# FLATTENING A SCALAR DATA VOLUME – PROGRAM flatten

FLATTENING A SCALAR DATA VOLUME – PROGRAM flatten	AASPI
Contents	
Overview	
Computation Flow Chart	
Output file naming convention	2
Invoking the flatten GUI	2
Theory	4
Example	4

## **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 phase, azimuth, and strike volumes. AASPI programs in flattening 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) components which 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:

X aaspi_util GUI - Post Stack Utilities (Release Date:	16_February_2022)	- 0	×
<u><u>File</u> Single Trace Calculations Spectral</u>	Attributes Geometric Attributes	Formation Attributes Volumetric Classification Image Processing	Help
Attribute Correlation Tools Display Tools	Machine Learning Toolbox Surfa		neter
SEGY to AASPI 1	AASPI to SEGY ormat conversion (single file) AASPI-fromat attribute volumes	un Patter a sizela data unuse Flatter a window of a single volume about a user-supplied horizo flatter components or a vector data volume flatten complex spectra data volumes generate stratal slices of a single data volume generate stratal slices of components of a vector data volume	<mark>, n</mark>
AASPI format input file name (*.H):	/ouhomes6/marf2925/projects/Tui	generate stratal slices of complex spectral data volumes	
Colorbar file name:	black_gray_white.sep	pca_waveform_classification som_waveform_classification	
Enter plot title: Minimum Time (s):	Input Seismic Amplitude Data	complex_pca_spectra q_estimation PSVM Well Log Analysis	
Maximum Time (s)	, []		

#### The following GUI appears:

X aaspi_flatten GUI (Release Da	e: 15_May_2022)	- (
]] <u>F</u> ile		
Flatten a user-defined wind	w of input data defined about a picked horizon	
Input data volume (*.H): //o	homes6/marf2925/projects/Tui3d/Tui3D_FullStack_Shift_m180_cropped.H Browse	
Unique project name: Tu	3D	
Suffix: 0		
Define reference horizon		
	4 Help - Horiz	on De
Input horizon filename:	/ouhomes6/marf2925/projects/Tui3d/Zone2_Lower_Horizon.dat Browse	
(Choose horizon type belo	w:) View horizon file Convert D	)S to
Window start wrt horizon i (vertical axis positive dow	ns [-0.3 n)	
Window start wrt horizon i (vertical axis positive dow	n s [0.3] n)	
Choose horizon type:	gridded (e.g. EarthVision) 💌	
Number of header lines to	skip: 6	
Total number of columns:	5	
Column number of line_no	1	
Column number of cdp_no	2	
Column number of time or depth picks:	5	
znull value (indicates miss	ng pick): -999999	
Vertical axis of picked sur	ace? Positive Down	
Vertical units of picked horizons:	ms	
(c) 2008-2022 AASPI for Li	ux - authors at Univ. Oklahoma, Univ. Alabama, Univ. Texas Permian Basin, and SISMO	_

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 <a href="http://mcee.ou.edu/aaspi/documentation/Software Structure-AASPI">http://mcee.ou.edu/aaspi/documentation/Software Structure-AASPI</a> 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:

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

$$d(t_k - T) = \sum_{j=0}^{J} D(\omega_j) \exp(-i\omega_j T) \exp(+i\omega_j t_k)$$
<sup>(2)</sup>

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:

#### Formation\_Attributes: Program flatten



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

#### Formation\_Attributes: Program flatten



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

#### Formation\_Attributes: Program flatten



Limiting the output range to be  $\pm 0.300$  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:

