slope of the P_x, P_y diagram: $(F9)$
- Calculate values of polarization: $(F10), (Enter)$
- Recording file *.Z*: $(F2), (F2)$
- Recording file *.P*: $(Alt) + (F2)$

References

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