FLATTENING A SCALAR DATA VOLUME – PROGRAM flatten

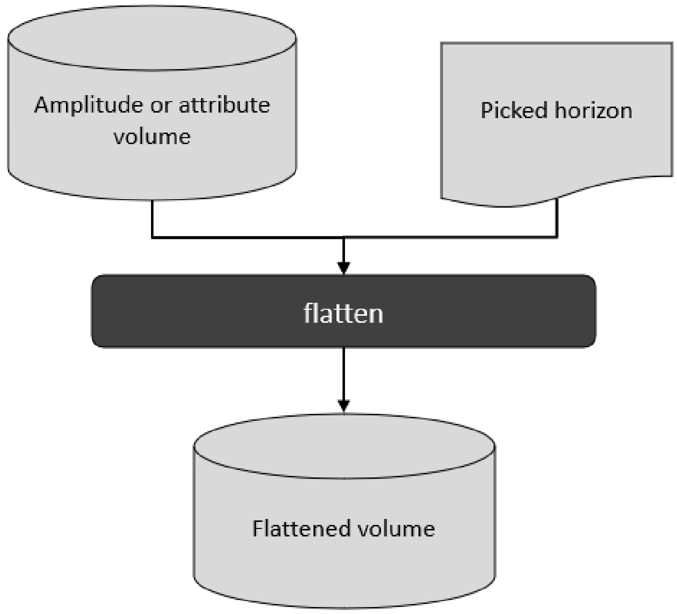
Contents

Overview

Extracting phantom horizon slices and stratal (or proportional) slices are two some of the more common interpretation activities performed in interpretation workstation software. Because the interpretation workstation is the place where you picked your horizons, it is the obvious place to do such slicing and subsequent analysis. Nevertheless, there are reasons to create flattened or stratal sliced subvolumes in the AASPI software. Generating flattened volumes has value if your commercial software does not have a state-of-the-art spectral decomposition algorithm and you wish to generate a suite of volumes about a target horizon. Similarly, AASPI provides horizon-based clustering (also called classification) algorithms that you may wish to use. The AASPI software also streamlines the multistep flattening process that needs to be used in flattening phase, azimuth, and strike volumes. AASPI programs **flatten**, **complex_spectral_flatten**, and **vector_flatten** flatten a user-defined window of input data defined about a picked horizon. AASPI program **unflatten complex_spectral_unflatten,** and **vector_unflatten** reverse these processes. AASPI program **stratal_slice, complex_spectral_stratal_slice,** and **vector_stratal_slice** generate a suite of stratal (proportional slices) between two user-defined horizons. Programs **flatten** and **unflatten** work on scalar data volumes. Because there is a discontinuity about ±180° for azimuth and at ±90° for strike, these vector components cannot be directly interpolated along the vertical axes. Program **vector_flatten** addresses this problem by first converting a magnitude and azimuth (or curvature strength and strike) vector components into geodetic (e.g., Northing and Easting) componentswhich can be directly interpolated and thus flattened. The flattened vector magnitude and azimuth components are then computed using simple trigonometry applied to the flattened geodetic components.

Computation Flow Chart

Program **flatten** reads in an input seismic or attribute volume as well as a picked horizon and generates a flattened output volume:



Output file naming convention

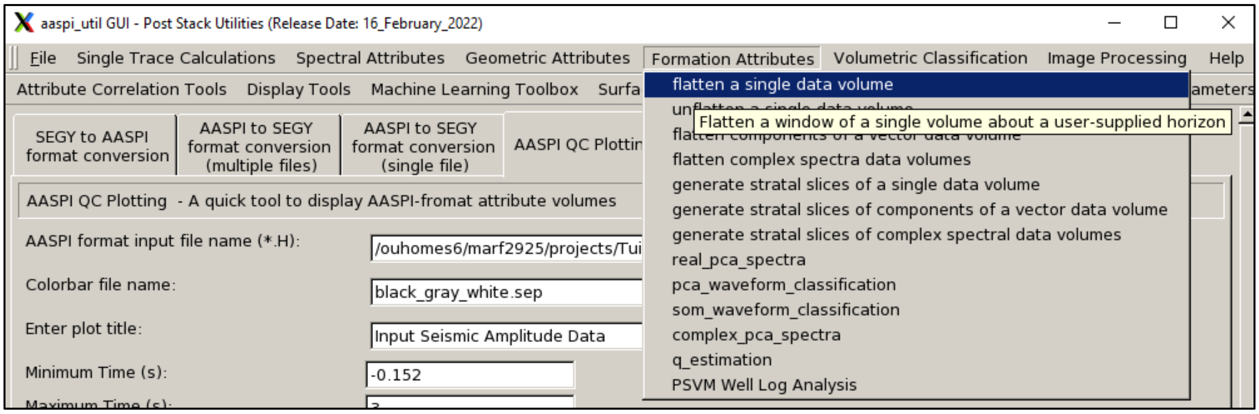
Program **flatten** will always generate the following output files:

Output file description	**File name syntax**
Flattened data volume	flattened_*input_filename+unique_project_name_suffix*.H
program log information	flatten_*unique_project_name_suffix*.log
program error/completion information	flatten_*unique_project_name_suffix*.err

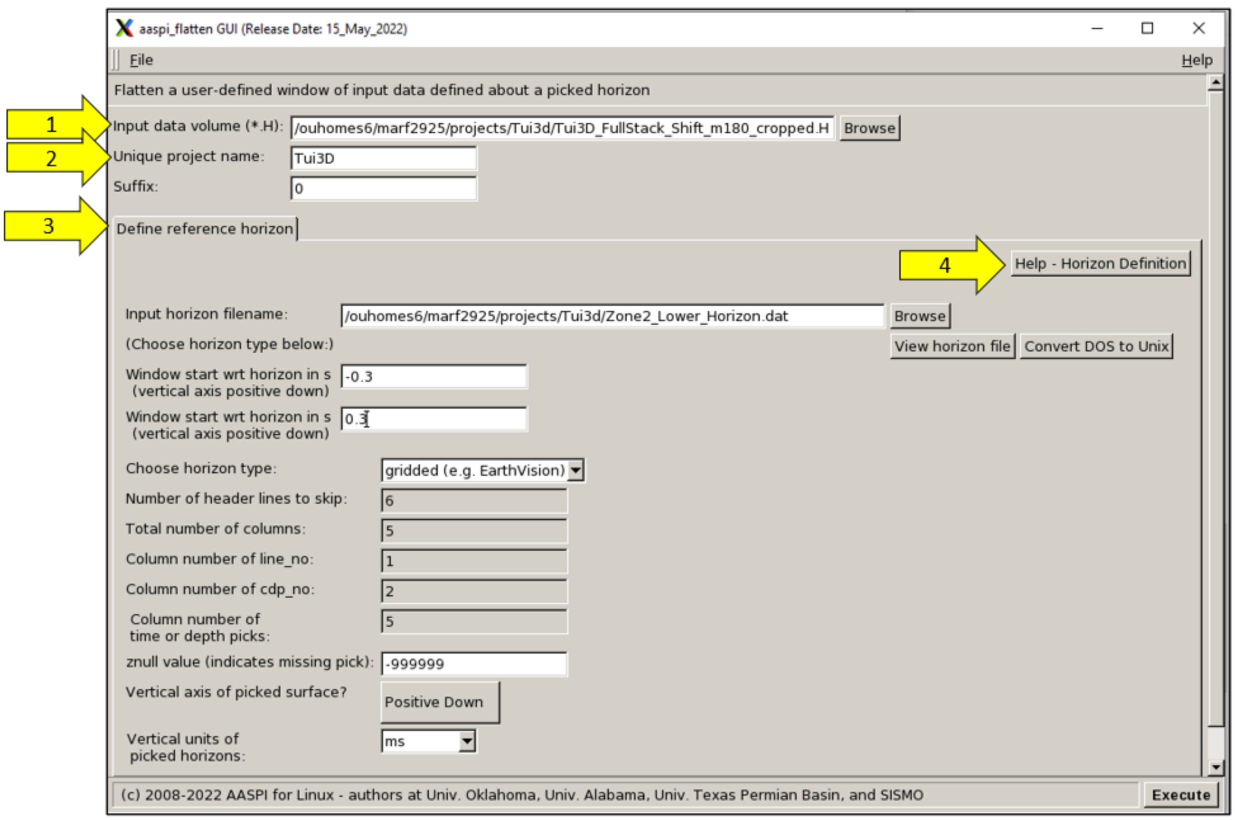
where the values in red are defined by the program GUI. The errors we anticipated will be written to the **.err* file and be displayed in a pop-up window upon program termination. These errors, much of the input information, a description of intermediate variables, and any software trace-back errors will be contained in the **.log* file.

Invoking the flatten GUI

Program **flatten** is launched from the *Formation Attributes* within in the main **aaspi_util** GUI:



The following GUI appears:



Begin by (1) entering the input data volume file name. Then enter the (2) a unique project name and suffix. There is (3) only one tab in the flattening software so it appears by default. The parameters in this tab are described in the (4) *Horizon Definition Help* panel or or if you are accessing this documentation from the web by clicking http://mcee.ou.edu/aaspi/documentation/Software_Structure-AASPI_horizon_definition.pdf .

Theory

Flattening of a scalar volumes $d(t)$ is most easily done using its frequency components $D(\omega)$ computed using a Fourier transform:

$$D\left(\omega_j\right)=\sum_{k=0}^{K} d(t_k)\exp\left(-i\omega_j t_k\right). \tag{1}$$

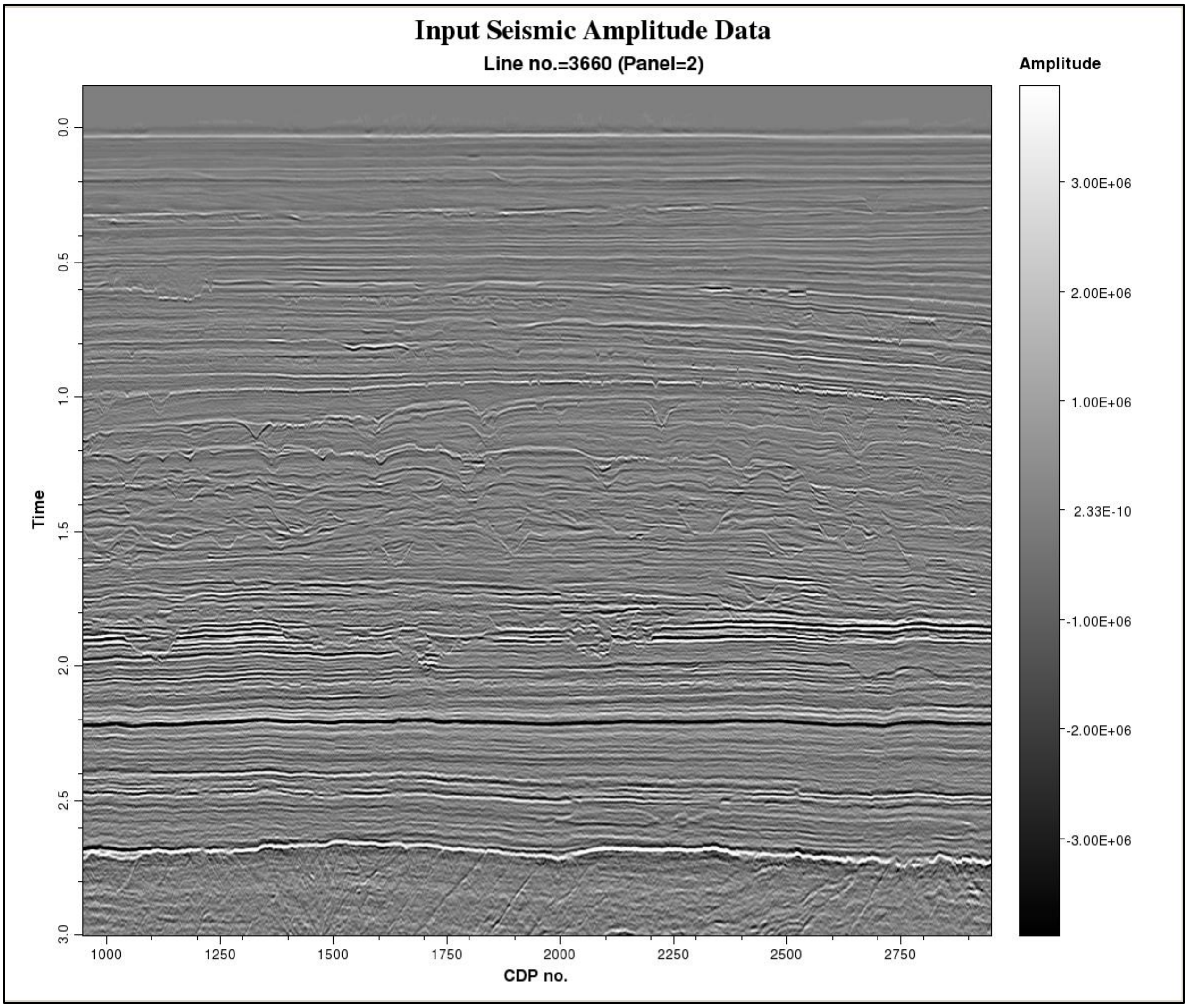
If we wish to shift the data centered about a picked horizon time T to time t=0, we simply use the shifting theorem in the inverse Fourier transform

$$d(t_k-T)=\sum_{j=0}^{J} D\left(\omega_j\right)\exp\left(-i\omega_j T\right)\exp\left(+i\omega_j t_k\right) \tag{2}$$

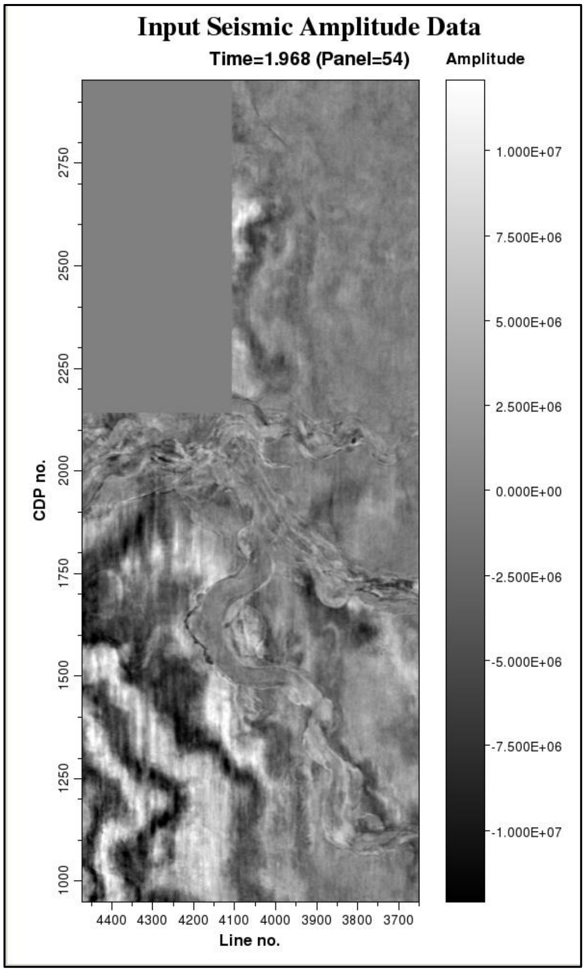
where the normalization constants have been left out.

Example

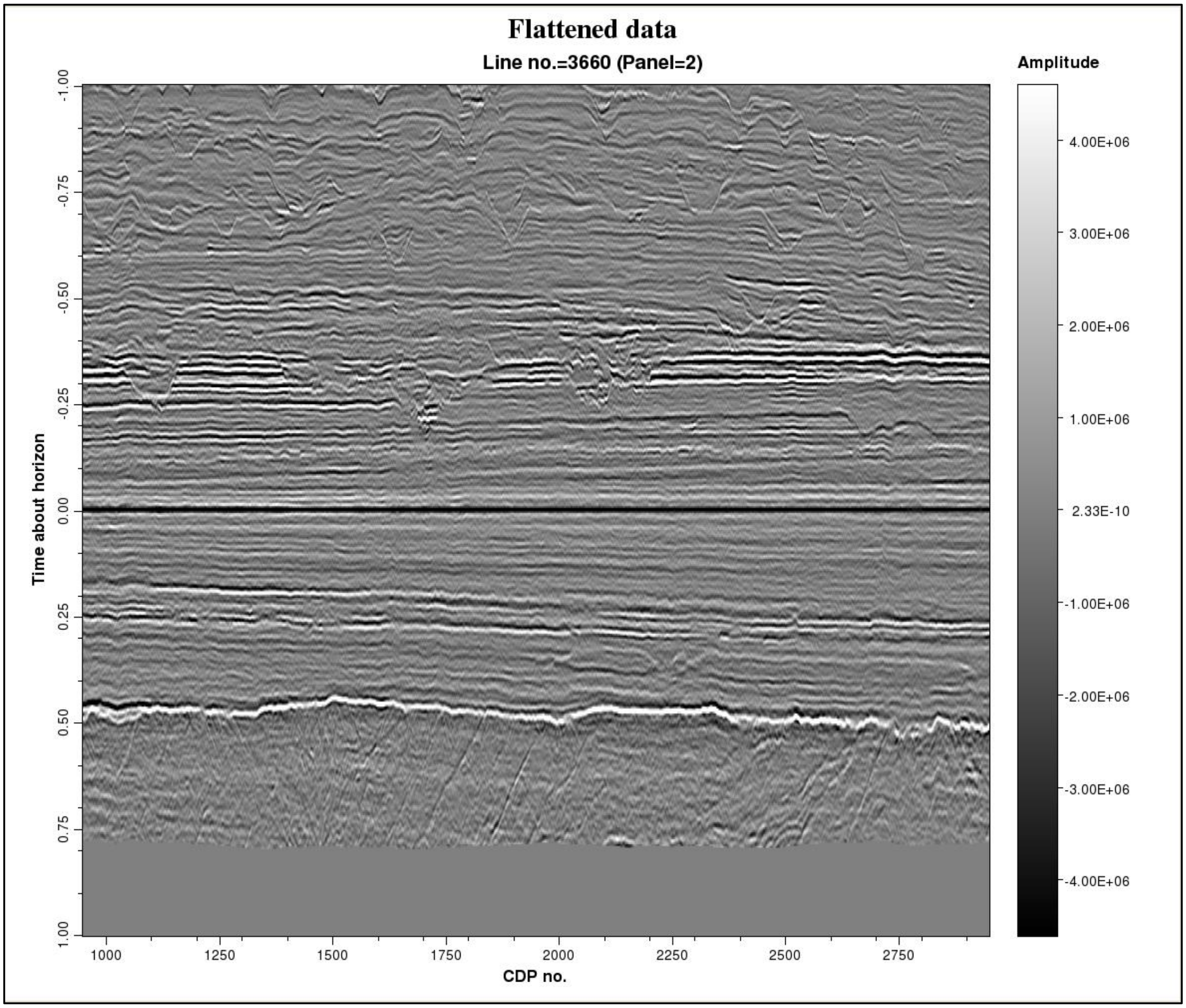
A vertical slice through the input data from the Tui3D survey acquired in the Taranaki Basin alooks like this:



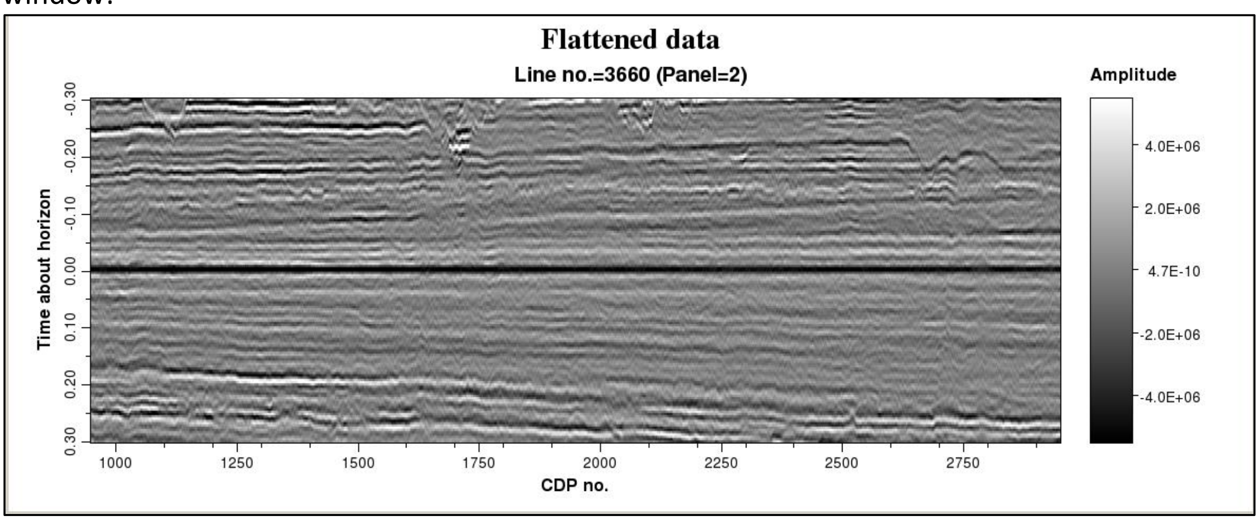
Whereas a time slice at t=1.968 s through the original volume shows parts of a turbidite system:



while the flattened volume ranging ±1 s around the picked horizon (the strong black trough at approximately t=2.2 s) looks like this:



Limiting the output range to be ±0.300 s about the picked horizon gives a narrow analysis window:



The time slice through the flattened volume along the picked through at *t*=0 s is rather uninteresting, while that at t=-0.236 s shows that turbidites seen previously on the unflattened time slice extend to a much greater lateral distance: