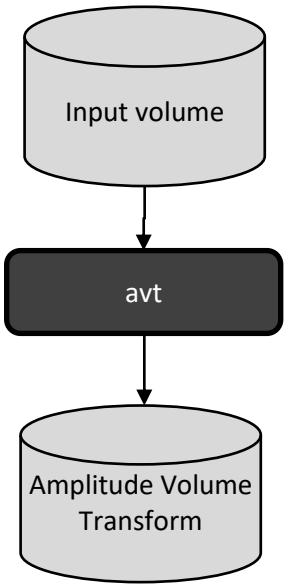
COMPUTING THE AMPLITUDE VOLUME TRANSFORM –PROGRAM avt

Contents

Computation flow chart

The input to program **avt** is a time- or depth-domain seismic amplitude volume. The input could be either the original seismic amplitude, a structure-oriented filtered amplitude from program **sof3d**, a spectrally balanced amplitude from program **spec_cmp** or **spec_cwt**, or even the amplitude processed by a commercial software package. The output files include various types of instantaneous attributes, which are Hilbert transformed data, instantaneous envelope, instantaneous phase, cosine of instantaneous phase, instantaneous frequency, weighted-average frequency, weighted-average bandwidth, wavelet phase, wavelet frequency, amplitude volume transform (AVT) data, sweetness, and unwrapping phase.



Output file naming convention

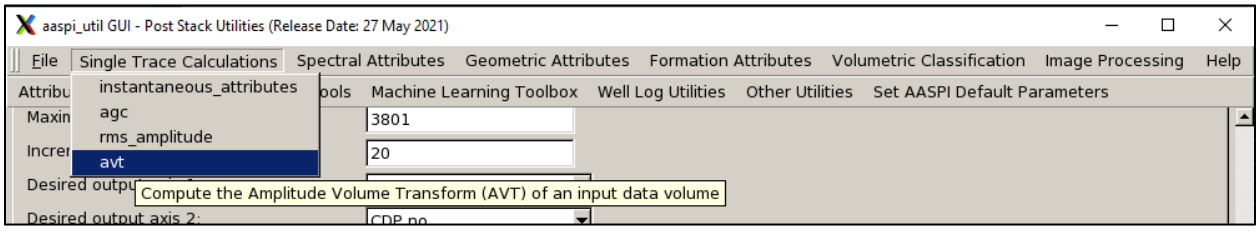
Program **avt** will always generate the following output files:
Program **agc** will always generate the following output files:

Output file description	File name syntax
Amplitude Volume Transform data volume	avt_*unique_project_name_suffix*.H
program log information	avt_*unique_project_name_suffix*.log
program error/completion information	avt_*unique_project_name_suffix*.err

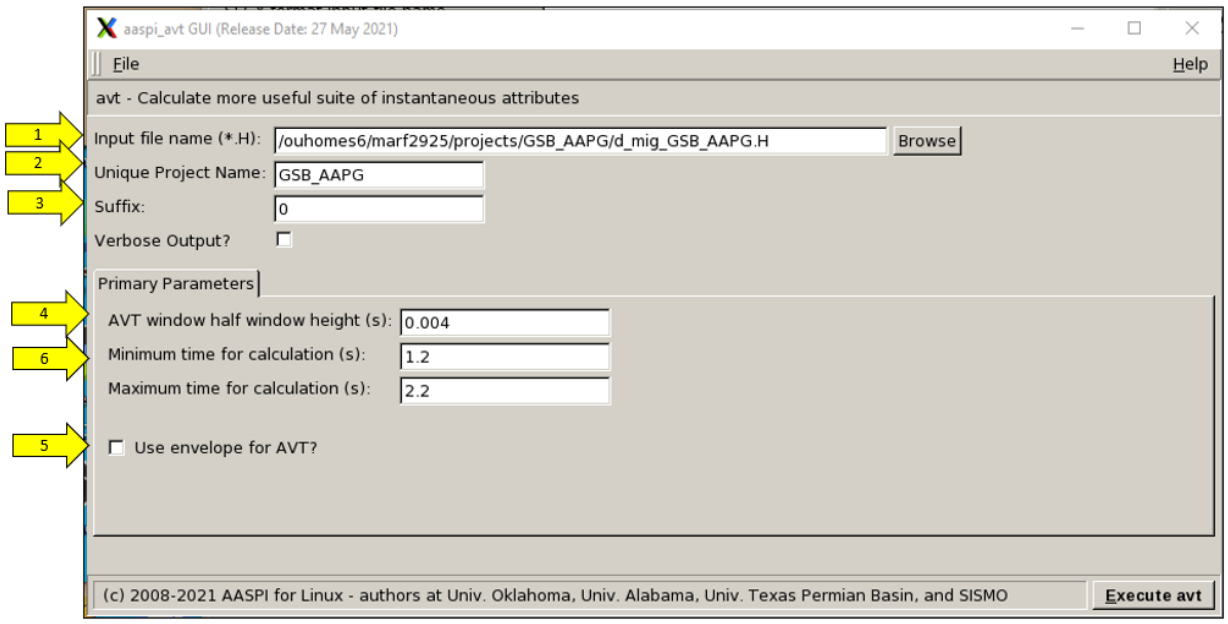
where the values in red are defined by the program GUI. The errors we anticipated will be written to the **.err* file and be displayed in a pop-up window upon program termination. These errors, much of the input information, a description of intermediate variables, and any software trace-back errors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

Invoking the avt GUI

The program **avt** is launched from **aaspi_util** GUI under *Single Trace Attributes* tab or by typing *aaspi_avt* in the command line:



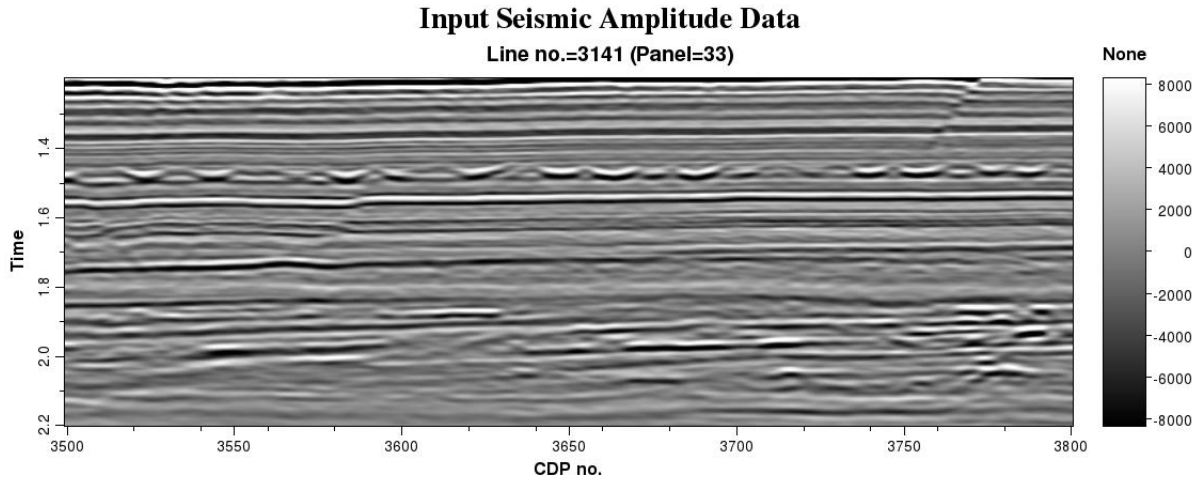
Clicking **avt** generates the following GUI:



Use the browser to (1) choose the input seismic data file. Then, as with most AASPI applications, provide (2) a unique project name and (3) a suffix that will be used to construct the output file names. Then (4) define a small half window height used to compute either the RMS amplitude or (5) Use envelope for AVT is selected the RMS envelope used in the AVT computation. Finally, (6) define time or depth limits of the computation.

Examples

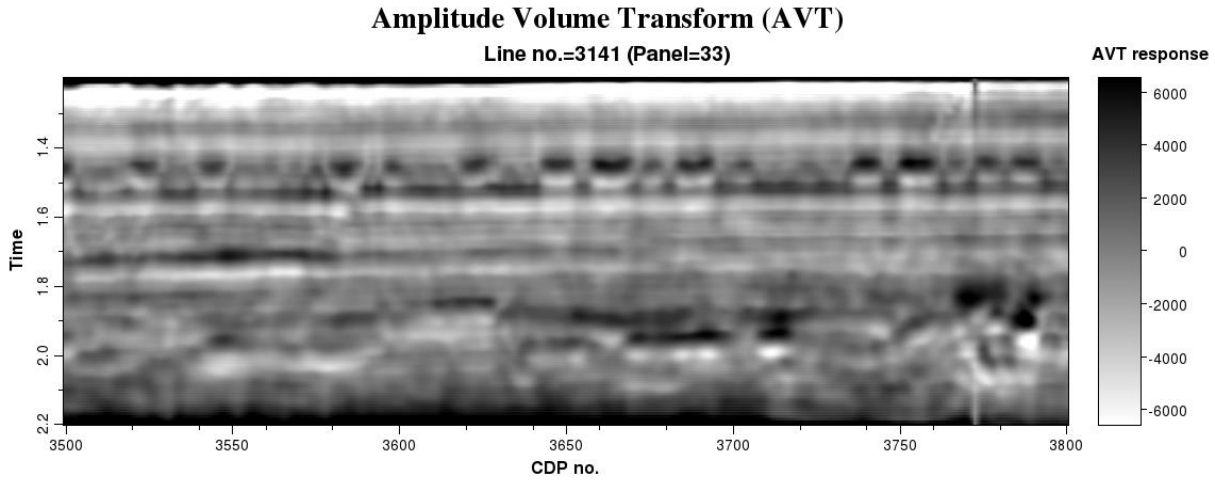
The seismic amplitude of GSB survey is used as example. A seismic line (inline=3141) is shown is the following.



Amplitude Volume Transform (AVT)

The AVT attribute (Bulhões, 1999; Bulhões and Amorin, 2005) produced by the program avt helps to identify the different geologic features, such as fault, channel, carbonate, reflector unconformities and terminations. It is calculated by the root square of the average of the square of envelopes that are within a defined analysis window, followed by the Hilbert transform.

The AVT result of inline 3141 is shown in the following image:



Theory of the Amplitude Volume* Transform *(AVT)

AVT is a nonlinear transform of the seismic data implemented using the following three steps:

1) Compute the analytic trace, $U(t)$, from the measured seismic data $u(t)$:

$$U(t_k) = u(t_k) + iu^{\mathrm{H}}(t_k)$$

where $u^H(t)$ is the Hilbert transform *of u(t)*. Then compute the envelope, $e(t)$, as the magnitude of the analytic signal:

$$e(t_j) = |U(t_j)| = \left\{ \left[u(t_j) \right]^2 + \left[u^{\mathrm{H}}(t_j) \right]^2 \right\}^{1/2}$$

2) Calculate the RMS envelope within a defined window $t_k - J\Delta t \le t \le t_k + J\Delta t$:

$$e_{\mathrm{RMS}}(t_j) = \left[\frac{1}{2K+1} \sum_{k=-K}^{+K} e^2(t_{j+k}) \right]^{1/2} .$$

3) Finally, to accentuate vertical changes, compute the inverse Hilbert transform of the RMS envelope,

$$e_{AVT}(t_j) = \mathrm{H}^{-1}\left[e_{rms}(t_j) \right] .$$

References

Bulhões, E. M., 1999, Técnica "VOLUME DE AMPLITUDES" para mapeamento de feições estruturais: 6th International Congress of the Brazilian Society of Geophysics, Rio de Janeiro, RJ, Brazil (in Portuguese).

Bulhões, E. M., and W. de Amorin, 2005, Princípio da Sismocamada Elementar e sua Aplicação à Técnica de Volume de Amplitudes (tec. VA): 9th International Congress of the Brazilian Geophysical Society, Salvador, Brasil (in Portuguese).