

Pyro-Shock Offset-Correction Program Manual
Strether Smith
strether.smith@gmail.com
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Introduction

This program reads a “CSV” data file, displays the data, and provides tools to correct shock-offset errors.

It runs on PCs that:

- Have pretty significant memory and compute power.
- That do not already have LabVIEW running on it.

An example data file: “Shock Example All.CSV” is provided. It is data from the test series described in http://www.pcb.com/ContentStore/MktgContent/WhitePapers/WPL_60_Pyroshock.pdf. The file includes all of the data channels acquired.

Installation

1. Create a directory: C:/SSC/ (that way we will have a clue where stuff is winding up).
2. Make a subdirectory: C:/SSC/Installer
3. Download the installation files into C:/SSC/Installer
4. Download the data file to C:/SSC
5. In the installer directory, run Setup.exe. (*Have patience... it may look dead for a while before doing anything useful*).
6. The program "Shock Correction" will appear in the start menu.

The Data File

The program is designed to analyze Excel-compatible “.CSV” files of the form shown in Figure 1

File "Channel"	1	2	3	4	5	6	7	8	9	10	11	
Time	Sample Nu	T2-Ch1	T2-Ch2	T2-Ch3 (Sa	T2-Ch6	T2-Ch7	T2 Ch9 (Pl	t2-Ch10	T2-Ch12	T2-Ch13	T2-Ch14	T2-Ch15
0	1	-7.48E-01	#####	2.16E+00	-5.46E-01	#####	4.85E+01	#####	#####	6.76E+00	2.46E-01	1.19E+01
8.33E-07	2	1.10E-01	#####	1.31E+00	1.17E+00	#####	4.79E+01	#####	#####	6.55E+00	3.19E-02	1.10E+01
1.67E-06	3	#####	#####	#####	1.38E+00	#####	4.30E+01	#####	#####	2.91E+00	#####	7.56E+00
0.0000025	4	#####	-7.48E-01	-8.36E-01	#####	#####	4.55E+01	#####	#####	4.19E+00	#####	8.20E+00
3.33E-06	5	#####	#####	6.64E-01	#####	#####	4.96E+01	#####	#####	4.62E+00	#####	1.10E+01
4.17E-06	6	3.24E-01	#####	3.24E+00	-9.75E-01	#####	5.35E+01	#####	#####	6.76E+00	2.46E-01	1.16E+01

Figure 1: CSV Data File

The file may contain:

- A header of any length. It does not contain any information that is used by the program.
- A row of Channel Labels: In this case, Row 16.
- A Time Column that optionally can be used to determine the sample rate: Column 1, in this case.
- The data, in columns starting, in this case, with Row 17/Column 3.

The location of this information will be specified in the program setup header.

Running the Program

- Navigate to the Start Menu and select “Shock Correction”.
- The opening page (Figure 2) will appear.

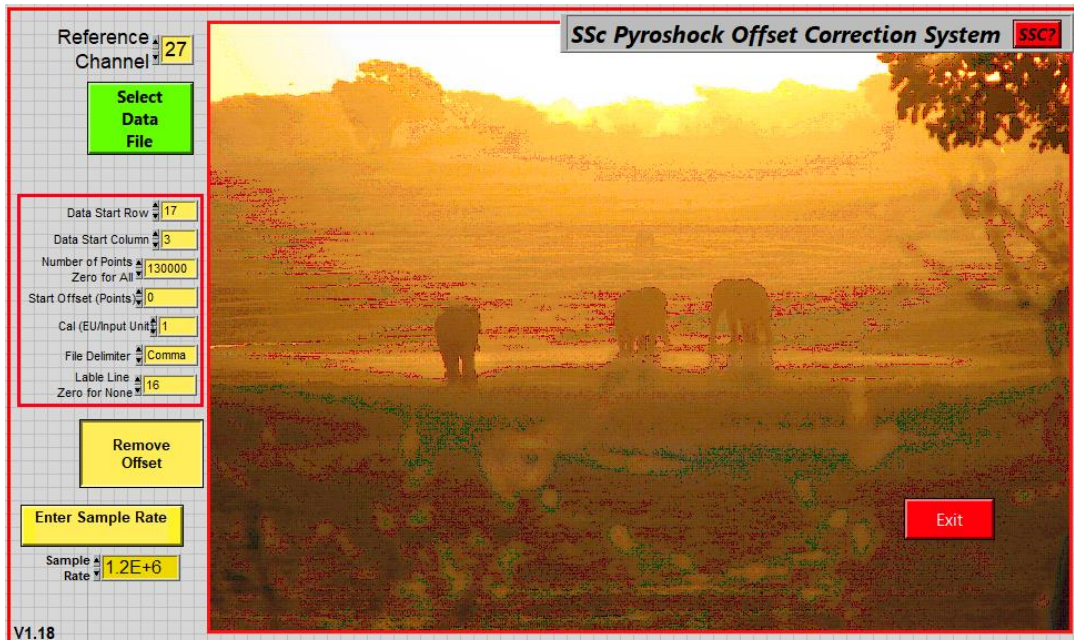


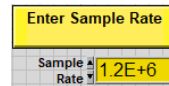
Figure 2: Opening Page

- The data file access controls are on the left.
 - **Reference Channel:** The channel that will be used to select the time range of the analysis. It defaults to 27 (for reasons to be discussed later) but any channel in the file can be chosen.
 - **Data Start Row:** The first line of data in the file (17 in the case of the example file).
 - **Data Start Column:** The column of the first channel in the file (3 in the case of the example file).
 - **Number of Points:** The number of points to be retrieved for the initial data-range selection. Entry of 0 will retrieve the whole file.
 - **Start Offset Points:** The number of points to skip before selecting the data range. (Use 0 for the example data file.)
 - **Cal EU/Input Unit:** Input-scale multiplier. If you want to change scaling from "G" to "KG" the entry would be .001. Note: Internal scaling assumes Gs and in/sec. (Comment: leave it a 1 for this version.)
 - **File Delimiter:** Allows use of data files with different delimiters. Options include comma (default), tab, and space(s).
 - **Label Line:** The line in the file that contains channel labels. Enter 0 for none. (Use 16 for the example data file.)

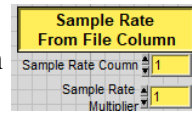
The “**Remove Offset**” control enables the subtraction of the mean of the shock precursor to be subtracted. The time range of the averaging process will be set later.

The sample rate can be set by entry or by calculation from a time record in the file.

To enter the sample rate directly (recommended), select:



To have the system calculate the sample rate, select:



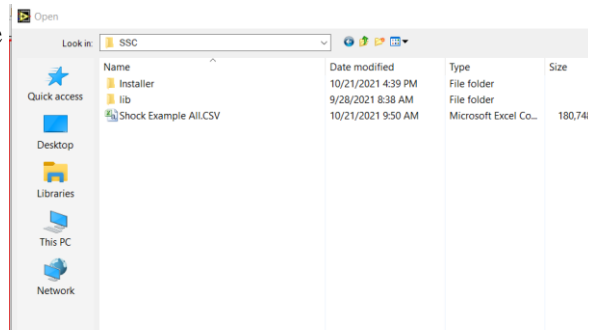
Note: Passing the cursor over a control will briefly bring up a short description. If the tip includes “RtClick for More” press the right mouse button to bring up more information.

If the time record is in units other than seconds, enter an appropriate multiplier. Example: .001 for a time record in milliseconds.

When the parameters are correctly set, press:



The file-selection window opens. Navigate to the data-file directory (C:/SSC) and select the desired file (Shock Example ALL.CSV).



After a short period to read the file, the time history for the channel selected in the Reference Channel control will be plotted.

Three cursors are available:

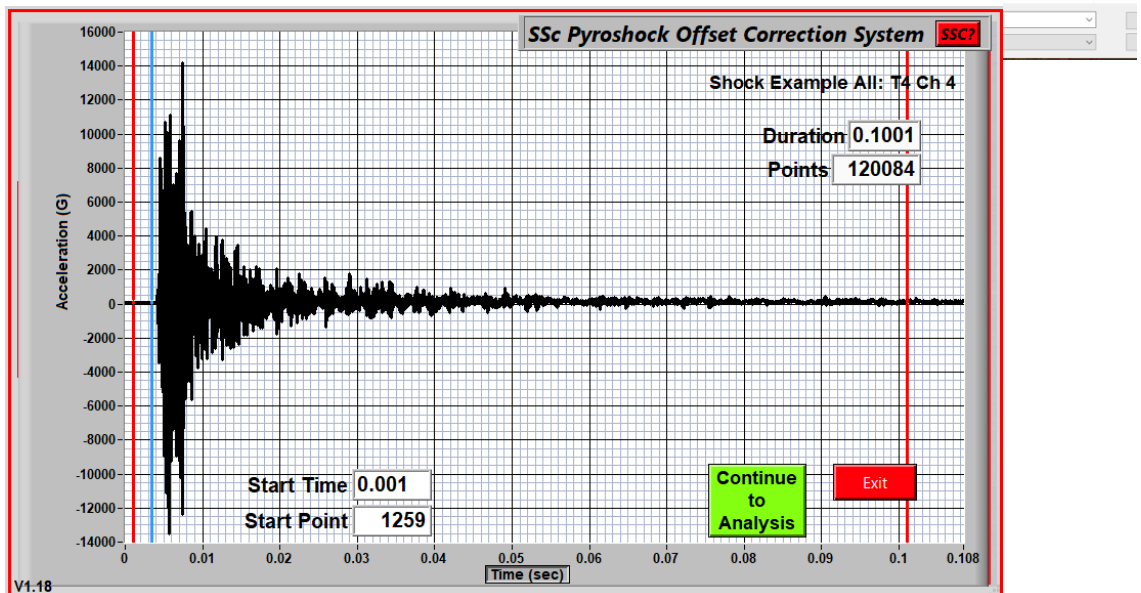


Figure 4: Data Time Range Selection

- The two red cursors select the time range for further analysis. It is suggested that a short precursor be chosen and, for this data set, about 0.025 second duration is appropriate.
- If “Remove Offset” has been enabled, the average of the data from time 0 to the blue cursor will be subtracted from the full time histories. The cursor should be set to just before the transient begins.

toggling the **Time(Sec)/Points** button switches the horizontal axis from Time to Points.

When the time ranges are properly set, press Continue to Analysis

The analysis/correction page for the channel selected earlier will appear:

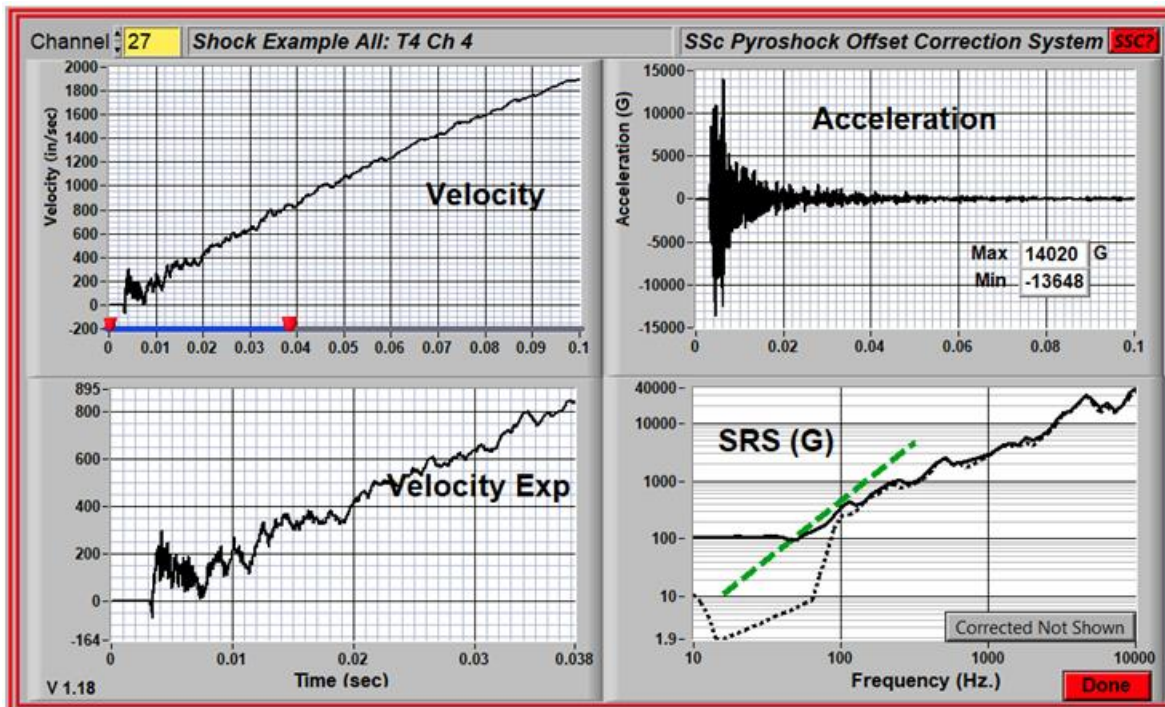


Figure 5 The Analysis/Correction Window

The frames are:

- Upper right is the measured acceleration.
- Upper left is the calculated velocity. It can be seen that it is increasing rapidly. *This must be an error because the test specimen is still in the room.*
- Lower left is an expanded view of the early part of the shock. The dynamics are more easily seen here.
- The lower right is the shock response spectrum (SRS).
 - The solid line is the positive spectrum.
 - The dotted curve is the negative SRS.

The positive and negative SRS responses should be nearly identical. This is obviously not the case below 100 Hz.

The slope of the SRS below the frequency of the lowest structural mode should be 12dB/Octave (Green Dashed Line).

This criterion is also failed.

Pressing the button will bring up the “correction tools” and the “corrected” results,

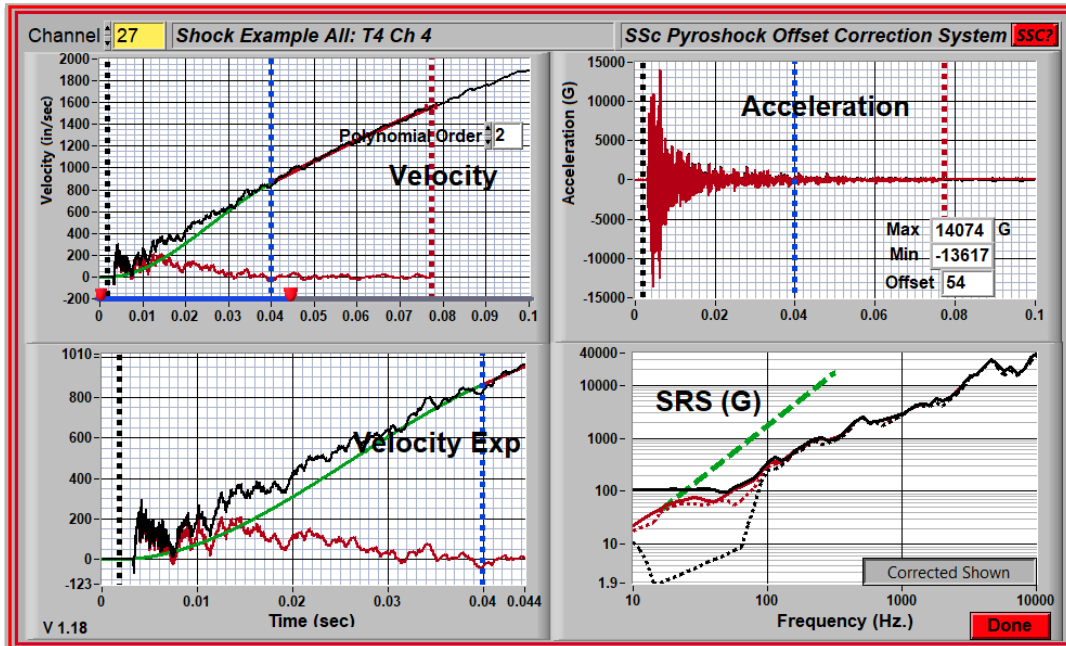


Figure 6: The Analysis/Correction Page (Correction Tools and Results)

shown in Red.

The velocity error is approximated with three segments:

- Zero between zero time and the black cursor (black curve).
- A polynomial between the blue and red cursor (red curve).
- A cubic spline to join the two (green curve).

The corrected acceleration is calculated over the time range below the red cursor where the velocity has been corrected. This is normally less than the full time history and may effect the SRS results.

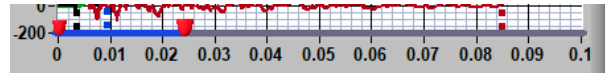
The velocity-error estimate is subtracted from the measured velocity, the result is differentiated to acceleration, and the SRS is calculated.

The results are shown with the Red traces.

The range of the segments is selected with the cursors. They can be adjusted in either of the velocity plots.

The Degree of the Polynomial is set with the **Polynomial Order 2** control. Second Order is almost always the best choice.

The range of the Expanded Velocity Plot can be adjusted with the slider control at the base of the Velocity Plot.



Appropriate adjustment of the cursors produces:

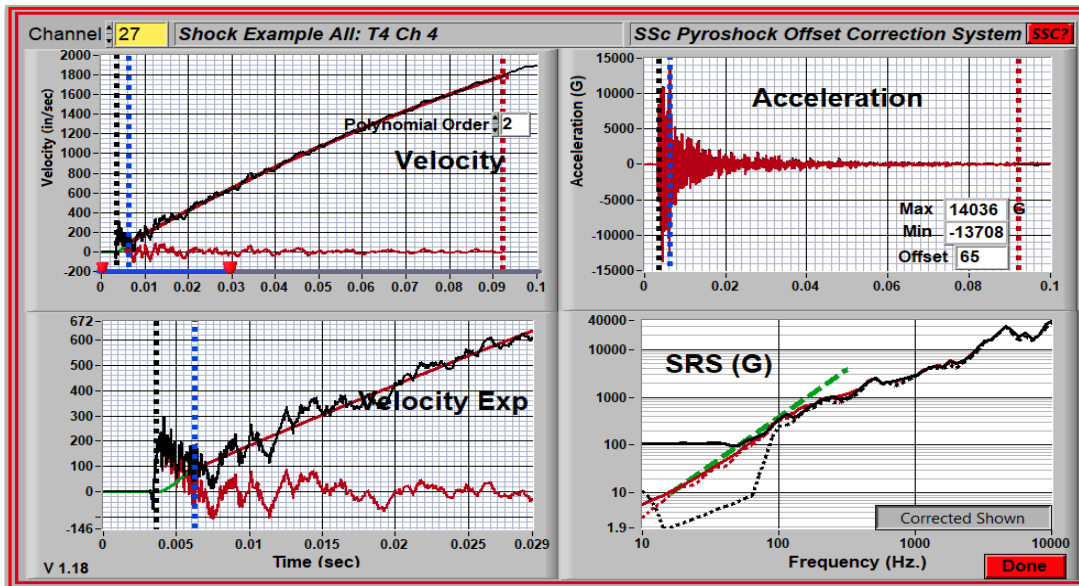


Figure 7 "Corrected" Results

It can be seen that:

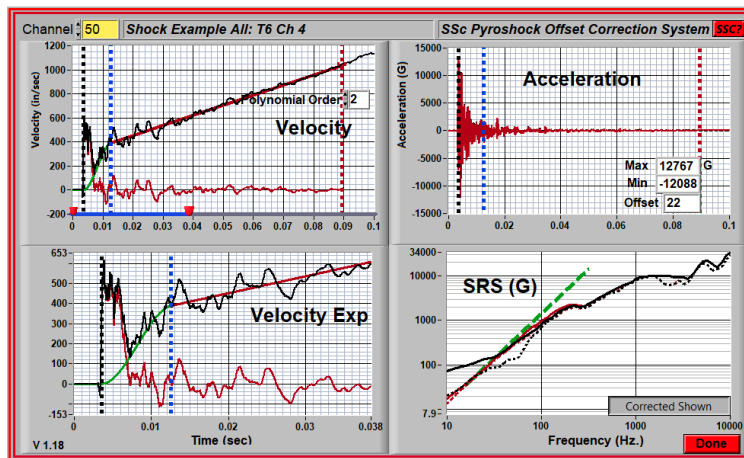
- The positive and negative SRS traces are very similar for the entire frequency range.
- The slope at low frequency is very close to 12dB/octave.

Tuning Suggestions

- The Black Cursor (the transition from Zero to the cubic spline) is normally placed just before the maximum dynamic response.
- The Red Cursor (the end of the polynomial fit) should be as far left as possible for a good fit.
- The Blue Cursor is then adjusted to get the best SRS result (matching Positive and Negative SRS).
- Be careful not to affect the high-frequency part of the SRS. This can happen when the blue cursor is too close to the black causing a sharp step.

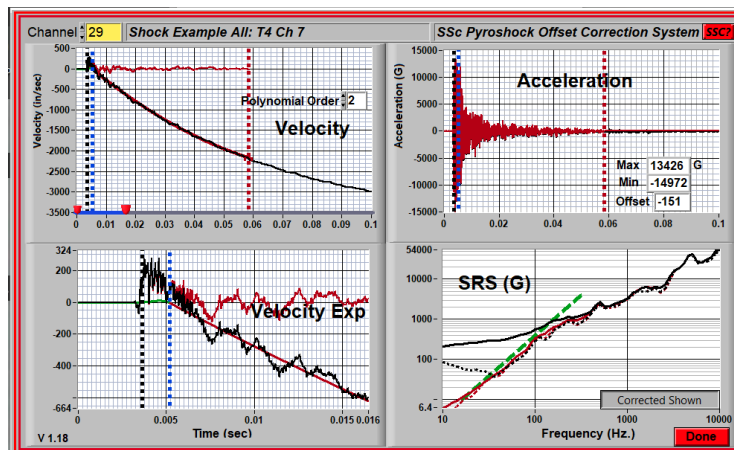
Examples

In the first case, the velocity goes strongly positive after the shock. The cubic spline does a good job of



handling the transition.

In the second case, the velocity goes strongly negative after the shock. This is a challenge for the fitting tools provided but the result is still significantly improved.



Resources

A technical paper discussing the shock-offset problem: [PCB Paper on Shock Accelerometer Offset](#)

A technical paper discussing the correction process (along with a demonstration movie and an example data file): [The PyroShock Acceleration Offset Error Problem: A Proposed Solution](#)