

THE PRESTACK STRUCTURE-ORIENTED FILTERING WORKFLOW

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Introduction

Structure-Oriented Filtering (SOF) involve many programs in AASPI software. Particularly, prestack SOF is tedious and time-consuming. To make the task more automatic, we designed a workflow GUI similar to AASPI geometric attribute workflow.

How to run

AASPI program aaspi_util_prestack (Release Date: April 8, 2015)
Eile Prestack Utilities Display Tools Other Tools
SEGY to AASPI format conversion (migrated data)SEGY to AASPI format conversion (unmigrated)SEGY to AASPI format conversion (raw data)AASPI to SEGY format conversion (single file)AASPI Workflows
AASPI Prestack Workflows
AASPI - Coherent Noise Suppression Workflow
AASPI <u>C</u> oherent Noise Suppression Workflow
AASPI - Prestack Structure-Oriented Filtering Workflow
AASPI Prestack Structure-Oriented Filtering Workflow

The AASPI Prestack Structure-Oriented Filtering Workflow GUI can be invoked from the **aaspi_util_prestack** as shown above or by typing in **aaspi_sof_prestack_workflow** separately in the terminal window. The following workflow GUI will then pop up.

AASPI - sof_prestack_workflow (Release D	ate: March 12, 2015)	
Eile AASPI_Utilities		<u>H</u> elp
Prestack structure-oriented filter w Step 1: Select Input seismic file and define the (these parameters will be used for all work	rorkflow: e processor nodes flow programs)	
Input seismic data file name (*.H): ropped_t	est_3500_aa.H Browse 1	
*Unique Project Name: cropped_test_3500		
Suffix: aa	2	
Verbose:		
Processors per node: 8 5		
Node List: localhost	6	
Cove workflow environment persons		
Step2 : Save parameter files for desired pro	grams	
Define parameters for prestack_mute	□ prestack_mute	
Define parameters for stack	□ <u>s</u> tack	
Define parameters for dip3d	□ dip3d	
Define parameters for filter_dip_components	filter_dip_components	
Define parameters for similarity3d	□ <u>s</u> imilarity3d	
Define parameters for sof_prestack	□ <u>sof_prestack</u>	
Step3 : Execute Iterative Structure-rOriented F	iltering Workflow	
Execute Iterative Structure-Oriented	Filtering Workflow	
		Reset selections

Step 1: Save the workflow environment parameters

In step 1 we need to input the prestack migrated seismic data 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 for **euler_curvature**, all of the other processes run on MPIs (*Arrow 4*). Mention the processors per nodes and the node list. In this case, we use the local machine with 8 processors, therefore we set the number of processors per node to be 8 (*Arrow 5*) and the node list to be "localhost" by default (*Arrow 6*).

After entering all the parameters, they are saved (*Green Arrow*) and will be subsequently used for all the processes. Note that, initially, all the steps will be disabled. When the "Save

Environment parameters" is clicked the *prestack_mute* and the *stack* buttons will be enabled as shown. These two accepts only the seismic amplitude as inputs and are thus activated. The subsequent buttons will be activated after their input file criterions are met.

AASPI - sof_prestack	_workflow (Release D	ate: March 12	, 2015)		
Eile <u>A</u> ASPI_Utilities					<u>H</u> elp
Prestack strue Step 1: Select Input seise (these parameters wi	cture-oriented filter v mic file and define th Il be used for all work	vorkflow: e processor no kflow program	odes s)		
Input seismic data file n	ame (*.H): ropped_t	:est_3500_aa.H	Browse		
*Unique Project Name:	cropped_test_3500	_			
Suffix:	aa				
Verbose:					
Use MPI:	$\overline{\mathbf{v}}$				
Processors per node:	8				
Node List:	localhost				
Step2 : Save paramete	er files for desired pro	grams			
Define parameters for p	restack_mute	□ _prestact	_mute		
Define parameters for st	ack	□ <u>s</u> tack		1	
Define parameters for di	ip3d	□ <u>d</u> ip3d		Enabled	
Define parameters for fil	lter_dip_components	⊑ <u>f</u> ilter_di	Ena	bled	
Define parameters for si	milarity3d	□ <u>s</u> imilarit	y3d		
Define parameters for so	of_prestack	□ <u>s</u> of_pres	tack		
Step3 : Execute Iterative	Structure-rOriented I	Filtering Work	low		
Execute Iterative S	tructure-Oriented	Filtering W	orkflow		
					Reset selections

Step 2: Save the parameters for each program

In this step each of the program is opened and their parameters are saved. The buttons are activated only when their input criterion are met. For example, the **dip3d** gets activated only after we open and save the *stack* parameters. The next figure shows the GUIs for **prestack_mute**, **stack**, **dip3d**, **filter_dip_component**, **similarity3d**, and **sof_prestack** programs as an example.

For the **prestack_mute** program, the user needs to specify muting times and offsets by clicking "Offset_Vs_Time Table" button (*Arrow 1*). Up to 5 offset bin-time pairs can be defined for the top mute (*red box*). The top mute is linearly interpolated between those pairs. Offset bin is not in distance unit (ft, m), but rather an axis specifically designed for AASPI-migrated data set. The user can determine the offset bin-time pairs simply by displaying the migrated gather and left-

clicking on the position where a mute point is prefered. The offset bin – time pair is displayed in the bottom of the plot (*blue arrow*). These pairs must be listed in increasing order of offset bin. If less than 5 pairs are needed, make sure the unused pairs are blank (i.e. do NOT put zeros there). After the table is set up, click *Execute* button (*Arrow 2*) and close the offset-vs-time table GUI (*Arrow 3*), then save parameters for **prestack_mute** (*green arrow*).

AASPI - prestack mute(Release Date: April 8, 2015)	AASPI - Plot (temp_crop_T0sRpx.H)
∐ <u>F</u> ile <u>H</u> elp]] <u>F</u> ile
Mute prestack gathers	
AASPI prestack mute. Output file will has prefix 'muted'.	
Input prestack seismic data filename (*.H): propped_test_3500_aa.H Browse	Input Seismic Amp
Unique Project Name: cropped_test_3500	
Suffix:	
Offset vs. time Table Offset vs. Time Table 1	8
Save parameters and return to workflow	and the second se
AASPI - offset vs. time table	P
Eile Help	
AASPI Offset vs. Time Table	μ Ξ ω
Offset Bin Time (unit1)	
Mute pick 1 0 0.0	The Contract of the local division of the lo
Mute pick 2 20 0.096	
Mute pick 3	
Mute pick 4 Mute pick 5	
N	Uffset ho.
2 Execute	Offset no.=20, Time (s)=0.096 (-0.106803)

🖪 AASPI - program stack (Relea	ase Date: April 8, 2015)	
<u>F</u> ile		<u>H</u> elp
stack		
Range- and azimuth-limited s	tack of migrated data volumes	
AASPI Input (*.H):	muted_cropped_test_3500_aa.H	Browse
Unique Project Name:	cropped_test_3500	
Suffix:	aa	
Alpha Trim Mean (Percent):	0	
Axis 2: min azimuth no. deg:	1	
Axis 2: max azimuth no. deg:	8	
Axis 2: inc azimuth no. deg:	1	Stack along axis 2?
Axis 3: min offset no. ft:	1	
Axis 3: max offset no. ft:	30	N
Axis 3: inc offset no. ft:	1	Stack along axis 3?
Axis 4: min cdp no. ft:	2	
Axis 4: max cdp no. ft:	203	
Axis 4: inc cdp no. ft:	1	
Axis 5: min line no. ft:	2	
Axis 5: min line no. ft:	275	
Axis 5: inc line no. ft:	1	
Compute RMS amplitude rather than stack sum?		
Save parameters and return	to workflow	

For the **stack** program, it is required that the result is fully stacked (i.e. stacked in both offset and azimuth direction). Thus, make sure all the "Stack along axis x" are checked (*yellow arrow*). Then hit save parameters (*green arrow*).

AASPI - program dip3d (Release Date: March 12, 2015)	AASPI - program dip3d (Release Date: March 12, 2015)
]] <u>F</u> ile	
dip3d - calculate 3d dip attributes using analytic semblance	din2d - calculate 2d din attributer using analytic comblance
Seismic Input (*.H): stack_cropped_test_3500_aa.H Browse	appa - carculate bu up attributes using analytic semblance
Unique Project Name: cropped test 3500	Seismic Input (*.H): stack_cropped_test_3500_aa.H
Suffix:	Unique Project Name: cropped test 3500
	Suffix
Typical Extended	
Use MPI:	Typical
Processors per node: 8	
Node list: localhost	
Verbose:	Delta Theta (degrees): 4
Build an LSF Script? Do Not Run Under LSF	Conversion velocity (ft/s) : 15000
Maximum LSF run time (hrs): 10	Dip Window Height (s): $0.01 - 5x$ completing interval
LSF Batch Queue:	= 5x sample interval
Inline window radius (ft): $165 = 2X$ Inline Interval	Convert theta_max from degrees to s/trace: 0 Calculate
Crossline window radius (ft): $165 = 2x \text{ xline interval}$	
Kuwahara window search:	Want Dip Components Result? M required
Search overlapping vertical windows?:	Want Dip Magnitude Result?
Search overlapping lateral windows?:	Want Dip Azimuth Result?
	Want Dip Confidence Result?
Remove mean from window?	Save dip3d parameters for subsequent workflow
Use L1-norm rather than L2-norm?:	Save assumption and action to Worldfow CUI
First Line Out: 2	
Last Line Out: 275	
First CDP Out: 2	
Last CDP Out: 203	

For the **dip3d** program, it is recommended to set up inline and crossline windows radii (under "extended" tab) to be twice as much as cdp and line intervals (red box). This will further enhance the filter while only moderately increase computational effort. After that, go back to "typical" tab. Recommended dip window height is 5x sample interval. Next, save parameter for **dip3d** (green arrow).

AASPI - program fil	ter_dip_components (Release Date: March 12, 2015)
<u>F</u> ile	
filter_dip_components Such filter benefits all	- filters inline and crossline components of structural dip in 3 subsequent dip-guided and dip-based attribute computations
Inline Dip (*.H):	inline_dip_cropped_test_3500_aa.H
Crossline Dip(*.H):	crossline_dip_cropped_test_3500_aa.H
Dip Confidence (*.H):	conf_cropped_test_3500_aa.H
Unique Project Name:	cropped_test_3500
Suffix:	aa
Typical Extended	
Filter to apply:	LUM
Smooth values > alp	oha % of max confidence. alpha: 0.5
Lower and Upper Per	rcentile, beta: 20
MSMTM range:	5
Window length (ft):	165
Window width (ft):	165
Window height (s):	0.01
Use rectangular_wine	dow?:
Save filter_dip_comp	ponents parameters for subsequent Workflow
Save parameters a	ind return to Workflow GUI

For the **filter_dip_component** program, it is recommended to use LUM filter type in order to preserve edges (such as faults). Also, it is a good practice to set window length, width, and height to be the same with **dip3d** program (*red box*). Then hit save parameters (*green arrow*).

Similarly, for the **similarity3d** program, windows length, width, and height should be kept the same as in **dip3d** (*red box*). The recommended similarity for SOF filter is energy ratio similarity

AASPI - program similarity3d (Release Date: March 12, 2015)				
<u>F</u> ile				
similarity3d - calculate 3d sim	ilarity-type attributes			
Seismic Input Filename (*.H):	stack_cropped_test_3500)_aa.H		
Inline Dip Filename (*.H):	inline_dip_lum_filt_crop	ped_test_3500_aa.H		
Crossline Dip Filename (*.H):	crossline_dip_lum_filt_cr	ropped_test_3500_aa.H		
Average Power Spectrum Filename (*.H):				
*Unique Project Name:	cropped_test_3500			
Suffix:	aa			
Typical Extended				
dTheta Interpolate (>0):	1			
Similarity Power (>0):	2			
Similarity Mean (0->1):	0			
Use constant test vector in outer product similarity?				
Balance data vector before computing covarian	rs 🗖 ice matrix?			
Analysis Window Definition	Parameters			
Analysis Window Definition Use data-adaptive analysis	Parameters	Use a fixed height window		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I	Parameters windows? Half Height (unit1):	Use a fixed height window		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window Taper applied to vertical an	Parameters windows? Half Height (unit1): ralysis window (Percent):	Use a fixed height window		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt	Parameters windows? Half Height (unit1): nalysis window (Percent): r, f_ref er spectrum): ive windows)	Use a fixed height window 0.01 20 80		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit	Parameters windows? Half Height (unit1): nalysis window (Percent): r, f_ref er spectrum): ive windows) i2) :	Use a fixed height window 0.01 20 80 165		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical an Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Parameters windows? Half Height (unit1): nalysis window (Percent): r, f_ref er spectrum): ive windows) i2) : unit2):	Use a fixed height window 0.01 20 80 165 165		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window M Taper applied to vertical an Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis wi	Parameters windows? Half Height (unit1): nalysis window (Percent): r, f_ref er spectrum): ive windows) iz) : unit2): indow?	Use a fixed height window 0.01 20 80 165 165		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis wi	Parameters windows? Half Height (unit1): halysis window (Percent): /, f_ref er spectrum): ive windows) i2) : unit2): indow?	Use a fixed height window 0.01 20 80 165 165 I%		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis with Results Want Energy Ratio Similarit	Parameters windows? Half Height (unit1): halysis window (Percent): r, f_ref er spectrum): ive windows) h2) : unit2): indow? ty Attribute?	Use a fixed height window 0.01 20 80 165 165		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis with Results Want Energy Ratio Similarit Want Outer Product Similarit	Parameters windows? Half Height (unit1): halysis window (Percent): r, f_ref er spectrum): ive windows) 12) : unit2): indow? ty Attribute?	Use a fixed height window 0.01 20 80 165 165		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis wi Results Want Energy Ratio Similarit Want Outer Product Similarity Want Sobel Filter Similarity	Parameters windows? Half Height (unit1): halysis window (Percent): r, f_ref er spectrum): ive windows) i2) : unit2): indow? ty Attribute? v Attribute? v Attribute? v Attribute?	Use a fixed height window 0.01 20 80 165 165 1		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis wi Results Want Energy Ratio Similarit Want Outer Product Similarity Want Sobel Filter Similarity Want Gradient Component	Parameters windows? Half Height (unit1): halysis window (Percent): r, f_ref er spectrum): ive windows) iz) : unit2): indow? ty Attribute? v Attribute? v Attribute? v Attribute? v Attribute? v Attribute? v Attribute? v Attribute? v v Attribute? v v v v v v v v v v v v v v v v v v v	Use a fixed height window 0.01 20 80 165 165		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis wi Results Want Energy Ratio Similarit Want Outer Product Similarity Want Sobel Filter Similarity Want Gradient Component Want Total Energy Attribut	Parameters windows? Half Height (unit1): halysis window (Percent): /, f_ref er spectrum): ive windows) iz) : unit2): indow? ty Attribute? v Attribute? Attribute? st Attribute? st Attribute? w	Use a fixed height window 0.01 20 80 165 165 165 Iv		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical an Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis with Results Want Energy Ratio Similarity Want Sobel Filter Similarity Want Gradient Component Want Total Energy Attribut Want Coherent Energy Attribut	Parameters windows? Half Height (unit1): halysis window (Percent): r, f_ref er spectrum): ive windows) i2) : unit2): indow? ty Attribute? v Attribute? v Attribute? s Attribute? ise? fibute? with the state of the state	Use a fixed height window 0.01 20 80 165 165 iv		
Analysis Window Definition Use data-adaptive analysis Fixed Covariance Window I Taper applied to vertical ar Reference frequency (Percentile of average pow (Used to define data-adapt Inline Window Radius (unit Crossline Window Radius (Use rectangular analysis wi Results Want Energy Ratio Similarity Want Energy Ratio Similarity Want Sobel Filter Similarity Want Gradient Component Want Total Energy Attribut Want Coherent Energy Attribut	Parameters windows? Half Height (unit1): halysis window (Percent): , f_ref er spectrum): ive windows) i2) : unit2): indow? ty Attribute? IV ty Attribute? IV ty Attribute? IV ts At	Use a fixed height window 0.01 20 80 165 165 167		

(yellow arrow), but the user can choose different type of similarities. Note that if multiple similarity types are selected, only the highest-priority similarity volume is used for SOF filter. The priority is listed in decreasing order, from energy ratio, outer product, to sobel filter similarities. In this case, only energy ratio similarity is used by **sof_prestack** program.

AASPI - program sof_prestack (Release Date: March 12, 2015)	
Eile	
Prestack structure-oriented filtering Filters migrated data along structural dip and across flattened offset bins	
Input 4D or 5D Volume (*.H): D:\AASPI_GIT\aaspi_testing\d_mig_gathers_cropped_test_3500_aa.H	Browse
Inline Dip (*.H): inline_dip_lum_filt_cropped_test_3500_aa.H	Browse
Crossline Dip(*.H): crossline_dip_lum_filt_cropped_test_3500_aa.H	Browse
Similarity Input (*.H): energy_ratio_similarity_cropped_test_3500_aa.H	Browse
*Unique Project Name: cropped_test_3500	
Suffix: aa	
Typical Extended	
Dip angle interpolation value:	
Rectangular Window? OFF	
Window height (s): 0.01	
Inline_window radius (ft): 165	
Crossline_window radius (ft): 165	
Offset window radius (no. of traces):	
Azimuth window radius (no. of traces):	
Search overlapping lateral windows? ON	
Search overlapping vertical windows? ON	
Retain DC bias?	
Compute rejected noise? ON 1	
Filter control by similarity, s :	
s_low: 0.5 s_high: 0.6 s_centered_window: 0.95	
Desired attribute volumes	
Want PC-filtered data?	
Want alpha-trimmed mean filtered data ? 🔽 Percentile bounds on each end of LUM filter: 20	
Want LUM-filtered filtered data ? 🔽 Percent rejected on each end: 20	
Want mean-filtered data?	

For the **sof_prestack** program, again, windows length, width, and height should be consistent with **dip3d** program. Since it is very computationally intensive for the program to filter along offset direction, it is recommended that maximum offset windows radius is 1 (*red box*). The user can choose to smooth along azimuthal direction, but it is not recommended for survey that exhibits anisotropy because we want to preserve the azimuthal displacement caused by anisotropy. If the user wants to see the difference between original data and filtered data, "compute rejected noise" should be turned on (*Arrow 1*). It is also recommended to output LUM-filtered data instead of PC-filtered data to preserve edges (*Arrow 2*). Next, hit save parameters (*green arrow*).

AASPI - sof_prestack_	workflow (Release D	ate: March 12, 2015)		
Eile <u>A</u> ASPI_Utilities				<u>H</u> elp
Prestack strue Step 1: Select Input seisr (these parameters wi	cture-oriented filter w mic file and define the II be used for all work	vorkflow: e processor nodes flow programs)		
Input seismic data file n	ame (*.H): ropped_t	est_3500_aa.H Browse		
*Unique Project Name:	cropped_test_3500			
Suffix:	aa			
Verbose:	Γ			
Use MPI:	V			
Processors per node:	8			
Node List:	localhost			
Step2 : Save paramete	r files for desired pro	grams		
Define parameters for pr	restack_mute	prestack_mute		
Define parameters for st	ack	₩ <u>s</u> tack		
Define parameters for di	p3d	₩ dip3d		
Define parameters for fil	ter_dip_components	✓ <u>filter_dip_compone</u>	ents	
Define parameters for si	milarity3d	✓ similarity3d		
Define parameters for so	of_prestack	☑ sof_prestack		
Step3 : Execute Iterative	Structure-rOriented F	iltering Workflow		
Execute Iterative S	tructure-Oriented	Filtering Workflow		
				Reset selections

Step 3: Execute the geometric attribute workflow

After all the parameters are set up for all the sub programs, click the execute button to start the workflow (*green arrow*). If the user wants to reset parameter settings, click "Reset selections" button (*orange arrow*) and start over again.