

# PROGRAMS FOR DATA REDUCTION AND OPTIMIZATION OF THE SYSTEM WORK

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**ABSTRACT.** During last years, some new computer programs were developed. In this article, will be described three of them.

The "Variable Stars Calculator" was developed for processing photometrical observations of variable stars. It helps the observer at each step from converting estimates of brightness into stellar magnitudes to searching a period of changing brightness, PCA analysis, searching extremums by the polynomial approximation etc. The program has Ukrainian, Russian an English interface languages and it is possible to add new ones.

The "PolarObs" was developed for processing polarimetical observations, obtained at the 2.6 Shain telescope in the Crimean astrophysical observatory. It was used either for processing observations of cataclysmic variable stars, or for comets.

"TrayDog" is a system tool for Windows with more than 50 functions. Enhanced Task manager, that can view and edit properties of process, windows, libraries, threads, network ports and opened files. Other functions are: switching between desktops by hot-key, minimize any window to the system tray area, system information, blocking pop-ups of any kind, view and connect network shared resources, alarm clock and many other functions. The interface of the current version is only in Russian.

These and some other programs can be downloaded from the pages <http://uavso.org.ua/breus>, <http://uavso.org.ua/breus>

**Key words:** Software; data reduction; photometric, polarimetric observations; system tools; BY Cam.

## 1. Variable Stars Calculator

The program "Variable Stars Calculator v3 PROF1" is intended for automatic processing of the observations of variable stars and other processes. It has the great set of new functions, useful not only for processing of the observations of variable stars but also for any other processes. It is possible by this program:

- to translate estimates of brightness using the Niyland - Blazhko method into stellar magnitudes,
- to transform the numbers of plates of plate's col-

lection in the Julian dates,

- to calculate the barycentric correction,
  - to calculate a phase curve,
  - to calculate the period of change of brightness,
  - to determine ekstrema of brightness of any star,
  - to calculate differences between the value of signal and the fitting polynomial,
  - to perform the Principal component analysis,
  - to compute partial restoration of signal (filtration),
  - to build any graph,
  - to look over double-channel diagrams.
- the program works as with single channel, as with multicolumn datafiles (five-colour photometry and other).

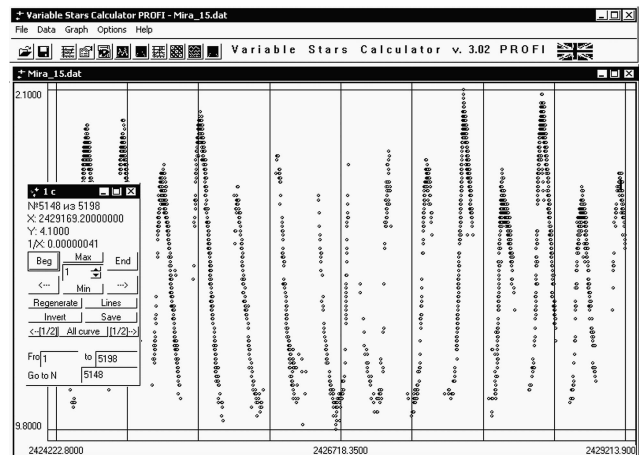


Figure 1: "Variable Stars Calculator": one column mode. A part of the light curve of the Mira (omicron) Ceti from the AFOEV database.

The program is multilingual, 3 languages of interface are currently supported: Ukrainian, Russian and English. Addition of other languages is possible (see chapter "Languages"). The program is published at my Internet page at the site of the Ukrainian association of variable stars observers (UAVSO) <http://uavso.org.ua/breus> and in the internet - catalogues softodrom.ru, softbox.ru, softnew.ru etc. The program works under the OS Windows. However, it may also run under Linux using Wine

(<http://www.wine.org>), e.g. under the Slax Linux (<http://slax.linux-live.org>).

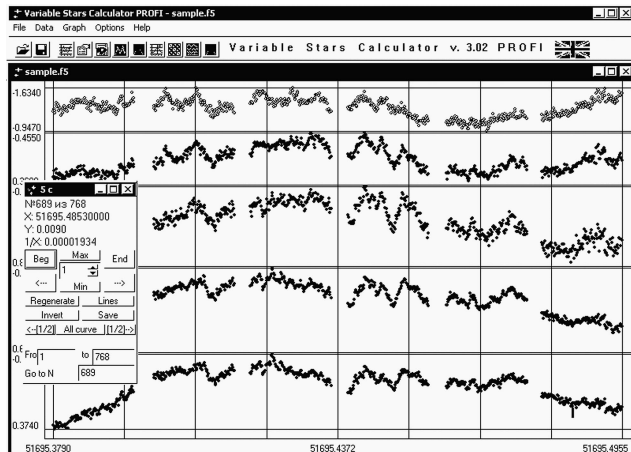


Figure 2: Variable Stars Calculator: UBVR photometry.

#### 1.1. Transformation of estimates of brightness to the stellar magnitudes.

The function is used for reducing visual observations. The Niyland - Blazhko method is optimal for determination of stellar magnitudes of variable stars. It's description is presented e.g. in the monograph by Tsessevich (1980). Using the program, it is possible to convert estimates to stellar magnitudes either from the paper "journal of observations", or from a file. User should enter estimates and magnitudes of comparison stars into the wizard-like dialog box. As a result of these actions, Julian dates (JD) and stellar magnitudes will be added into a data file.

#### 1.2. Transformation of numbers of plates of plate's collection into JD.

The function was made for the observations on photo-plates of 7-camera astrograph of the Odessa astronomical observatory. Using the astrograph database (compiled by A.I.Pikhun), the program reads the file that contains numbers of plates and stellar magnitudes and outputs the file that contents Julian dates and magnitudes.

#### 1.3. Calculation of barycentric correction.

The method is described by Soma et al. (1988). This algorithm was translated into the Delphi programming language. The user can enter the coordinates of the star and the program will apply barycentric correction to the Julian dates in the datafile.

#### 1.4. Calculation of phase curve.

While processing observations of periodic variable star, the user can use the option of calculating the phase curve (dependence of stellar magnitude on a phase), which are much more "dense" than the individual curves, if the interval of observations is much larger than the period (e.g. Tsessevich 1980). The phase curve can be viewed either in the Variable Stars Calculator, or in another viewer that works with ANSI text files.

#### 1.5. Calculation of period of change of brightness

In this program, the periodogram analysis of variable signal is realized using the Lafler-Kinman method. The detailed description of the method and its basic modifications and comparison of their statistical properties, is presented by Andronov and Chinarova (1997).

The periodogram can be viewed either in the Variable Stars Calculator, or in another viewer. Then the user can calculate the phase curves using the periods that correspond to the minimal values of the test-function.

#### 1.6. Viewing of the graphs

The program has one big module for graph drawing that consists of the graph window and panel of navigation, that can be moved. User can set many options. Among them - line connection, viewing some selected columns of the datafile, range files, data reduction, exporting graph as a picture of different format and colors (from black and white to 24bit), viewing double-channel diagrams and many other functions.

#### 1.7. Determination of moments of extremums of brightness using the polynomial approximation

The light curve is approximated by a polynomial (up to degree 10) and the program calculates extremums of the polynomial. All moments of extremums (corresponding to different degrees) are listed in the dialog box and the user can select them and view corresponding polynomial, moment and accuracy estimate.

#### 1.8. The PCA analysis and signal filtering.

This function can be used for multicolumn files. The detailed description of method and it's basic

modifications are described by Andronov (2003). By choosing the corresponding menu item, the user can see on the graph the principal components instead of the light curve. After it, the function of signal filtering will be allowed. In the dialog box, the user can unselect that components, which are suggested as "noise" and then make partial restoration of the signal.

## 2. PolarObs

Cataclysmic variables are observed, particularly, in the Crimean Astrophysical observatory using the 2.6 meter Shain telescope with a new polarimeter constructed by N.M.Shakhovskoy and D.N.Shakhovskoy. It contains of the rotating  $\lambda/4$  phase plate and an immobile analyzer. Data are saved in a file as 8 columns of counts. Processing of observations requires a software which would automatize it. A review on polarimetry is presented in this volume by Kolesnikov (2007). Because of new 2-channel polarimeter with the  $\lambda/4$  phase plate, the use of old software is impossible. Besides, the possibilities of the old program (Shakhovskoy et al. 1998) under MS DOS was limited, as compared with programs under MS Windows. The new program "PolarObs" was developed (Breus et al. 2007).

All data files consist of series of observations. Any series (observations of star, background, comparison star, standard star) have properties - filter and exposure time. When opening the data file, the program automatically determines the type of series, at the same time enabling the user to apply or change it. This style minimizes the number of keys to be pressed.

After opening a data file, the program shows 2 curves - the light curve of object at the top, measurements of background at the bottom of the workspace (for 1 from 8 channels). After smoothing the values of background by a polynomial, the background values are subtracted from the signal separately for all channels. User can smooth the values of the comparison star to determine the stellar brightness of object.

After it, the program calculates linear combinations of counts in channels, hereafter named the "vectors" S1-S4. The first and second vectors determine the circular polarization, and the third and fourth - the linear polarization. After this step, it is possible to save the "P-file", containing as photometry as these vectors.

User can save the "C-file" instead, that contains no photometry. This function was developed for processing polarimetric observations of comets. This file can be viewed later. The next step will be to analyze the diagram of the vectors S2 on S1 and S4 on S3. Under the graphs, there are the values of polarization, position angle and other information.

If user is processing observations of standart of zero or nonzero polarization, these values are a final result.

While processing the star (object), it is possible to

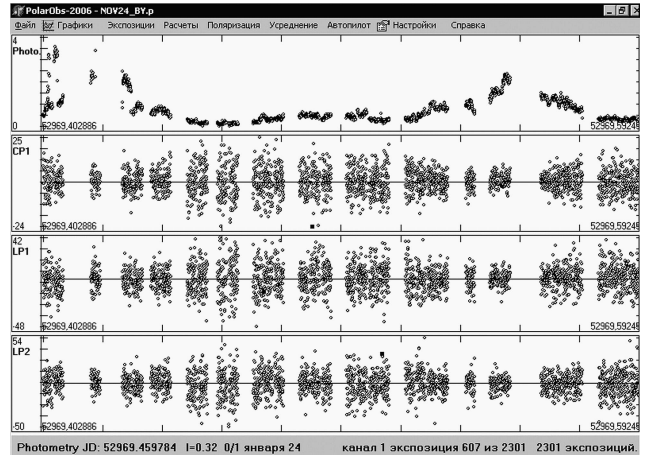


Figure 3: PolarObs: P-file mode (potometry, circular polarization, linear polarization). The observed star - BY Cam.

turn the diagram of circular polarization for adduction of axis connecting 0 and center of distribution to the OX direction and linear polarization to an angle determined for the standard of nonzero linear polarization. It is possible to approximate vectors by a polynomial

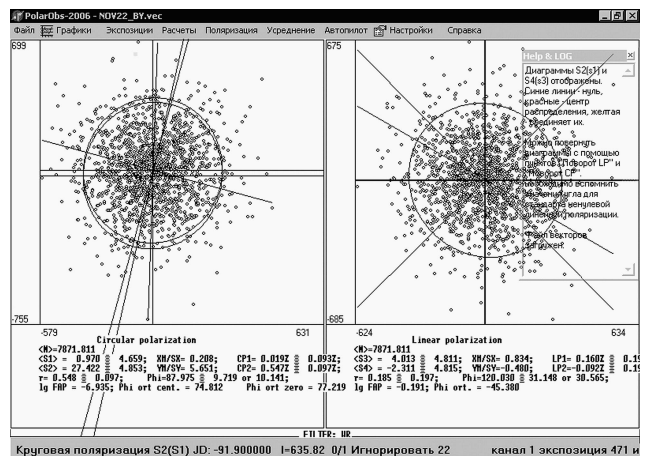


Figure 4: PolarObs: vector diagrams. Observations of BY Cam.

or to determine mean points and their accuracy estimate. To determine the statistically optimal number of points, we use 3 test functions, which are listed in a listbox.

Some modules, like approximation by a polynomial and component for drawing the graphs, which were developed earlier for our program "Variable Stars Calculator", were used in "PolarObs".

Many processes, including search of data files on the user's disk are automated, that make the work easier. The program settings allow to change an interface and some parameters. While processing observations, the user can save files of different format, that can be used

by other software as well. The help is made like a popup transparent window, which also contains all tips and messages.

The program passed the practical tests. Using PolarObs, there were processed observations of different cataclysmic variable stars - AM Her, BY Cam, V1432 Aql, QQ Vul and comets.

### 3. TrayDog

TrayDog is a system tool for OS Windows. It has more than 50 functions. Some brief description of the main functions of the program (full description can be viewed on my web-sites (Breus 2007)).

#### 3.1. Enhanced Task manager

With it user can view all launched processes, change it's priority, kill process etc. It is possible to view the windows of the process, threads, used libraries (dll), the "parent process" (process that launched current one). The network and disk activity of the process can be also viewed. User can see which files and ports are opened by some program. Sometimes it helps to kill wrong-working processes, find computer viruses and for programming purposes like find the classname or handle of some window.

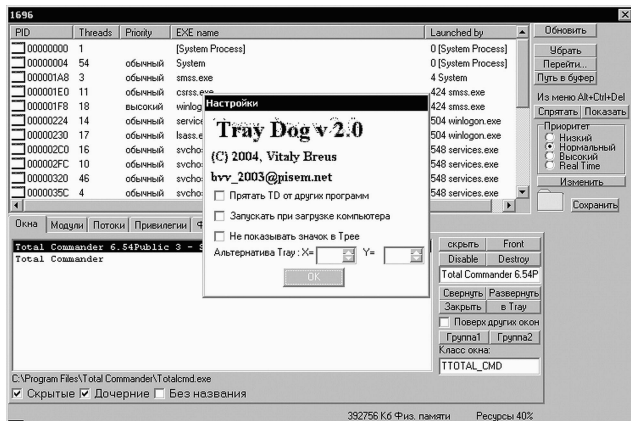


Figure 5: TrayDog: Task manager and options dialog.

#### 3.2. System information

TrayDog doesn't show more system information than a famous products but some functions are rare and it can easy save all information for further comparing. The program shows version and serial number of the operating system, bios version and date, real frequency of the CPU, drive list and file systems, find virtual drives among them, show all dial-up connections with logins, passwords and phone numbers, environment variables etc.

#### 3.3. Other functions

- Switching between desktops by hot-key
- Minimize any window to system tray area
- Blocking pop-ups of any kind, listed in a text file
- Setting folder or drive icons
- Creating virtual drives from any folder
- Disabling system shutdown (used for some installations that can't ask should computer be restarted now or later)
- View and connect network shared resources
- Alarm clock with user specified music file
- Launch up to 20 programs from list by one click, "launch in the past" (for shareware software).
- Hiding any process from other software
- Hiding all desktop icons, some Start-menu items, clock, Start button etc.
- Saving desktop icons positions for further restoring after changing screen resolution or system failure.
- Clearing last documents, URLs, searched files and other history lists
- Changing mouse cursor icons
- Quick launch of Control-Panel applications
- Blocking ANY network access
- Quick IP - Name and Name - IP resolving
- Blocking and opening any CD Drive
- Turning off the monitor
- Turning off the system speaker (Win9x)
- Quick (2-seconds) shutdown (Win9x)
- View kernel driver list (Win9x)

and many other functions. Current version is available only in Russian. Now we develop a new version TrayDog-2007.

A complete list of my programs is available from the WEB site (Breus, 2007).

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