

# **Constructing a Geometric Attribute Workflow**

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# Introduction

Attribute computation of very large data volumes can take considerable time. Experienced interpreters may already have familiarity with other data volumes from the same basin. Alternatively, they may have already analyzed a subset of the data using the 'interactive' steps described above. In this situation it may be useful to set up a workflow that will run a suite of attribute programs in the background, perhaps overnight.

The workflow here is one of two currently provided. Unlike a mature 3D seismic processing system like ProMax, Seisup, or Focus, the linking and interchangeability is rigidly fixed. After sponsor feedback, we can either improve the workflow described below, or develop an alternative strategy.

### Geometrical attribute Workflow

File volumetric A	ttributes <u>F</u> ormation	n attributes <u>D</u> isplay	Tools <u>O</u> ther Utilities	Set <u>A</u> ASPI Defau	lt Parameters <u>H</u> e
SEGY to AASPI format conversion	AASPI to SEGY format conversion (multiple files)	AASPI to SEGY format conversion (single file)	AASPI QC Plotting	AASPI Workflows	AASPI Prestack Utilities
AASPI Volumetric A	ttribute Workflow an	d Footprint Suppress	sion Workflow		
AASPI - Geometric	Attribute Workflow (	Structural and Ampli	itude)		
AASPI <u>G</u> eometr	ic Attribute Workflow				
AASPI - Seismic Fo	otprint Suppression	Workflow			
	Supprossion Workfl	ow			
AASPI <u>F</u> ootprint	Suppression working	<u> </u>			

The AASPI Geometrical Attribute Workflow GUI can be invoked from the main **aaspi\_util** as shown above or by typing in **aaspi\_geom\_attr\_workflow** separately in the terminal window. The following workflow GUI will then be displayed.

	e Date. August .	13, 2012)		11-1
				Hel
Geometrical Attribute v Step 1: Select Input seismic file a	nd define the	the attributes in nodes (to be u	batch mode sed for all th	e e process)
Input seismic data file name (*.H)	soft_test/s	eismic_data.H	Browse	
*Unique Project Name:	geom_attr		1	
Suffix:	0		~2	
Verbose:	Г З			
Use MPI:	<b>₽</b> 4			
Processors per node:	12	5		
Node List:	plite hematit	æ 6		
Step2 : Save p Step3 : Execut (Activation and deactivation of th Save parameters for dip3d attribu	arameter files e Geometrical e buttons are utes	for desired pro Attribute Work automated acc	grams flow ording to the	e workflow)
Save parameters for imagefilt3d	attributes	imagefilt3	d	
Save parameters for similarity3d	attributes	<u>similarity</u> :	3d	
Save parameters for sof3d attribu	utes	sof3d		
Re-Run similarity3d attributes	1 - 222	<u>R</u> e-run si	milarity3d	
Save parameters for Curvature30	attributes	curvature	3d	
Save parameters for Euler curvat	ure attributes	Euler cur	/ature	
Save parameters for GLCM3D att	ributes	glcm3d		
Save parameters for spec_cmp a	ttributes	spec_cm	2	
Execute Geometrical Attribute	Workflow			
(c) 2008-2012 AASPL - The Univ	arsity of Oklah	oma		Reset selection

#### Step 1: Save the workflow environment parameters

In step 1 we need to input the seismic amplitude file and set up the project name and the MPI parameters which will be used for all the MPI processes. The seismic amplitude file is selected first (*Arrow 1*). Enter the project name and the suffix (*Arrow 2*). Verbose can be selected if required (*Arrow 3*). It is recommended to use MPI because except **euler\_curvature** all the other processes run on MPIs (*Arrow 4*). Mention the processors per nodes and the node list. Each of our machines *tripolite.ou.edu* and *hematite.ou.edu* have 12 processors in it. Thus in the processors per node 12 is mentioned (*Arrow 5*) and in the node list *tripolite* and *hematite* is mentioned (*Arrow 6*).

After entering out all the parameters these parameters are saved (*Green Arrow*) which will be subsequently used for all the processes. Note that initially all the attribute buttons will be disabled. When the "Save Environment parameters" is clicked the **dip3d** and the **spec\_cmp** buttons will be highlighted as shown. These two takes in only the seismic amplitude as inputs and are thus activated. The subsequent attribute buttons will be activated after their input file criterions are met.

X AASPI - geom_attr_workflow (Release Date: Augu	ust 19, 2012)
Eile AASPI_Utilities	Help
Geometrical Attribute workflow ru Step 1: Select Input seismic file and define t	ns the attributes in batch mode he nodes (to be used for all the process)
Input seismic data file name (*.H): soft_te	st/Seismic_data.H Browse
*Unique Project Name: geom_a	ttr
Suffix: 0	
Verbose:	
Use MPI: 🔽	
Processors per node: 12	
Node List: plite hem	atite
Save environment parameters	
Save environment parameters	
Step2 : Save parameter fi Step3 : Execute Geometri (Activation and deactivation of the buttons a	les for desired programs ical Attribute Workflow are automated according to the workflow)
Save parameters for dip3d attributes	「 dip3d
Save parameters for imagefilt3d attributes	magefilt3d
Save parameters for similarity3d attributes	similarity3d
Save parameters for sof3d attributes	□ sof3d
Re-Run similarity3d attributes	Re-run similarity3d
Save parameters for Curvature3d attributes	Curvature3d
Save parameters for Euler curvature attribut	tes Eller curvature
Save parameters for GLCM3D attributes	□
Save parameters for sner, cmp attributes	
Sure parameters to spec_emp dambates	
Execute Geometrical Attribute Workflow	
(c) 2008-2012 AASPI - The University of Ok	lahoma Reset selections

Step 2: Save the parameters for the volumetric attributes

In this step each of the attribute program is opened and their parameters are saved. The buttons are activated only when their input criterion are met. For example, the **imagefilt3d** gets activated only after we open and save the **dip3d** parameters. The next figure shows the GUIs for **dip3d** and i**magefilt3d**. The parameters are mentioned and the Save and Exit button (*green arrow*) is selected.

File Help	∬ <u>E</u> ile			Help
Elle     Help       dip3d - calculate 3d dip attributes using analytic semblance     Seismic Input (*.H):	image_filt3d - calculate structural dip in 3D Inline Dip (*.H): Crossline Dip(*.H):	es simple image processing filte	ers along	
*Unique Project Name: geom_attr Suffix: 0 Typical Extended	Dip Confidence (*.H): *Unique Project Name Suffix: Typical Extended	conf_geom_attr_0.H	rowse	
Ineta Max(degrees)       20         Delta Theta (degrees):       4         Ref. Velocity:       10000         Dip Window Height:       0.01         Convert theta_max from degrees to s/trace, m/trace or ft/trace:       0.00800844         Want Dip Components Result?       If required         Want Dip Azimuth Result?       Image: Confidence Result?         Want Dip Confidence Result?       Image: Confidence Result?         Save dip3d parameters for AASPI Geometric Attribute Workflow       Image: Confidence Result Resul	Filter to apply: Smooth values > alp Lower and Upper Per MSMTM range: Window length: Window width: Window height: Use rectangular_win Save image_filt3d pa Save parameters a	oha % of max confidence. alpha rcentile, beta: dow?: arameters for AASPI Geometric / and return to geom_attr_workflo	a: 0.5 20 5 110 110.015 0.002	rkflow
Save parameters and return to geom_attr_workflow	(c) 2008-2012 AASPI -	University of Oklahoma	Execute	image_fiit3

				Contraction of the local division of the loc	
					Help
Geometrical Attribute we Step 1: Select Input seismic file an	orkflow runs t d define the i	the attributes in nodes (to be u	n batch moo sed for all th	ie ne process)	
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*Unique Project Name:	geom_attr				
Suffix:	0				
Verbose:	Г				
Use MPI:	N				
Processors per node:	12				
Node List:	plite hematit	e			
Save environment parameters					
Save environment parameters					
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Save parameters for Euler curvatu Save parameters for GLCM3D attri	butes	□ glcm3d			
Save parameters for Euler curvatu Save parameters for GLCM3D attri Save parameters for spec cmp att	butes tributes	□ glcm3d			
Save parameters for Euler curvatu Save parameters for GLCM3D attri Save parameters for spec_cmp att Execute Geometrical Attribute V	butes tributes Workflow	□ glcm3d □ <u>spec_cm</u>	• <b></b> -		

Note that after saving the **imagefilt3d** parameters, the **similarity3d**, **curvature3d** and the **glcm3d** buttons are activated since the three require the inline and crossline dip volumes as an input.

AASPI - program similarity3d (Release Date: September 21, 2012)      Eile     similarity3d - calculate 3d similarity-type attributes Seismic Input (*.H):soft_test/Seismic_data.H     Browse Inline Dip (*.H):nline_dipgeom_attr_0.H     Browse Crossline Dip(*.H):sline_dipgeom_attr_0.H     Browse *Unique Project Name:geom_attr	The GUI for <b>similarity3d</b> ; the output from the <b>imagefilt3d</b> will be input to this program. Enter the proper parameters and then save and exit ( <i>green arrow</i> ). The parameter file gets saved automatically as a similarity3d.parms file
Suffix:       0         Typical       Extended         Inline Window Radius:       110.015         Crossline Window Radius:       110         Covariance Window Half Height:       0.01         dTheta Interpolate (>0):       1         Similarity Power (>0):       2         Similarity Mean (0->1):       0         Constant Vector       Image: Constant Vector         Results       Want Energy Ratio Similarity Attribute?       Image: Constant Vector         Want Energy Ratio Similarity Attribute?       Image: Constant Vector       Image: Constant Vector         Want Energy Ratio Similarity Attribute?       Image: Constant Vector       Image: Constant Vector         Want Energy Ratio Similarity Attribute?       Image: Constant Vector       Image: Constant Vector         Want Outer Product Similarity Attribute?       Image: Constant Vector       Image: Constant Vector         Want Cober Filter Similarity Attribute?       Image: Constant Vector       Image: Constant Vector         Want Coberent Energy Attribute?       Image: Constant Vector       Image: Constant Vector         Save similarity3d parameters for AASPI Geometric Attribute Workflow       Save parameters and return to geom_attr_workflow	
(c) 2008-2012 AASPI - The University of Oklahoma Execute sin	nilarity3d

X AASPI - sof3d (Release	Date: September 21, 2012)	The GUL for sof3d: the output from the
Eile	Help	
sof3d - 3d structure-or	riented filtering	imagefilt3d and the similarity3d will be input to
Input Volume (*.H):	_soft_test/Seismic_data.H Browse	this program. Enter the proper parameters and
Inline Dip (*.H):	nline_dipgeom_attr_0.H Browse	then save and exit (green arrow). The parameter
Crossline Dip(*.H):	sline_dipgeom_attr_0.H Browse	file gets saved automatically as a sof3d.parms file
Similarity Input (*.H):	_similarity_geom_attr_0.H Browse	
*Unique Project Name:	geom_attr	
Suffix:	0	
Typical Extended		
dTheta Interpolate:	1	
Rectangular Window	? OFF	
Window height (s):	0.01	
Inline Window Radius	5: 110.015	
Crossline Window Ra	adius: 110	
Search overlapping l	lateral windows? ON	
Search overlapping	vertical windows? ON	
Retain DC Bias?	OFF	
Filter control by simil	arity, s :	
s_low: 0.75	s_high: 0.85	
Desired attribute vol	umes	
Want PC Filtered dat	ta? 🔽 Number of Eigenvectors: 1	
Want alpha-trimmed	d mean filtered data ? 🔽 Percent rejected on each end:	
Want LUM-filtered d	ata ?	
Want mean-filtered	data?	
Save sof3d parameter	ers for AASPI Geometric Attribute Workflow	
Save parameters a	and return to geom attr workflow	
(c) 2008-2012 AASPI -	University of Oklahoma Execute sof3d	

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Suffix:	0				
Verbose:	Г				
Use MPI:	ব				
Processors per node:	12				
Node List:	plite hematit	e			
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	2				
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Course and the feetime of Fib2d	butes	<u>dip3d</u>			
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Save parameters for imagefilt3c Save parameters for similarity3c Save parameters for sof3d attrib Ro Rup similarity3d attributes	butes I attributes I attributes butes	✓     dip3d       ✓     jmagefilt3       ✓     similarity3       ✓     sof3d		-	
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Save parameters for imagefilt3c Save parameters for similarity3c Save parameters for sof3d attril Re-Run similarity3d attributes Save parameters for Curvature3 Save parameters for Euler curva Save parameters for GLCM3D at Save parameters for spec_cmp Execute Geometrical Attribut	d attributes d attributes butes 3d attributes ature attributes attributes attributes attributes	Øip3d       Øip3d       Ímagefilt3       Similarity3       Øip3d	d id milarity3d 3d rature	<b>\</b>	

Note that with the saving the **sof3d**, the re-run **similarity3d** is activated. The re-run similarity calculates again the energy-ratio and Sobel-filter attributes, taking in the PC or LUM filtered seismic dataset (output from the **sof3d** program). Thus, it is sometimes better to re-run the **similarity3d** attributes so that the attributes are created on the filtered volume.

File	He
Compute 3D volumetric structural or amplitude curvature	a,
hape components, reflector rotation and reflector converg	ence
	Curvature Type
ype 1: STRUCTURAL CURVATURE (k). Click here to switch	to Amplitude Curvature!
line Component (* H):	nline_dipgeom_attr_0.H Browse
rossline Component (*.H):	sline_dip_geom_attr_0.H Browse
Jnique Project Name:	geom_attr
uffix:	0
onstant multiplier of k (makes k values either in km or kft):	1000
max operator radius in(m or ft):	2200.3
ertically compress the operator (fraction):	1
Eractional Derivative Device La c	ambida Min. Jass a so
riacuonal Derivative Power: 10.5	anoda Miri. [311.148
Bandpass	
Bandpass is ON. Click here to Disable!	
lambda1: 21783 lambda2: 1244.59 lambda3:	622.296 lambda4: 311.148
weight 1: 1 weight 2: 0.66 weight 3:	0.33 weight 4: 0
Most Lissful Cupature Attributes	
Principal Curvatures (k1 >= k2)  Strike of the  Reflector Rotation about the normal  Reflector Co	Principal Curvatures Psil and Psi2
T Relector Rotabolt about the normal T Relector Co	nvergence
Shape Measurements	
Curvedness C Shape Index C Dome C Ridge C	Saddle 🗖 Valley 🗖 Bowl
Historical curvature attributes	
□ Max and Min Curvatures ( kmax  >=  kmin ) □ Most	Pos and Most Neg Curvature 🗖 Strike of Most Pos and Most Neg Curvatures
Г Gaussian Curvature Г Mea	n Curvature 🔽 Dip Component of Curvature
Strike Component of Curvature     Azim	1. of Min and Max Curvatures
Save curvature3d parameters for AASPI Geometric Attribu	te Workflow
Save parameters and return to geom attr workflow	
The second	

The GUI for **curvature3d**; the output from the **imagefilt3d** will be input to this program. Enter the proper parameters and then save and exit (*green arrow*). The parameter file gets saved automatically as a curvature3d.parms file.

*Note*: Only one of the curvature programs (either structural or amplitude curvature) can be executed at one time. By default, the structural curvature GUI will pop up. To run the attributes for the amplitude curvature, it can be done separately or one can toggle the button (highlighted in blue) to change into amplitude curvature.

<u>F</u> ile			H
ructrural Curvature	mplitude curvature		
euler_curvature - Gene	erate Euler (apparent) curva	ture	
c1 curvature (*.H):	k1_geom_attr_0.H	Browse	
(2 curvature(*.H):	k2_geom_attr_0.H	Browse	
(1 strike (*.H):	k1_strike_geom_attr_0.H	Browse	
<2 strike(*.H):	k2_strike_geom_attr_0.H	Browse	
nline Dip (*.H):	nline_dipgeom_attr_0.H	Browse	
Crossline Dip(*.H):	sline_dipgeom_attr_0.H	Browse	
Unique Project Name:	geom_attr		
Suffix:	0		
	Output parameters		
First output azimuth (0	-90		
Last output azimuth ((	)-180): 60		
Output azimuth incren	nent (0-180): 30		
Save parameters for A	ASPI Geometric Attribute Wo	orkflow	
Save euler_curvatur	e (k) parameters and return	to geom at	tr_workflow
Execute Euler Curvatur	e (k)		

The GUI for **euler\_curvature**; the output from the **curvature3d** will be the input to this program, thus the button for **euler\_curvature** gets activated only after saving the **curvature3d** parameters. Enter the proper parameters and then save and exit (*green arrow*). The parameter file get saved automatically as a euler\_curvature.parms file.

*Note*: By default, the structural Euler curvature GUI will pop up. To run the attributes for the amplitude Euler curvature, it can be done separately or one can go to the next tab to change into amplitude Euler curvature. Also remember that if the parameters for structural curvature are saved for the **curvature3d** program, the parameters for structural Euler curvature should be saved and vice-vesa.

X AASPI - geom_attr_workflow (Release	Date: August 1	9, 2012)	-		×
Eile AASPI_Utilities					Help
Geometrical Attribute we Step 1: Select Input seismic file an	orkflow runs t d define the r	he attributes in nodes (to be us	batch mode ed for all the	process)	
Input seismic data file name (*.H):	_soft_test/S	eismic_data.H	Browse		
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Suffix:	0				
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Save parameters for Euler curvatu	re attributes	Euler curv	ature		
Save parameters for GLCM3D attri	butes	፼lcm3d			
Save parameters for spec_cmp at	ributes	₽ <u>spec_cmp</u>			
Execute Geometrical Attribute	Norkflow	-			
(c) 2008-2012 AASPI - The Univer	sity of Oklaho	oma 🚺		eset select	tions

#### Step 3: Execute the geometric attribute workflow

Above shows the GUI for one of the typical workflows. To execute the workflow, press the "Execute Geometrical Attribute Workflow" (*green arrow*). The reset selection button (*orange arrow*) can be pressed if one wants to reset the program selections.

A typical workflow for *structural geometrical attributes* will be dip3d>imagefilt3d>similarity3d>sof3d>rerun-similarity3d>k\_curvature3d>k\_euler\_curvature>

A typical workflow for *amplitude geometrical attributes* will be dip3d>imagefilt3d>similarity3d>sof3d>rerunsimilarity3d>e\_curvature3d>e\_euler\_curvature>glcm3d>spec\_cmp



The above shows the terminal window after saving all the \*.parms (parameter) files. The aaspi\_env.parms is a text file with the information of the input seismic file, the project and the suffix names and the MPI settings. We can do cat *aaspi\_env.parms* to see the file contents. The other \*.parms contents the saved parameters from all saved programs.

At any time, the terminal window will show the progress of the workflow. The text file *aaspi\_geom\_attr\_workflow.out* can be checked to see the completion status of the workflow or whether there is any error in the execution of the program.