Light Curve Viewer

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Wednesday, December 3, 2025

Preface

Light Curve Viewer (LCV) is ‘a test workbench for different light-curve-related procedures’.

Currently, it implements some methods from:

Andronov, I. L., (Multi-) Frequency Variations of Stars. Some Methods and Results, Odessa Astronomical Publications, vol. 7, p. 49-54 (1994) [1994OAP.....7...49A]

Andronov, I. L., Advanced Time Series Analysis of Generally Irregularly Spaced Signals: Beyond the Oversimplified Methods, Knowledge Discovery in Big Data from Astronomy and Earth Observation, 1st Edition. Edited by Petr Skoda and Fathalrahman Adam. ISBN: 978-0-128-19154-5. Elsevier, 2020, p.191-224 [2020kdbd.book..191A]

System Requirements

The program runs on both Windows and Linux. It has been tested under Windows 7, 10, and 11, as well as Debian 12 and 13, and Linux Mint Cinnamon.

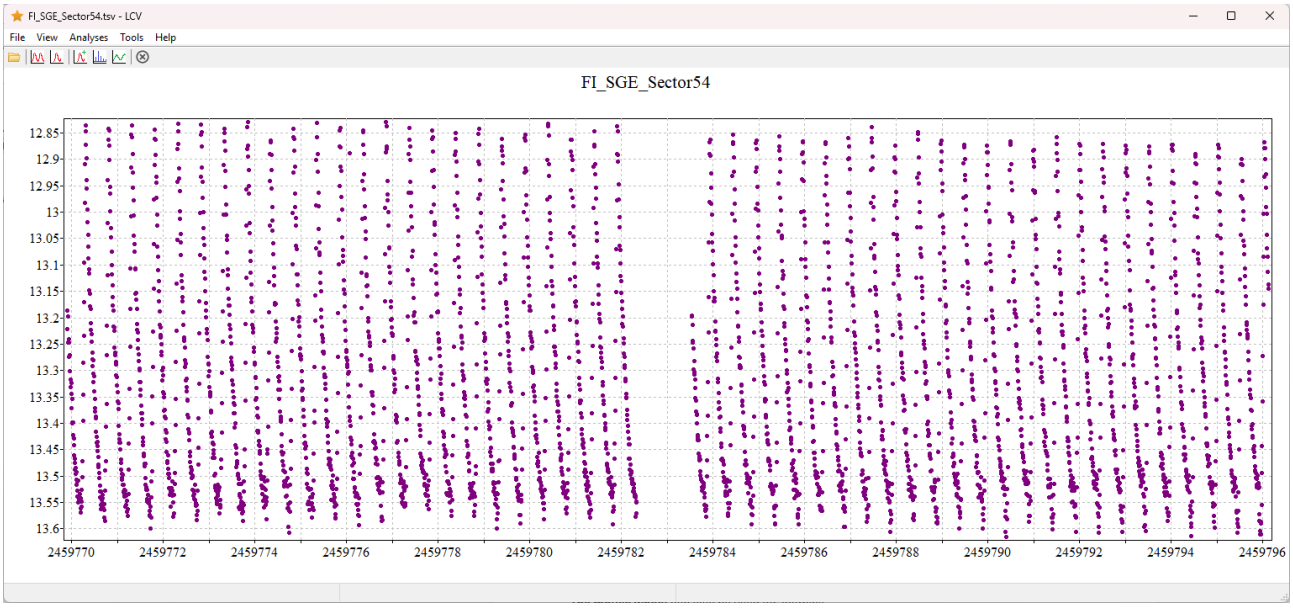
The source files can be compiled using Lazarus/Free Pascal. Testing was performed with Lazarus 3.8 on Linux, Lazarus 4.4 on Windows, and Free Pascal 3.2.2.

The program uses the precompiled libraries lapack_min.dll (Windows) and liblapack_min.so (Linux), which are included in the distribution.

Main program window

The main program window contains a chart showing loaded data. Use File->Open to load data from a text file (see 'Input file format').

After loading, the data is displayed as a 'scatter chart':



Manipulating chart

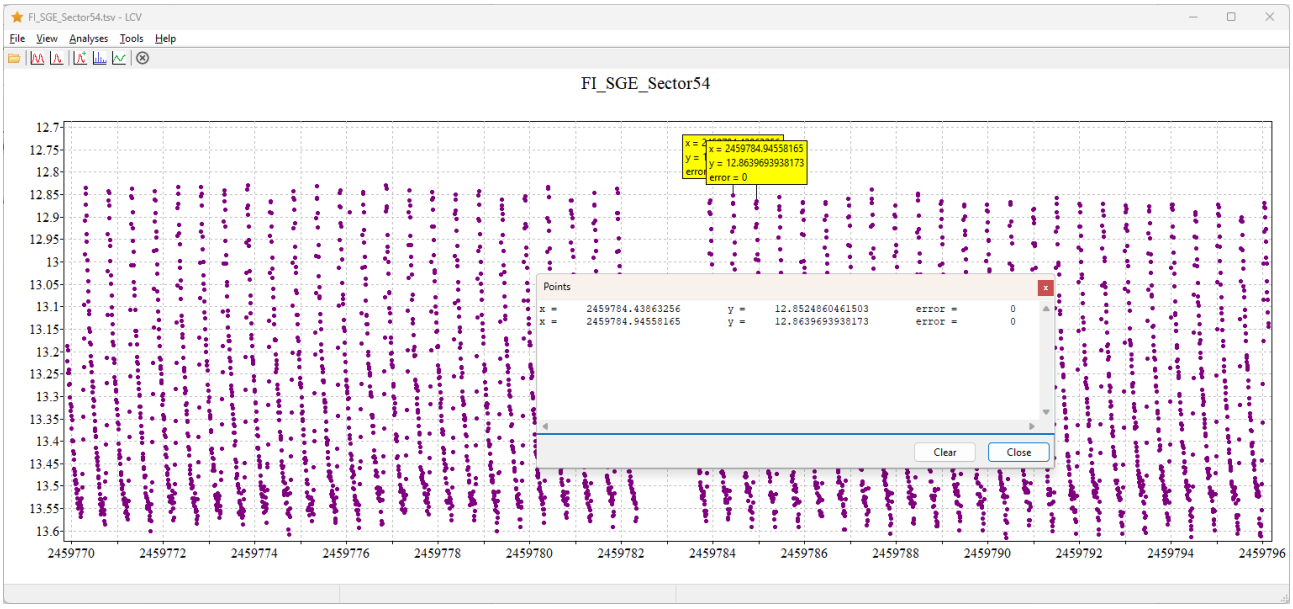
Ctrl + Left Mouse Button Dragging: select a part of the chart (zoom)

Shift + Left Mouse Button Dragging: shift the viewport (panning)

Ctrl + Left Mouse Button Clicking: restore the original view

Left Mouse Button Click on a point: add a label to the clicked point. To remove the label, click the point again.

Ctrl + Shift + Left Mouse Button Click: add a label to the clicked point and show the coordinates in a small window



The mouse wheel can also be used for zooming.

Clicking the right mouse button on the chart opens a pop-up menu with the following functions:

- copy the chart image to the Clipboard
- save the chart image to a PNG file
- set the chart extent

Main Menu

- File

• Open...	Open a data file
• Save a copy of Visible Data As...	Save a copy of the data (currently visible, after zoom) into a data file
• Exit	Close the program

- View

• Raw Data	Plot data as is
• Phase Plot	Plot the active phase plot or calculate a new one
• Cycle-by-cycle color	Plot each cycle in the phase plot in a different color
• Show Data	Display data (observations)
• Show Errors	Display error bars
• Show Model	Display the current approximation and its error corridor
• Inverted Y Axis	If checked, the Y axis is inverted
• Chart Properties...	Open the Chart Properties dialog
• Chart Extent...	Set the chart extent
• Show Observations...	Display data in a tabular form

- Analyses

• Phase Plot	Calculate a new phase plot
• Periodogram...	Open a dialog with the periodogram parameters
• Polynomial Approximation...	Open a dialog with the parameters of the polynomial (algebraic + trigonometric) approximation
• Approximation Info...	Display information about the current approximation
• Detrend	Subtract the approximation from the data
• Detrend Alg. Polynomial Only	Subtract the algebraic part of the approximation only

- Tools

• Magnitude Shift	Add a value to the magnitudes (Y-values)
• Descriptive Statistics	Show some data statistics
• Options	Tune the program settings

- Help

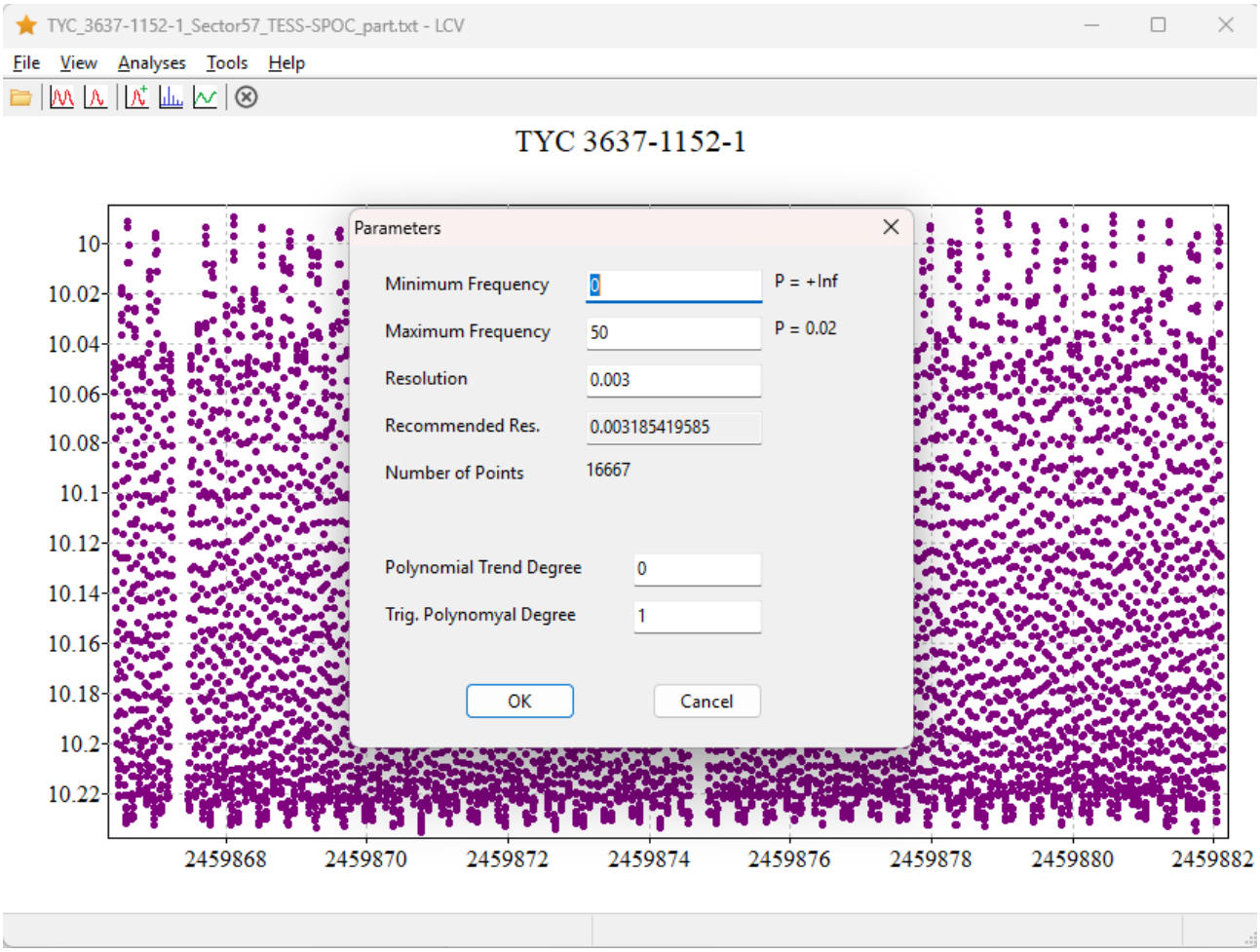
• User Manual Online...	Open the manual in the system web browser (from GitHub)
• User Manual (Local)...	Open the manual in the PDF viewer (from the local program's directory)
• About	

Periodogram

The periodogram analysis can be invoked via the menu command or by clicking the corresponding toolbar button.

In the example below, the file “TYC_3637-1152-1_Sector57_TESS-SPOC_part.txt” from the “lcv_testdata” folder is used.

If a data file is loaded, the “Periodogram” tool button and the “Analyses->Periodogram…” menu item become active. After clicking either, the following dialog appears:



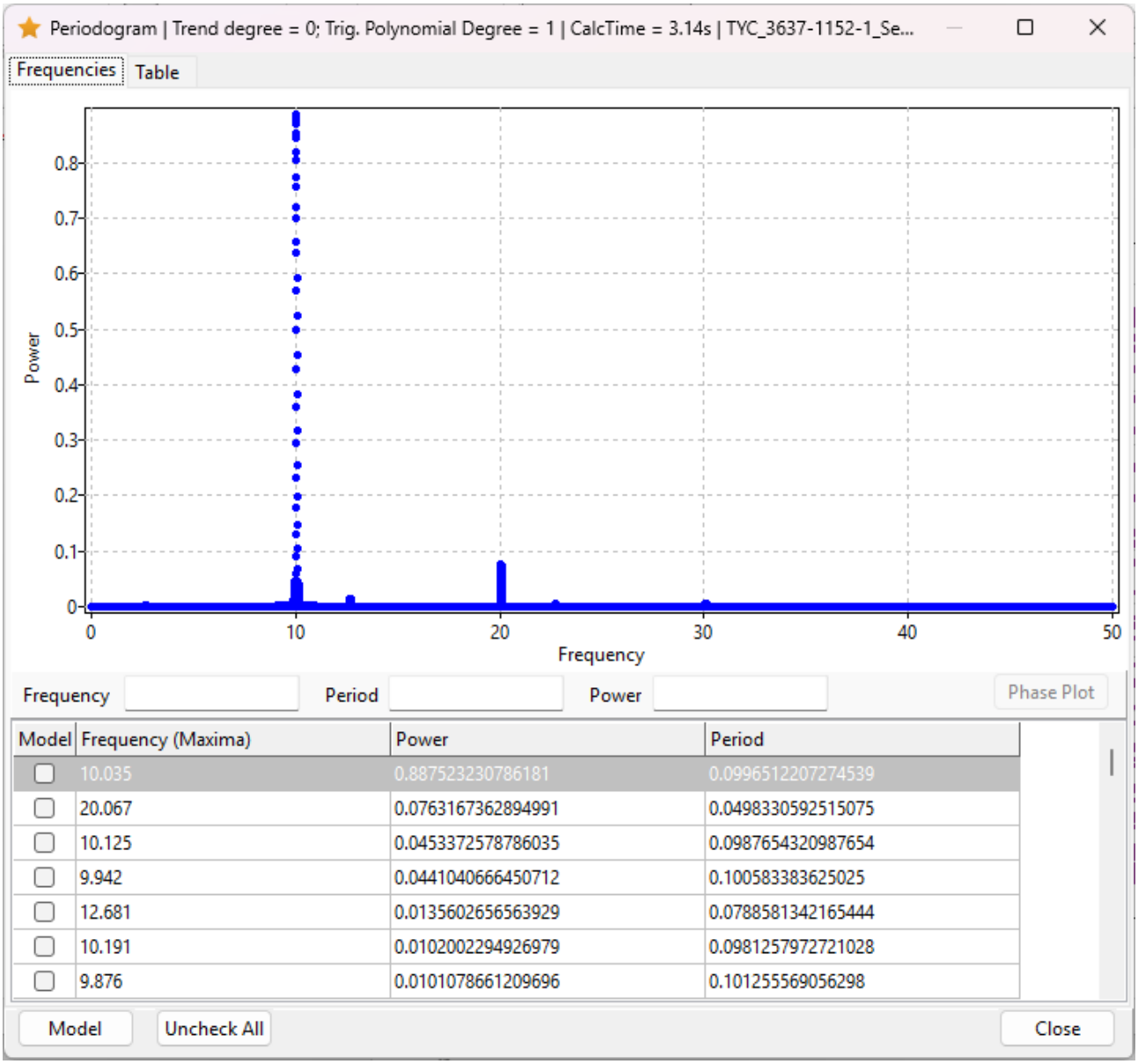
The user must specify the low and high frequency bounds as well as the resolution. Optionally, the degree of the polynomial trend can be defined; this trend is taken into account during periodogram calculation and suppresses near-zero frequencies that may arise if the input data contain a trend. If a trigonometric polynomial degree greater than 1 is specified, the analysis fits the corresponding trigonometric polynomial (a sinusoid with its harmonics) rather than a simple sinusoidal function at each test frequency (see the “Multi-harmonic fit” section in https://ui.adsabs.harvard.edu/abs/1994OAP.....7...49A/abstract for more information). Finally, click OK to start the analysis.

The analysis fits a sinusoidal function (or, if the trigonometric polynomial degree is greater than 1, a sinusoid with harmonics) for each test frequency. For each frequency, the following statistic is then calculated:

$$S(f) = 1 - \frac{\sigma_{O-C}^2}{\sigma_O^2}$$

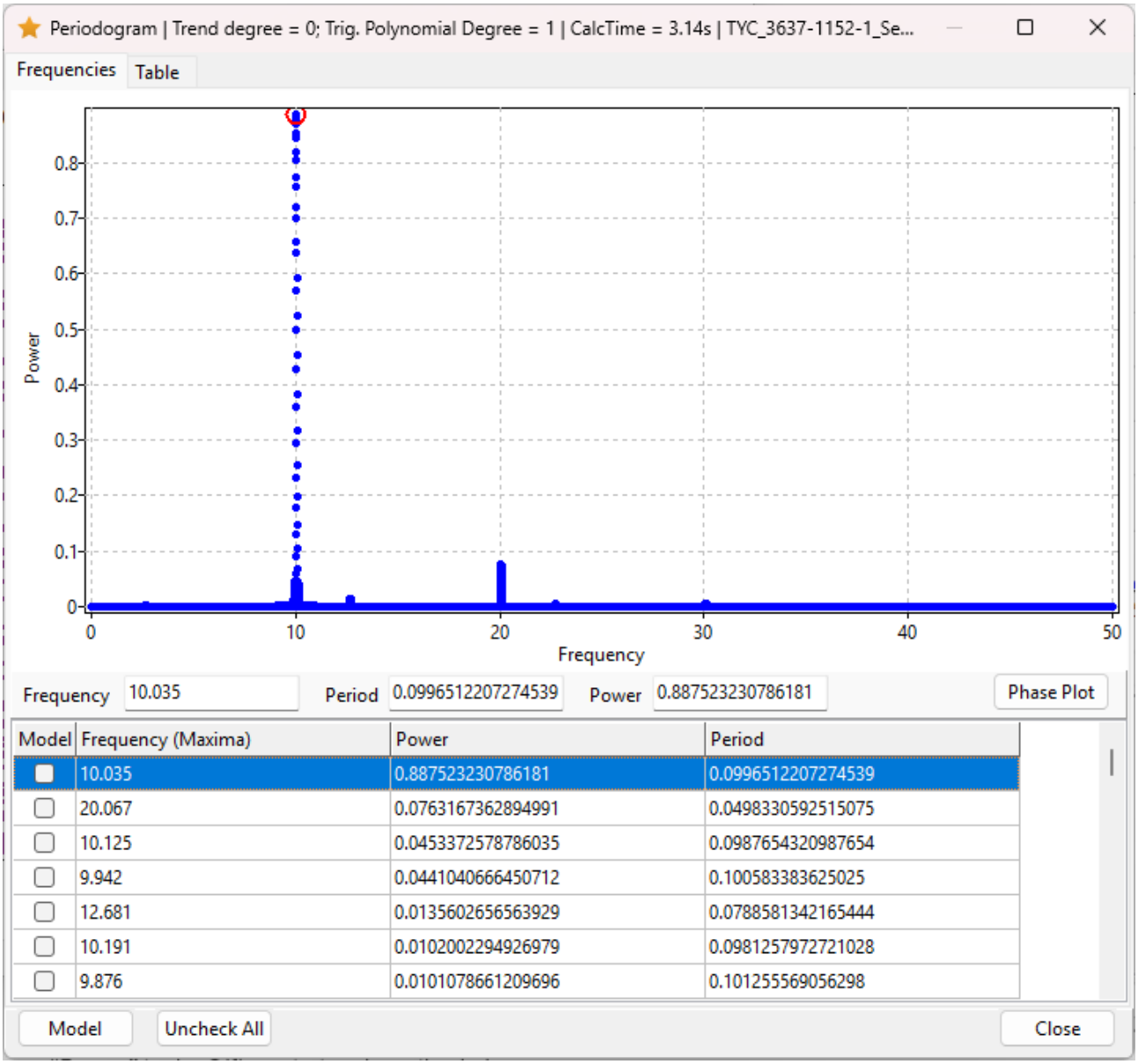
where σ_O is the r.m.s. deviation of the observed magnitudes from the mean value; σ^2_{O-C} is the r.m.s. deviation of the observed magnitudes from calculated ones (see https://ui.adsabs.harvard.edu/abs/1994OAP.....7...49A/abstract for details). Note that, in its simplest form, the periodogram calculated in this way is equivalent to the Ferraz-Mello DC DFT (the "power" in the Ferraz-Mello periodogram is the statistic S(f) multiplied by the factor $(n-1)/2$, where n is the number of observations).

When the process is complete, the following dialog appears:



"Power" corresponds to the statistic S(f) described above.

The table below the chart lists the periodogram maxima in descending order. Clicking an item in the table highlights the corresponding maximum in the chart:



In turn, clicking a point in the chart highlights the nearest maximum in the table. If the selected point does not exactly correspond to a maximum, the table item is grayed. To select the exact position, click the table entry directly. The keyboard and mouse functions for zooming and panning the plot are similar to those described in the Manipulating Chart section.

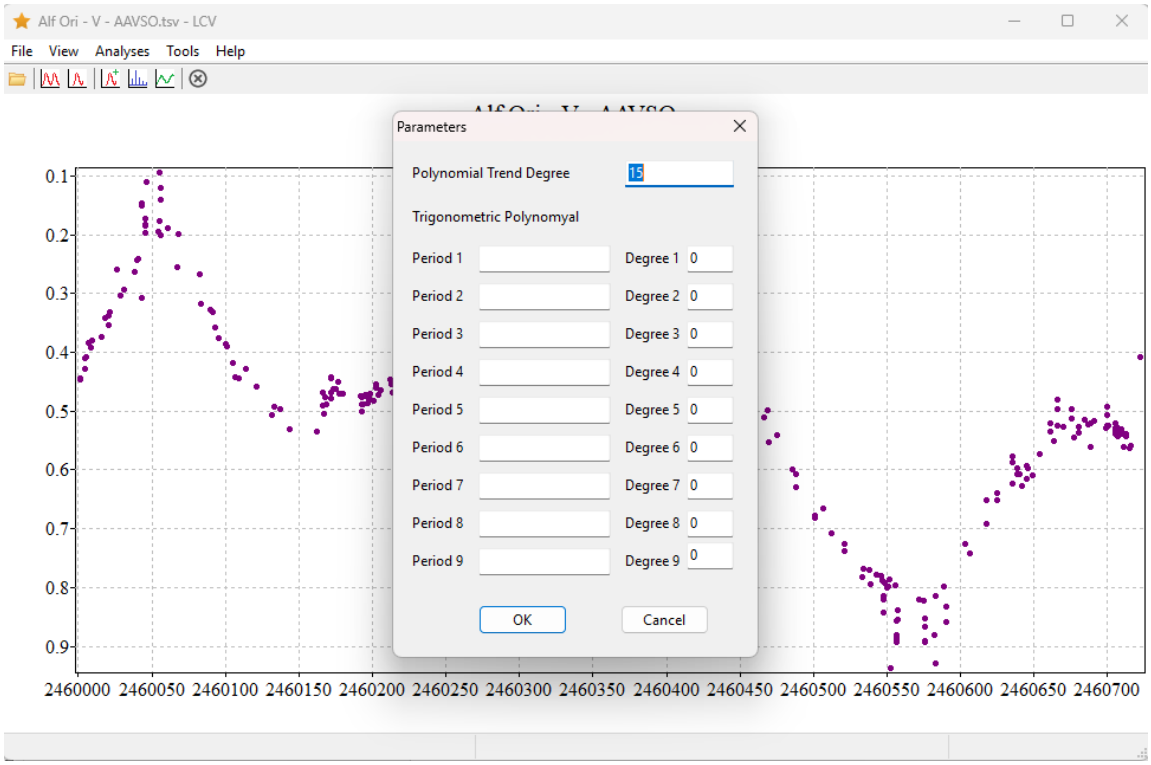
The [Phase Plot] button opens the Phase Plot dialog for the highlighted period.

The user can select one or more frequencies (in the “Model” column) and click the [Model] button. The Polynomial Fit dialog then opens, prepopulated with the selected periods.

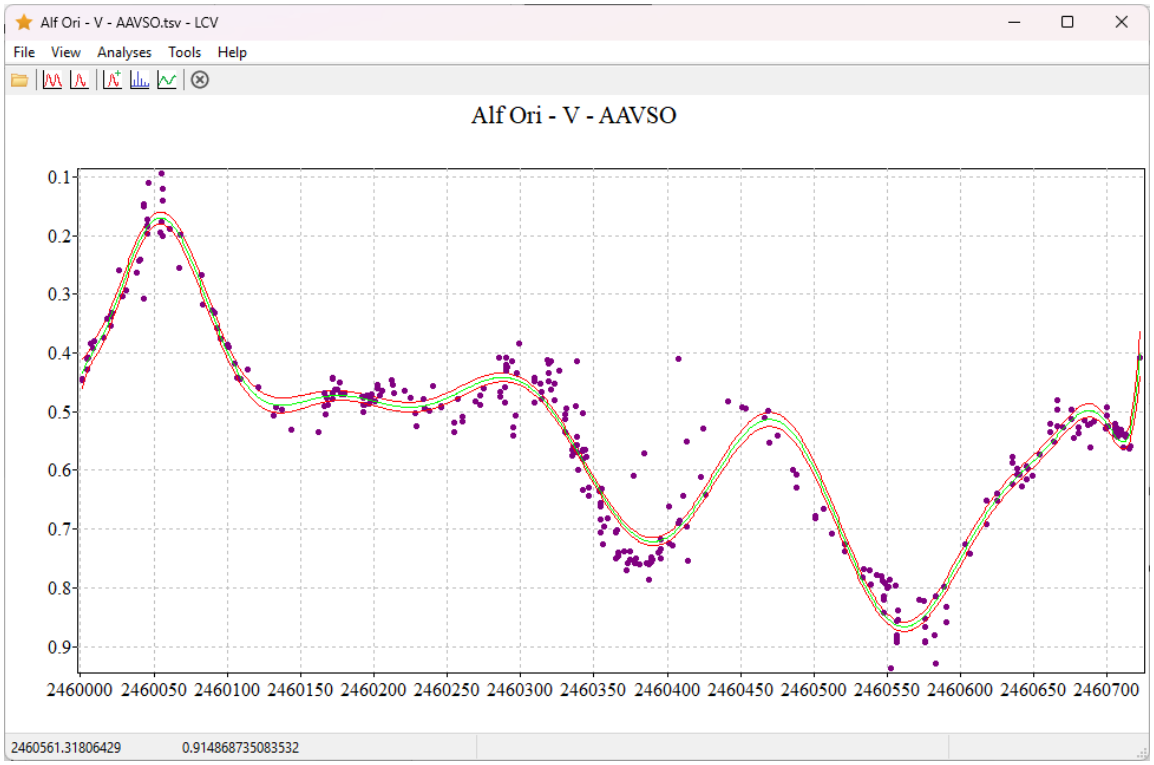
Polynomial approximation

The Polynomial Approximation analysis is invoked by clicking either the Analyses->Polynomial Approximation... menu item or the corresponding toolbar button.

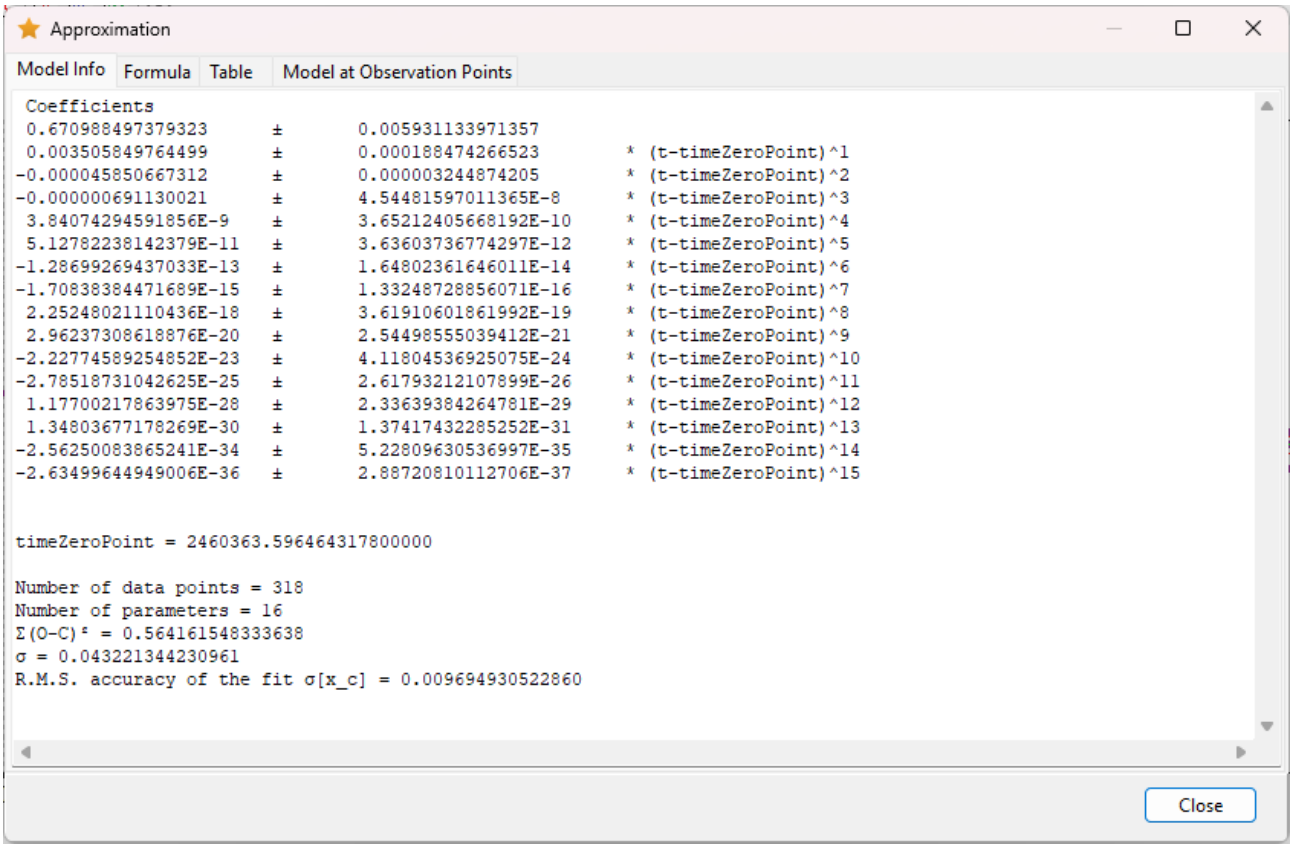
The approximation fits a combination of an algebraic polynomial with the trigonometric ones. To fit a pure algebraic polynomial, specify the polynomial trend degree and set all periods to zero (or set degrees corresponding to each period to zero):



Then press OK. The polynomial approximation, together with its error corridor, will be displayed:

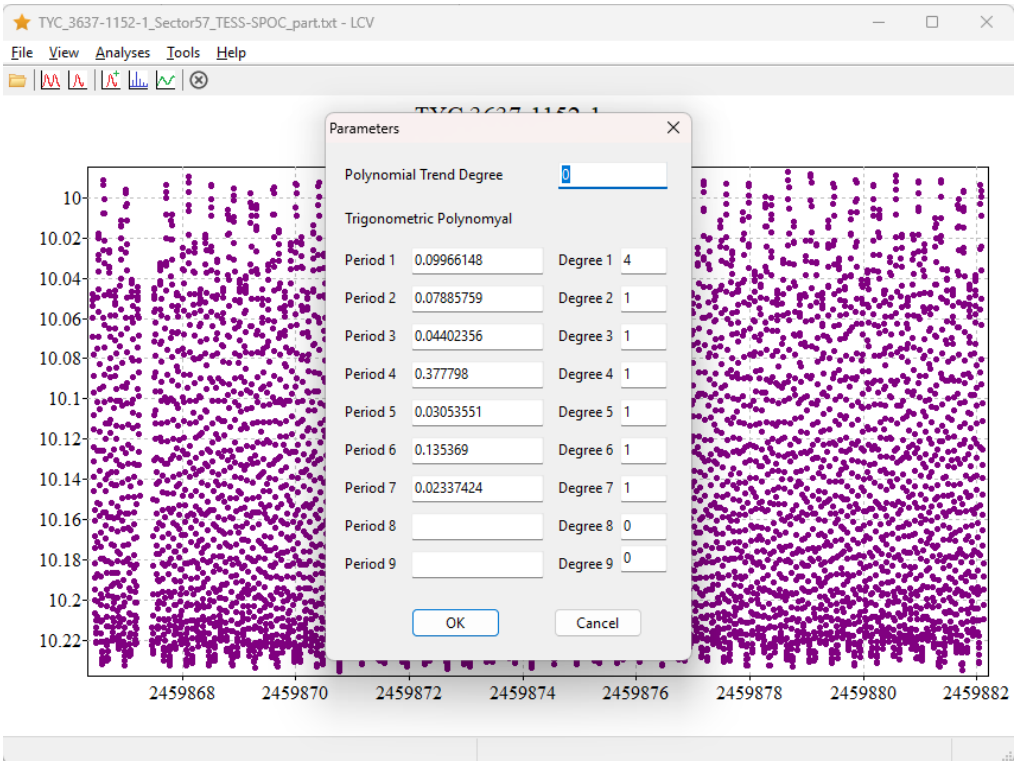


Use the Analyses->Approximation Info... menu item to see the approximation details:

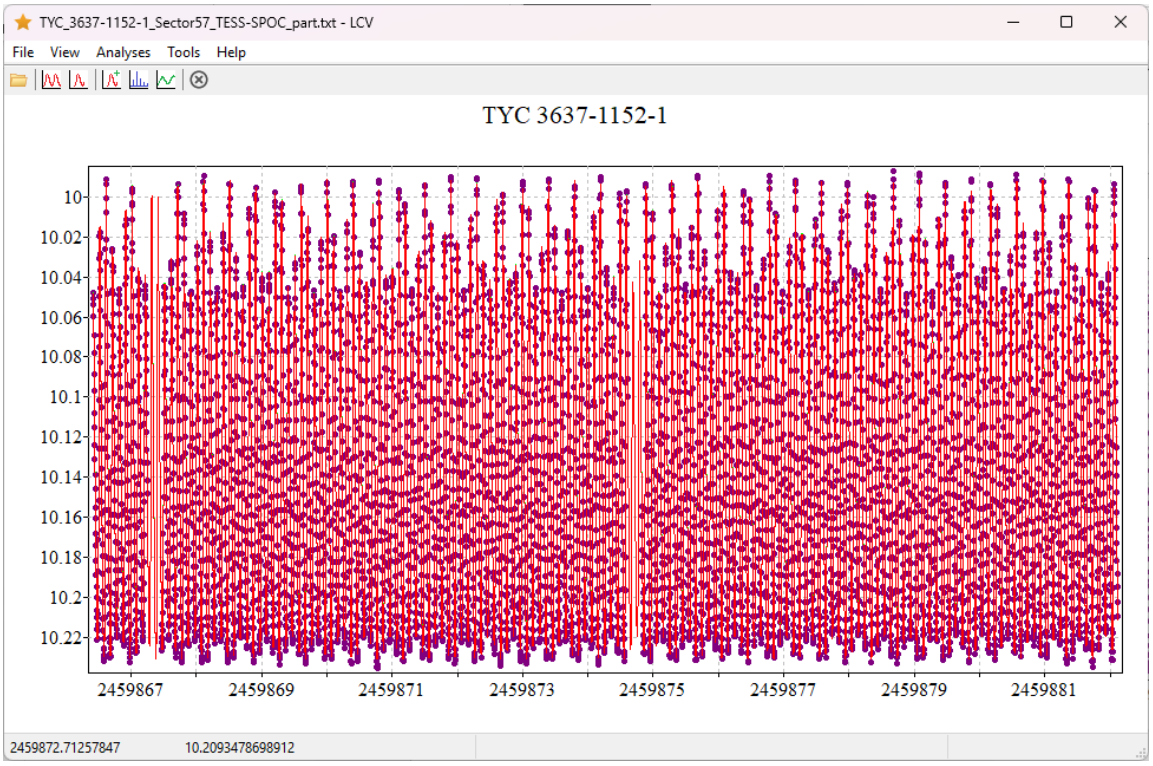


An approximation using trigonometric polynomials (with or without an additional algebraic component) is also available. The user may specify up to nine independent periods. For each period, a number of harmonics can also be defined. If the number of harmonics is set to zero, that period is ignored

In the example below, the file “TYC_3637-1152-1_Sector57_TESS-SPOC_part.txt” from the “lcv_testdata” folder is used.



Click OK to calculate and display the approximation together with its error corridor.



Details of the approximation are available through Analyses->Approximation Info...

Input file format

After installation, you can find example files in the **Documents\lcv_testdata** folder.

Text files with data must contain at least two columns, separated by spaces or tabs. If the columns are separated by tabs, each tab is considered one separator (spaces in this case are ignored). If the columns are separated by spaces, repeating spaces are considered one separator; leading spaces are ignored.

Lines starting with the '#' sign are ignored, as are empty lines.

The first column must contain X-values (i.e., dates) and the second – Y values (i.e., magnitudes or fluxes). The third column must contain Y-errors (uncertainties) if it is present. All other columns are ignored.