Volumetric attributes: Improving Dip Estimates – Program
filter_dip_components

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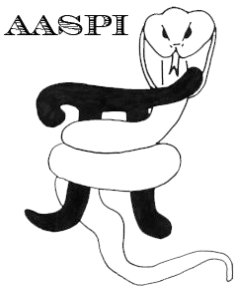
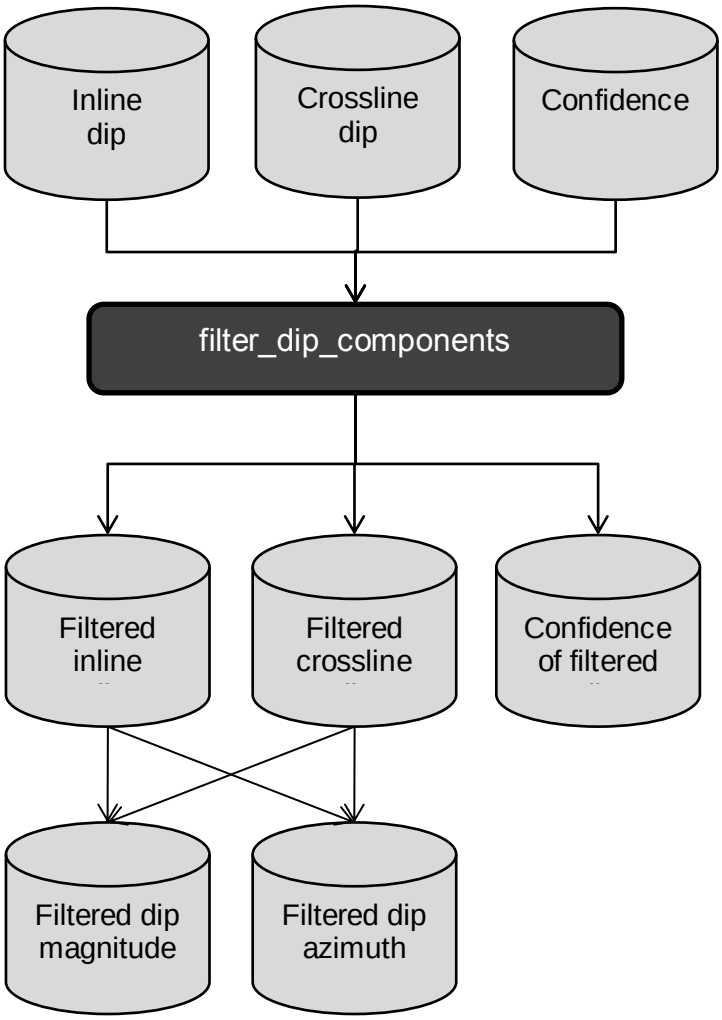


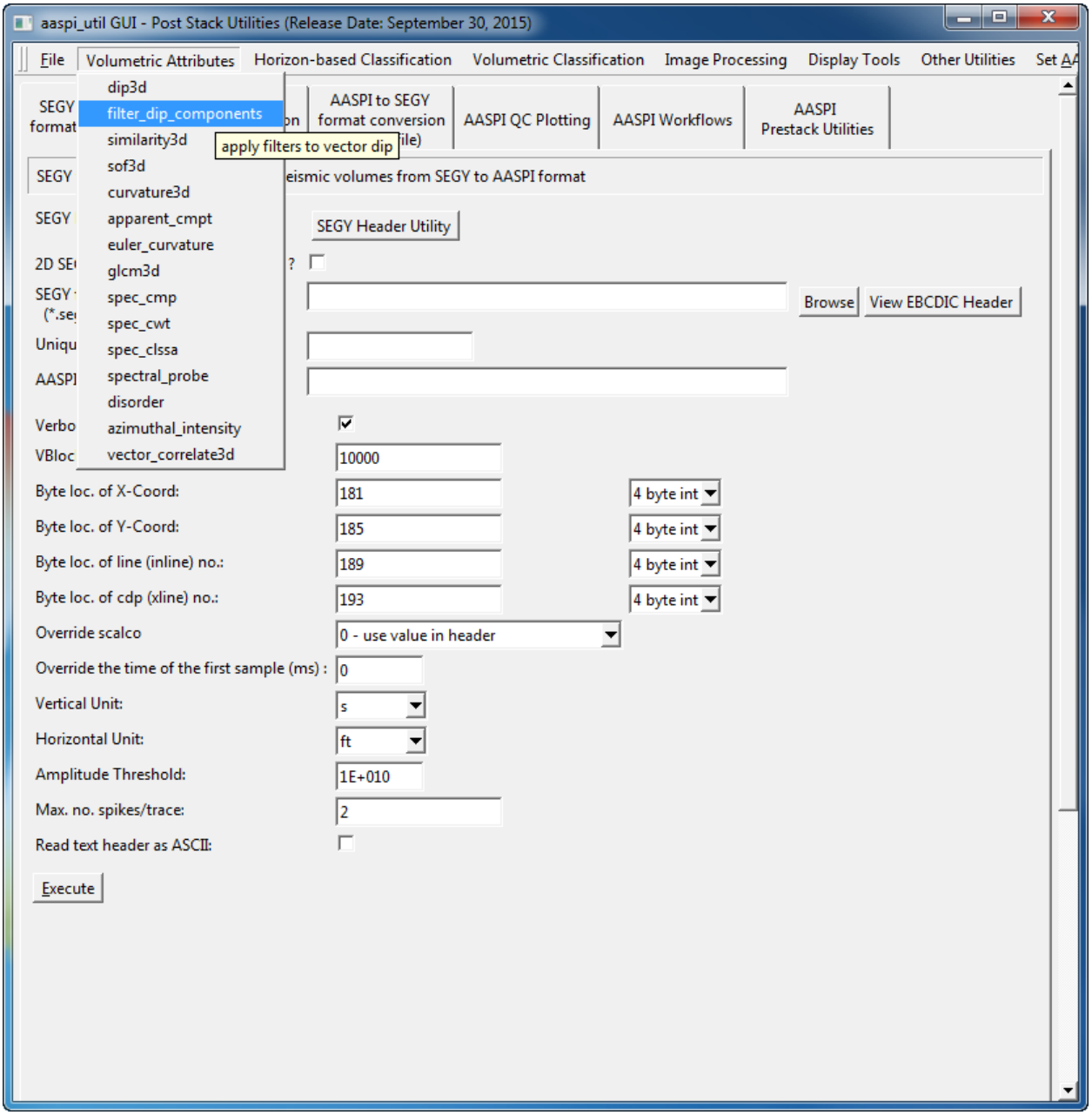
Computation flow chart

The input to program **filter_dip_components** includes estimates of the inline and crossline dip components as well as the confidence of these estimates. The initial input to program **filter_dip_components** is the output of program **dip3d**. The confidence computed in program **dip3d** is simply the semblance along dip of the analytic traces that fall within the (potentially uncentered) Kuwahara window used in the computation. Program **filter_dip_components** can be run iteratively, whereby the output can be used as input for the next iteration.

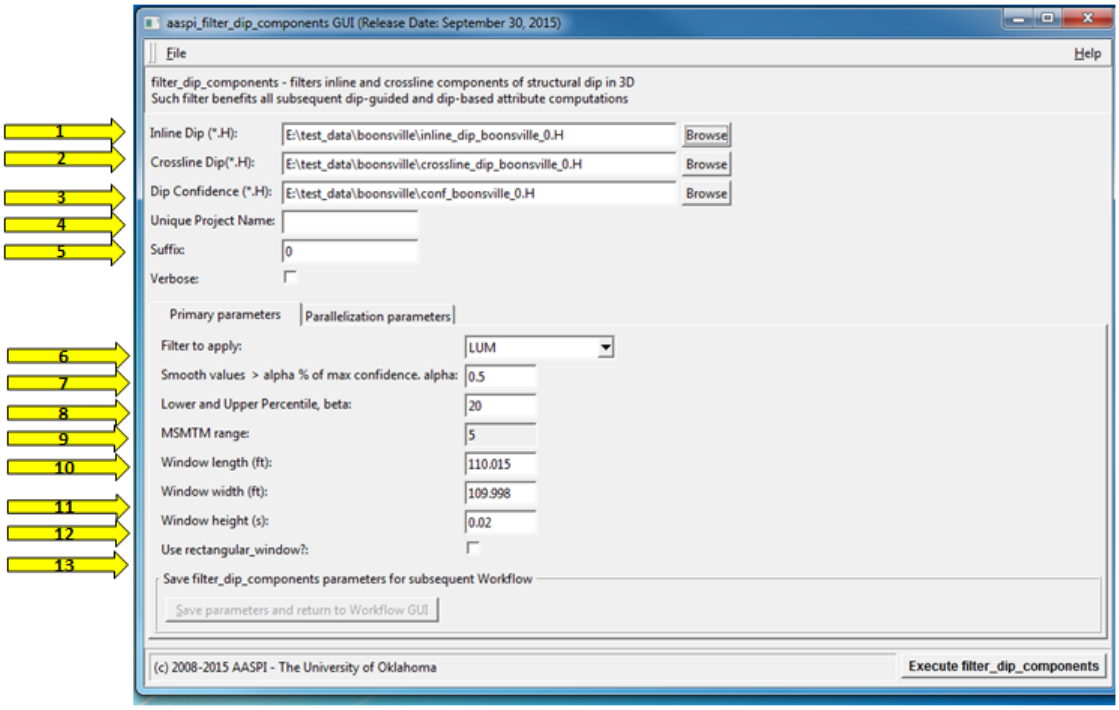


Computing mean, median, and other filtered dip volumes

Return to the **aaspi_util** menu and now choose program **filter_dip_components.**



The following window appears:



filter_dip_components has three input files: (1) inline and (2) crossline components of dip and the (3) confidence (analytic semblance) of the estimate. There will be two output files – the filtered inline and crossline components of dip. Since June 2010, the algorithm runs under MPI. I've set the *Suffix* to be '1' indicating that this is the first pass of filtering. The possible filters at present include LUM (lower-upper-middle), MSMTM (multistage median-based modified trimmed mean), *median* and *mean* filters. Dossary and Marfurt (2007) show the applicability of LUM and MSMTM filters.

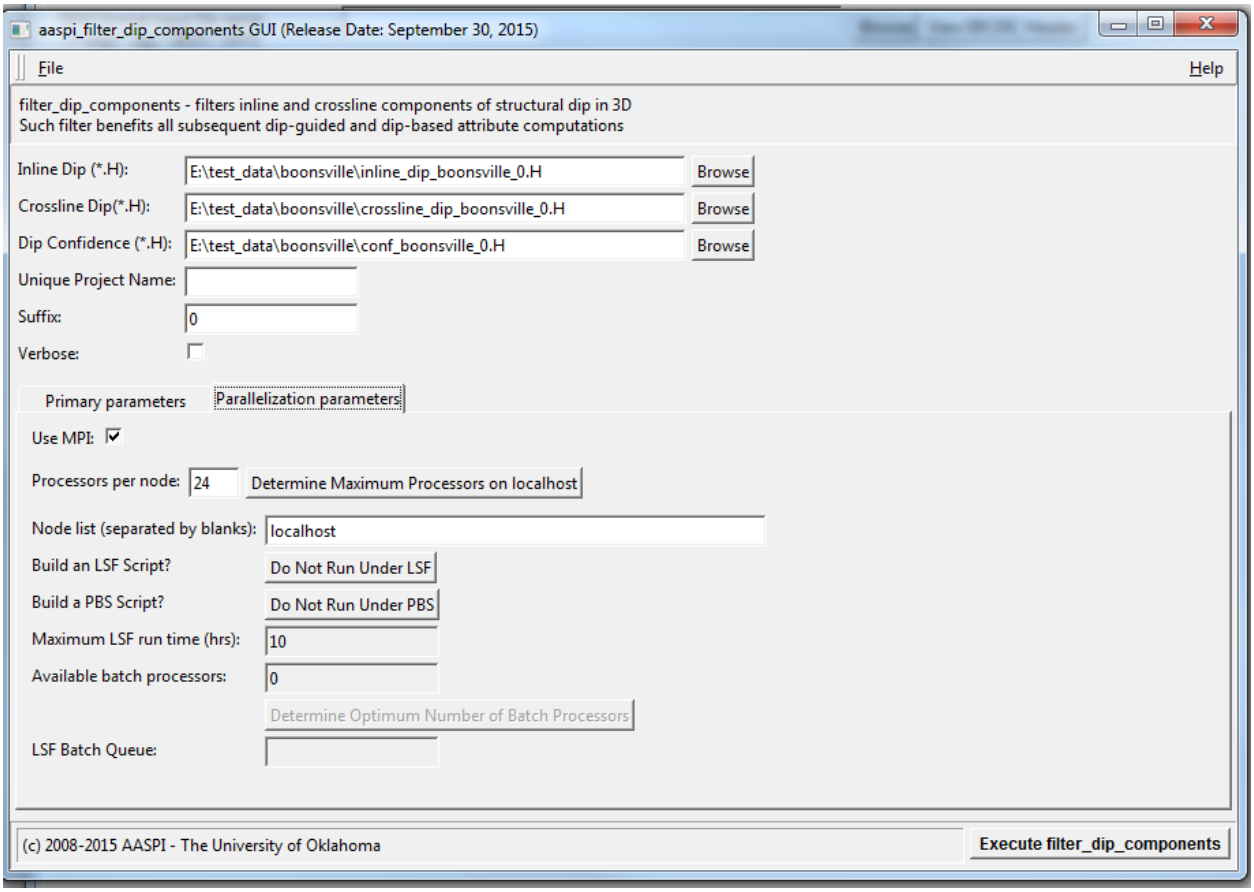
Among the parameters, (7) the confidence, *alpha*, is active for all the filters in the list; *alpha* does not work on the values of dip as in an alpha-trimmed mean filter, but rather on the confidence estimate. For the default value of *alpha=0.5*, the values that fall within the analysis window are sorted according to their confidence. If the confidence falls below *alpha=0.5* of the most confident estimate of dip, we reject it. For those values for

which we are quite confident, we take the selected filtered value as our output. The default window size consists of the neighboring traces and samples, in this case +/-25m and +/- 0.02 s.

If you have selected the LUM filter, then the (8) *beta* value becomes active. If we set *beta* to be 50%, the result will be the same as using the median filter, where as if we set it to 0%, the result will be as if we had not filtered the data. If we set *beta* to be between 0 – 50%, for example, 20%, then values which fall between 20 – 80 % of the confidence estimate will be kept. Values that fall below 20% of the confidence estimate will be set to the lower threshold 20% confidence value, and values that fall above 80% of the confidence estimate will be set to the upper threshold 80% confidence value. Values that fall below our lower threshold and above our upper threshold will be clipped.

The MSMTM (Multistage median-based modified trimmed mean) filter is able to preserve detail, meaning it acts as an edge preserving filter, a lineament preserving filter and can smooth noise. The MSMTM is a modified trimmed mean (MTM) filter that implements a multistage median filter (MSM). A data sample's value is kept if it lies in the range of [$m - q$, $m + q$], where m is calculated using a MSM filter and q is a user defined range. Larger values of q result in some smearing of lineaments through higher amplitude "noise" areas, while smaller values of q better preserve narrow lineaments. For further discussion, please refer to Dossary and Marfurt (2007).

The *Parallelization parameters* panel only asks for the list of nodes and the number of processors per node:



Like all AASPI codes, click *Execute* and intermediate information will be printed in the xterm from which aaspi_util was launched:

Volumetric attributes: Improving Dip Estimates – Program **filter_dip_components**

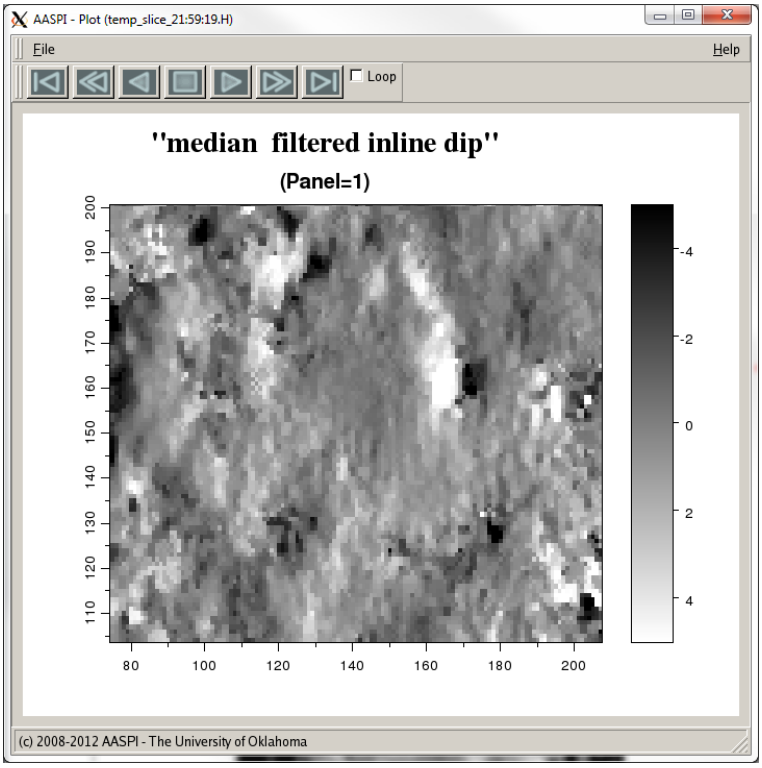
```
  8:data preloaded
  6:data preloaded
  7:data preloaded
 0: first_line,current_line,last_line,ETA      105     110     201     0.003 h
 0: first_line,current_line,last_line,ETA      105     120     201     0.003 h
 0: first_line,current_line,last_line,ETA      105     130     201     0.002 h
 0: first_line,current_line,last_line,ETA      105     140     201     0.002 h
 0: first_line,current_line,last_line,ETA      105     150     201     0.002 h
 0: first_line,current_line,last_line,ETA      105     160     201     0.001 h
 0: first_line,current_line,last_line,ETA      105     170     201     0.001 h
 0: first_line,current_line,last_line,ETA      105     180     201     0.001 h
 0: first_line,current_line,last_line,ETA      105     190     201     0.000 h
 0: first_line,current_line,last_line,ETA      105     200     201     0.000 h
         1 :end loop over lines
         1 number of traces processed:         1649
 process                                    task       time (hr)  time/trace (s)
  1:                              read  data           0.000           0.000
  1:                         send data via MPI         0.000           0.000
  1:                      receive data via MPI         0.000           0.000
  1:                      send results via MPI         0.000           0.000
  1:                   receive results via MPI         0.000           0.000
  1:                      calculate attributes         0.000           0.000
  1:                     write results to disk         0.000           0.000
  1:                              total time           0.004           0.008
         1 : memory residing only on slaves deallocated
         1 : attempt to deallocate p_out
         1 : attempt to deallocate q_out
         1 : attempt to deallocate conf_out
         1 : attempt to deallocate line_index
line_index deallocated
in_memory deallocated
lag_interp deallocated
t_lag_interp deallocated
t_lag_interp,start_cdp,end_cdp  deallocated
         1 : shared arrays residing on both master and slave deallocated
         8 :end loop over lines
         8 number of traces processed:         1552
 process                                    task       time (hr)  time/trace (s)
  8:                              read  data           0.000           0.000
  8:                         send data via MPI         0.000           0.000
  8:                      receive data via MPI         0.000           0.001
```

Once the job is completed, typing *ls –ltr* at the terminal prompt shows that the following files were created:

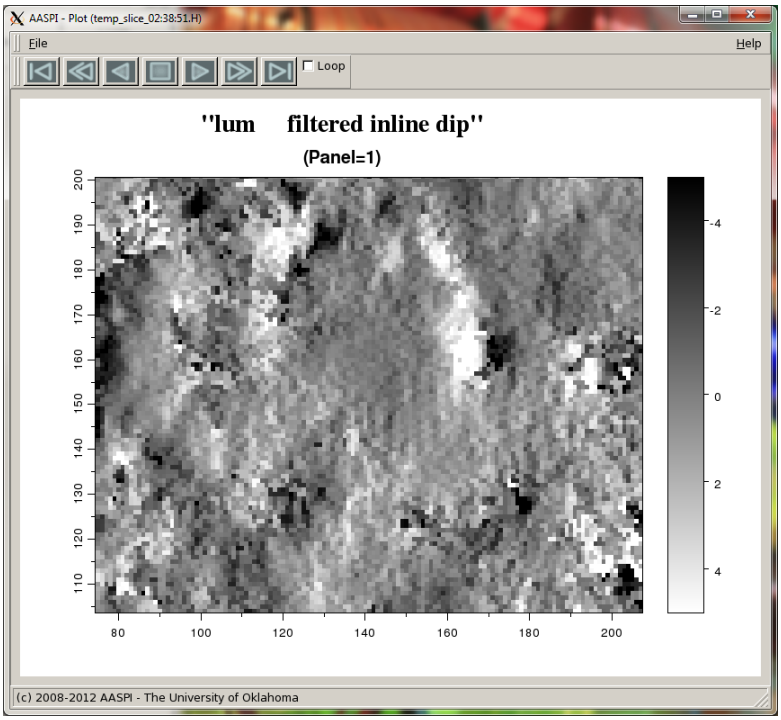
```
-rw-r--r--  1 kmarfurt aaspi       31 Aug  3 16:10 live_processor_list
-rw-r--r--  1 kmarfurt aaspi     1921 Aug  3 16:10 inline_dip_median_filt_boonsville_1.H@@
-rw-r--r--  1 kmarfurt aaspi     2987 Aug  3 16:10 inline_dip_median_filt_boonsville_1.H
-rw-r--r--  1 kmarfurt aaspi     1927 Aug  3 16:10 dip_magnitude_median_filt_boonsville_1.H@@
-rw-r--r--  1 kmarfurt aaspi     3023 Aug  3 16:10 dip_magnitude_median_filt_boonsville_1.H
-rw-r--r--  1 kmarfurt aaspi     1925 Aug  3 16:10 dip_azimuth_median_filt_boonsville_1.H@@
-rw-r--r--  1 kmarfurt aaspi     3040 Aug  3 16:10 dip_azimuth_median_filt_boonsville_1.H
-rw-r--r--  1 kmarfurt aaspi     1927 Aug  3 16:10 crossline_dip_median_filt_boonsville_1.H@@
-rw-r--r--  1 kmarfurt aaspi     3005 Aug  3 16:10 crossline_dip_median_filt_boonsville_1.H
-rw-r--r--  1 kmarfurt aaspi     1909 Aug  3 16:10 conf_median_filt_boonsville_1.H@@
-rw-r--r--  1 kmarfurt aaspi     2776 Aug  3 16:10 conf_median_filt_boonsville_1.H
-rw-r--r--  1 kmarfurt aaspi    22535 Aug  3 16:11 image_filt3d_boonsville_1.out
[kmarfurt@opal boonsville]$
```

Note that we have created filtered versions of the inline dip and crossline dip components. The part of the name *median_filt* denotes the kind of filter that was applied. Had we applied a LUM filter, we would see *lum_filt* instead. Program **filter_dip_components** also generates new versions of dip magnitude and dip azimuth computed from the filtered dip component volumes.

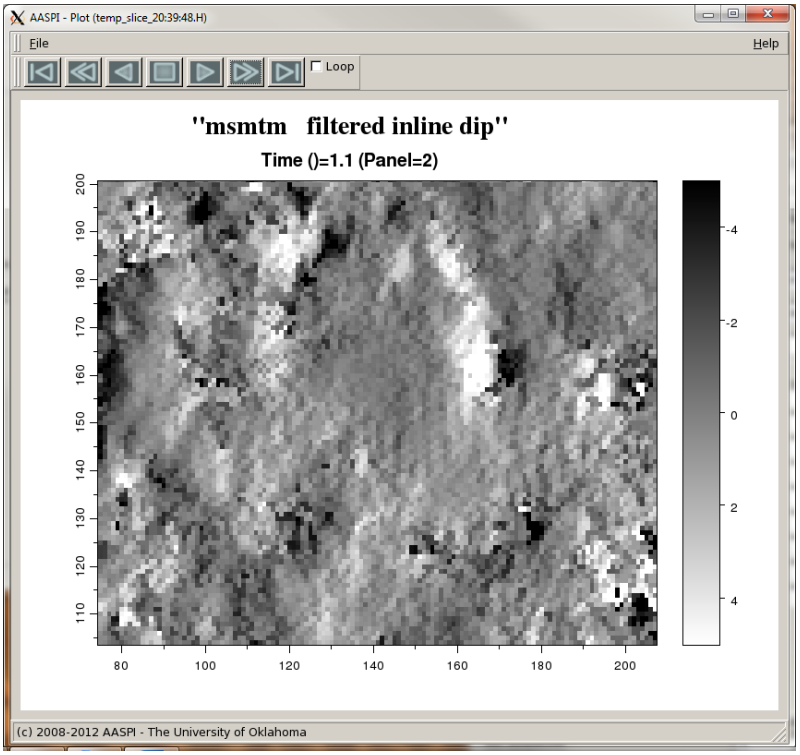
The results of the median filter look like this (time slice, t = 1.1 sec):



Here we see what the result of the LUM filter looks like (time slice, t = 1.1 sec):

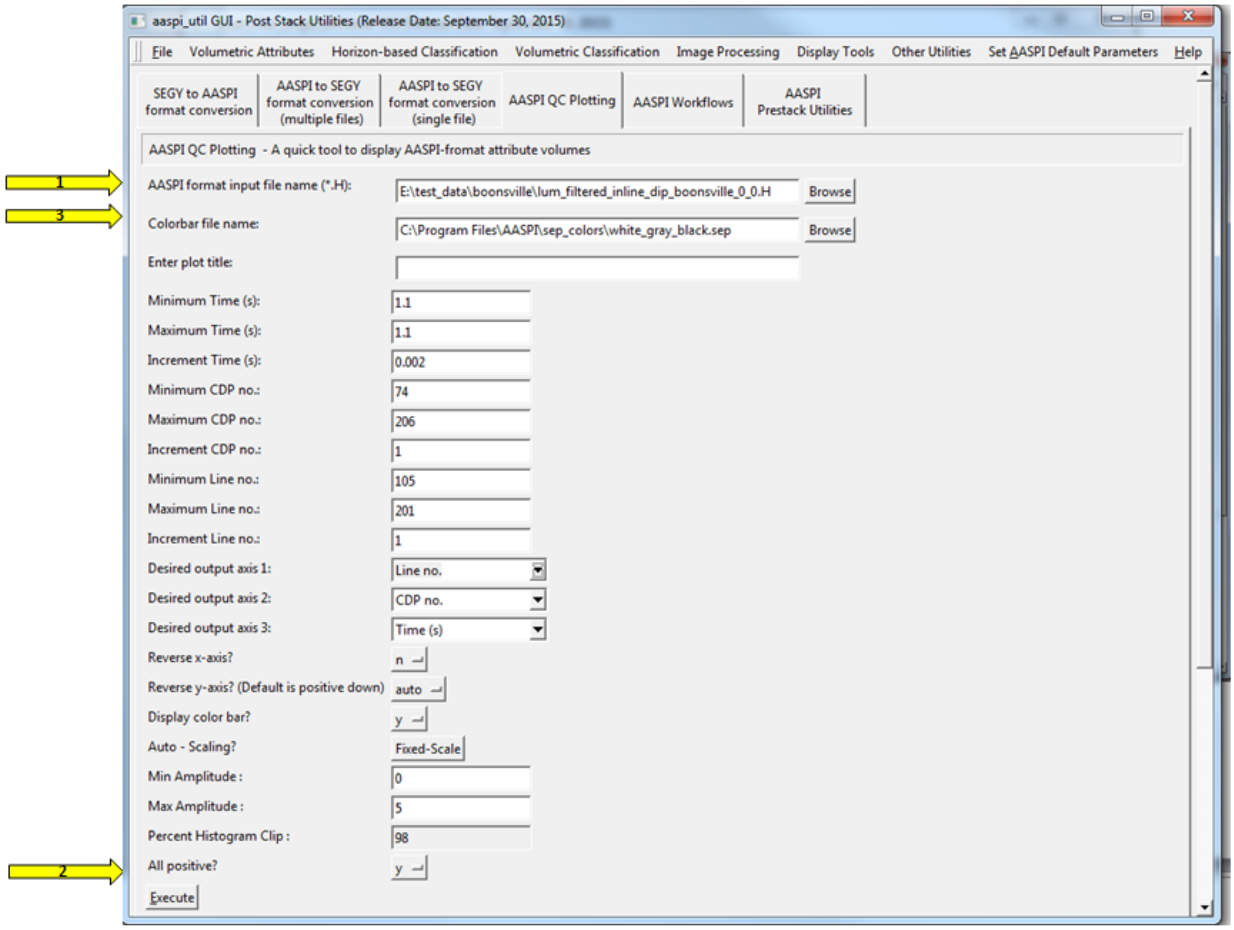


And here is the result of the MSMTM filter with q = 4 (time slice, t = 1.1 sec)

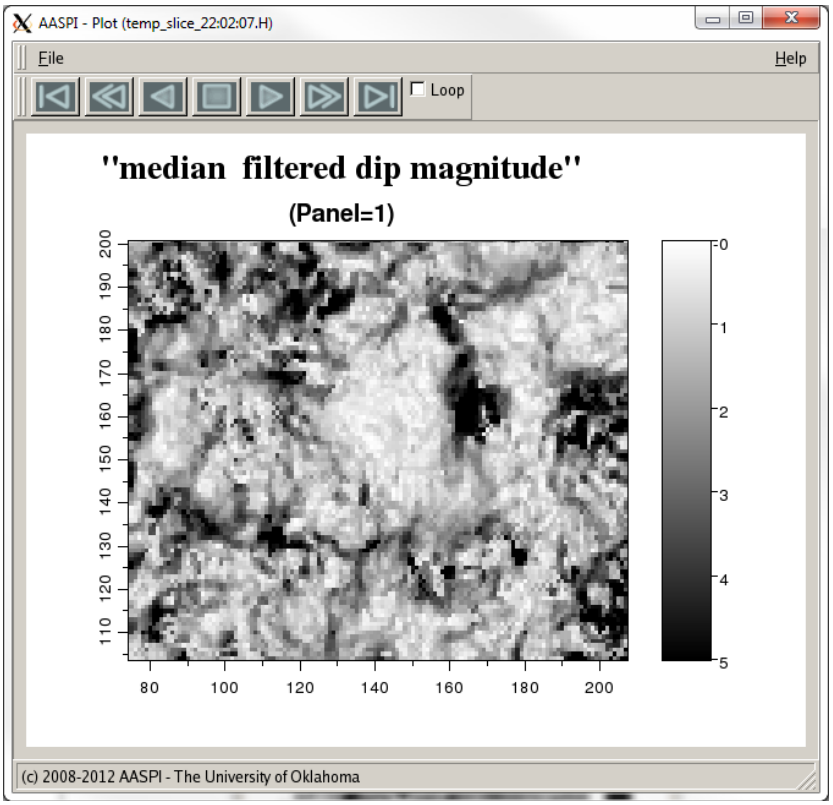


We note that the median filtered image is overall is less noisy, smoother, with a little less N-S acquisition footprint. However, it also has somewhat lower resolution than the input image shown previously. In comparison to the median filter, the LUM filtered image shows more acquisition footprint, but it has enhanced the collapse features too. The MSMTM filter improves in regards to the footprint and shows better details near the collapse features.

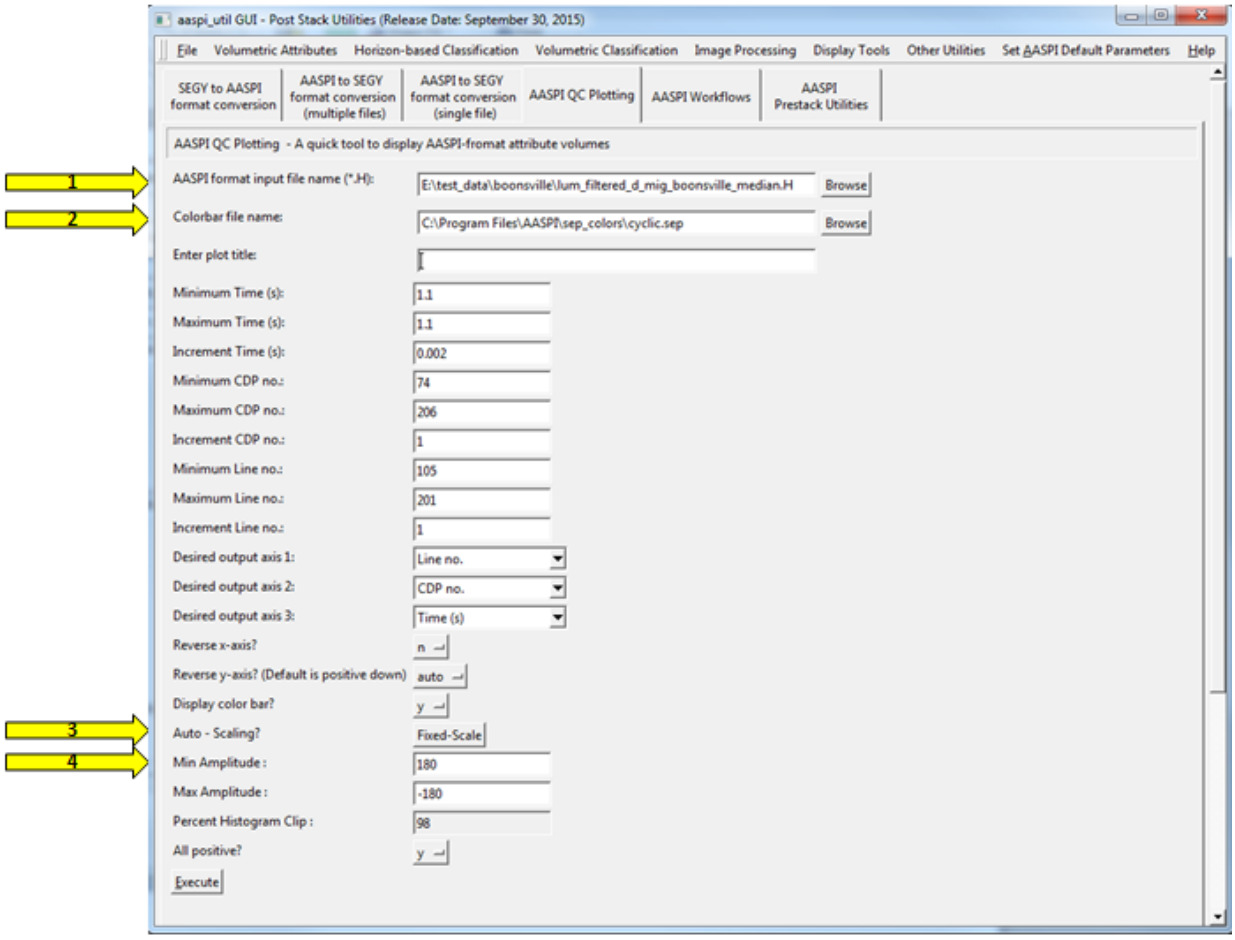
Let's now plot the filtered dip magnitude. Return to the main *AASPI_UTIL* GUI and select the tab titled *'AASPI QC Plotting'*:



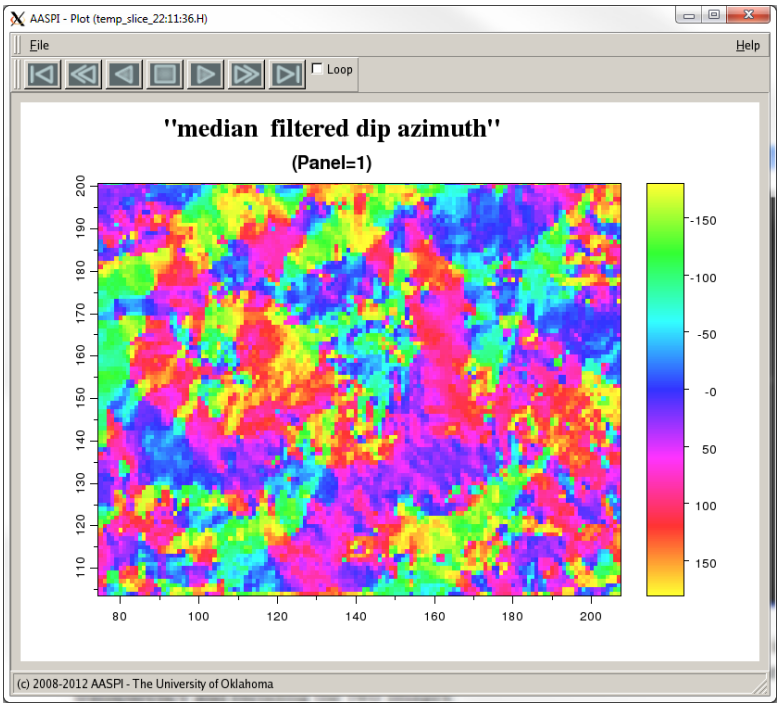
First select the file *dip_magnitude_median_filt_boonsville_1.H to* plot. Dip magnitude will be strictly positive, so we will want to (2) set the *All positive?* option to *y*. Finally (3) we will want to plot dip magnitude against a white-gray-black colorbar so that flat dips appear as white. The resulting image looks like this:



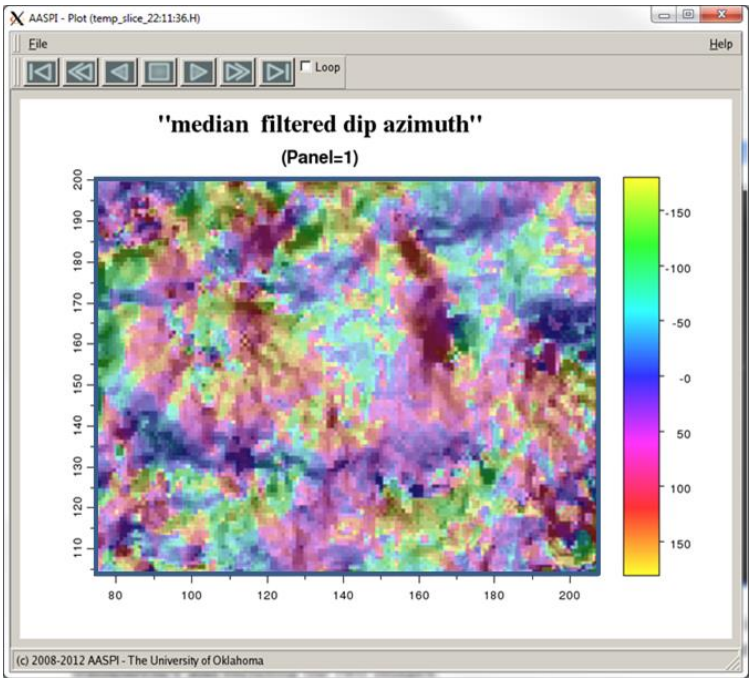
The very steep dip (black areas) corresponds to collapse features. Let's now plot the dip azimuth. Our *AASPI QC Plotting* GUI looks like this



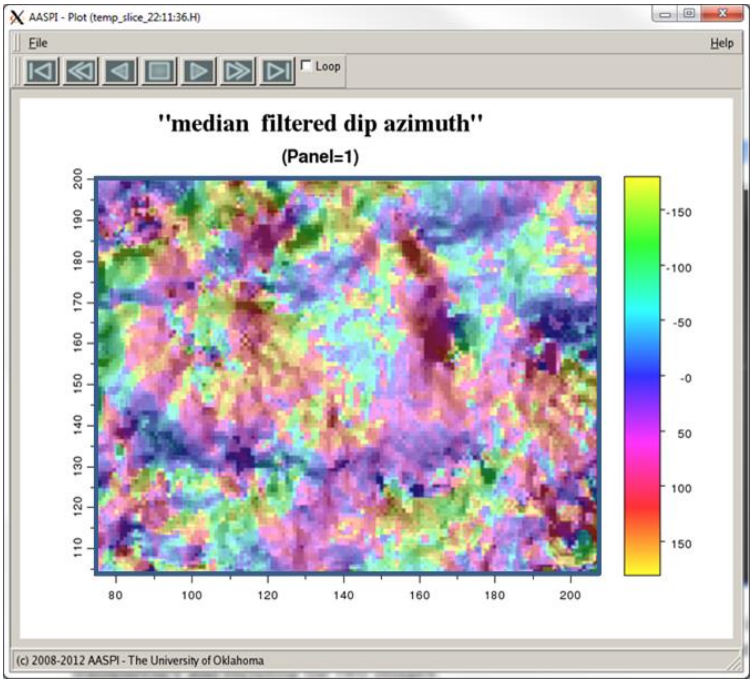
Enter the (1) file name *dip_azimuth_median_filt_boonsville_1.H* as the *AASPI Input*. Then (2) choose the cyclic.sep color bar so that -180^0 will plot up with the same color as $+180^0$ (yellow for this colorbar). (3) Turn the *Auto Scale* to be *Off* to turn off the histogram scaling and instead use explicit clipping. The ranges of these attributes are (4) -180^0 to $+180^0$.The result will look like this



A drawback of dip azimuth is that it is meaningless when the dip magnitude is very close to 0.0 (the white areas in the dip magnitude image). We can better visualize these areas by using transparency and blending the two images:



However, this image is somewhat disappointing in that the areas of greater dip where the dip azimuth estimates are accurate are now blackened out. We can ameliorate this problem by plotting the dip magnitude against a black-gray-white color bar, thereby rendering the strong dip-magnitude areas more pastel:



However, the image is still less than ideal.

References:

al-Dossary, S., and K. J. Marfurt, 2007, Lineament-preserving filtering: Geophysics, **72**, P1-P8.

Corrao, A., M. Fervari, and M. Galbiati, 2011, Hewett Plattendolomite: Reservoir Characterization by Resolution Enhanced Seismic data: GCSSEPM 31st Annual Bob. F. Perkins Research Conference on Seismic attributes – New views on seismic imaging: Their use in exploration and production, 66-99.