

THE PRESTACK STRUCTURE-ORIENTED FILTERING WORKFLOW

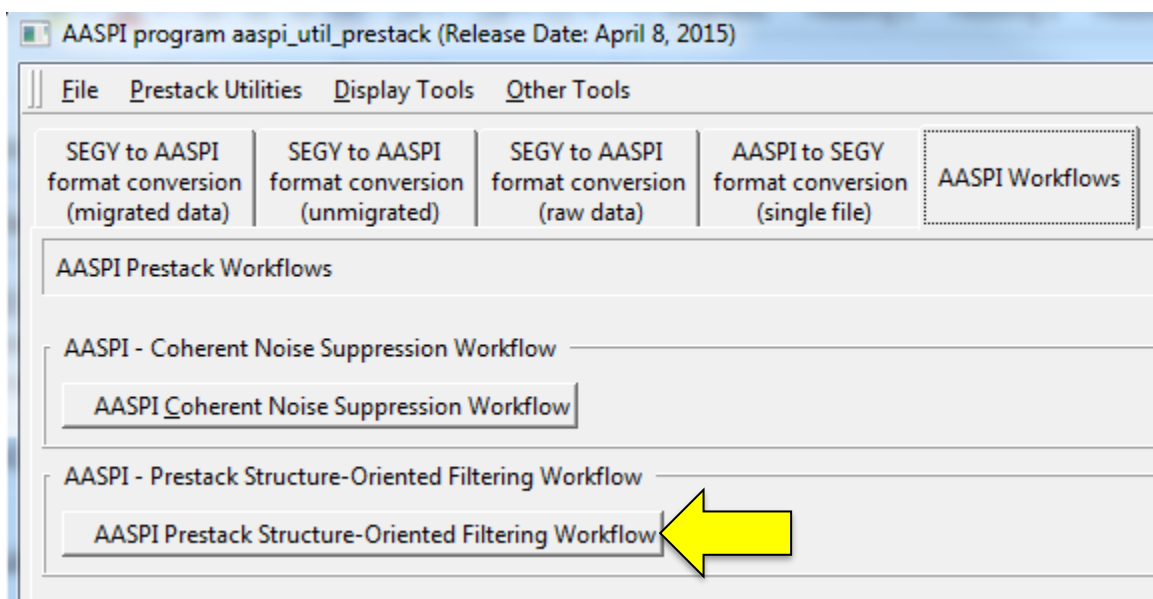
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Introduction

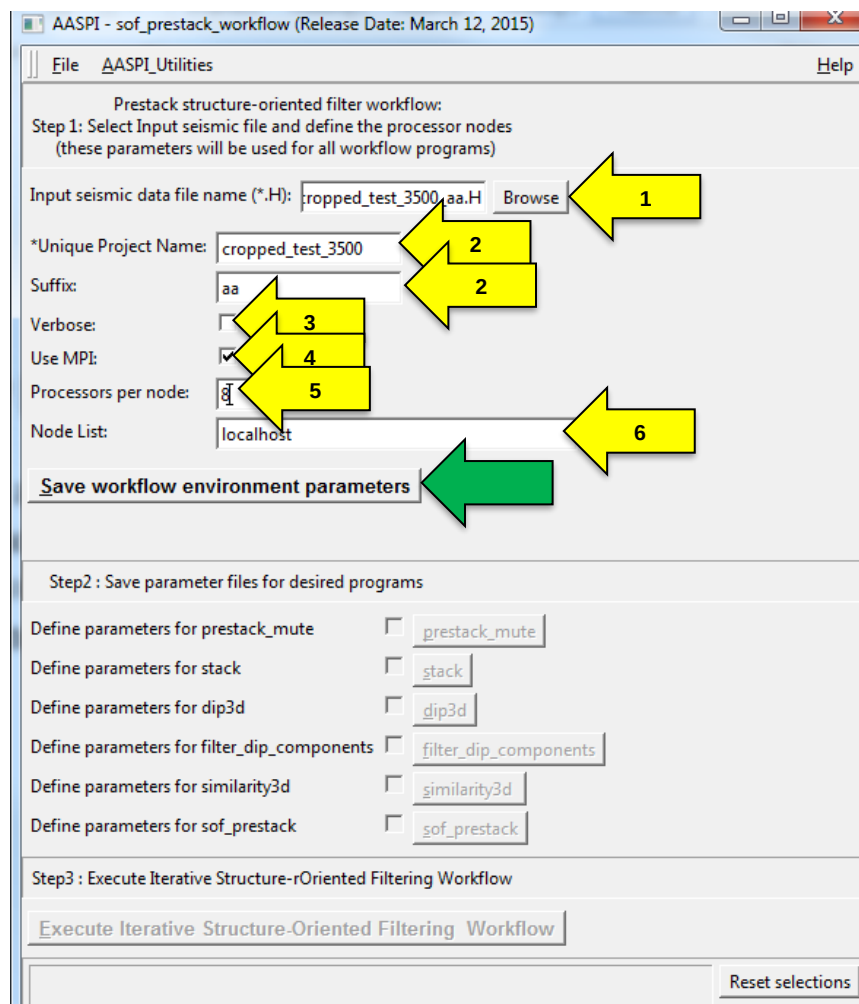
Structure-Oriented Filtering (SOF) involve many programs in AASPI software. Particularly, prestack SOF is tedious and time-consuming. To make the task more automatic, we designed a workflow GUI similar to AASPI geometric attribute workflow.

How to run



Prestack Workflows: Prestack Structure-Oriented Filtering

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.



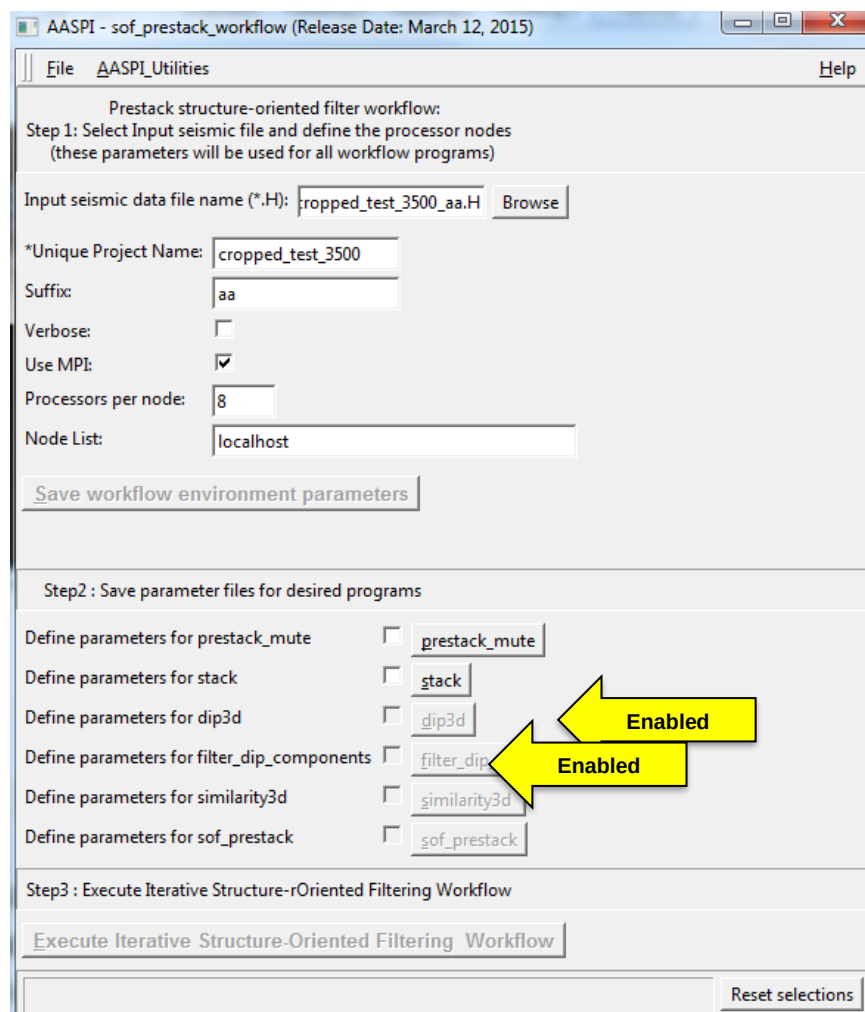
Step 1: Save the workflow environment parameters

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

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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.



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-

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clicking on the position where a mute point is preferred. 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)

Mute prestack gathers |

AASPI prestack mute. Output file will has prefix 'muted'.

Input prestack seismic data filename (*.H):

Unique Project Name:

Suffix:

Offset vs. time Table **Offset vs. Time Table** 1

2

AASPI - offset vs. time table

AASPI Offset vs. Time Table |

	Offset Bin	Time (unit1)
Mute pick 1	0	0.0
Mute pick 2	20	0.096
Mute pick 3		
Mute pick 4		
Mute pick 5		

2

AASPI - Plot (temp_crop_T0sRpx.H)

Input Seismic Amp (Panel: 3)

Time (s)

Offset no.

Offset no.=20, Time (s)=0.096 (-0.106803) 3

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AASPI - program stack (Release Date: April 8, 2015)

File Help

stack

Range- and azimuth-limited stack 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

Axis 3: min offset no. ft: 1

Axis 3: max offset no. ft: 30

Axis 3: inc offset no. ft: 1

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?

Stack along axis 2? ☒

Stack along axis 3? ☒

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*).

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The image displays two screenshots of the AASPI program dip3d GUI (Release Date: March 12, 2015). The left screenshot shows the 'Extended' tab, and the right screenshot shows the 'Typical' tab. Both screenshots have annotations: a yellow arrow pointing to the 'Extended' tab on the left and the 'Typical' tab on the right. A red box on the left highlights the 'Inline window radius (ft): 165' and 'Crossline window radius (ft): 165' fields, with text indicating they are '2x inline interval' and '2x xline interval'. A red box on the right highlights the 'Dip Window Height (s): 0.01' field, with text indicating it is '5x sample interval'. A green arrow on the right points to the 'Save parameters and return to Workflow GUI' button.

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).

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AASPI - program filter_dip_components (Release Date: March 12, 2015)

filter_dip_components - filters inline and crossline components of structural dip in 3. Such filter benefits all 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 > alpha % of max confidence. alpha: 0.5

Lower and Upper Percentile, beta: 20

MSMTM range: 5

Window length (ft): 165

Window width (ft): 165

Window height (s): 0.01

Use rectangular_window?: ☐

Save filter_dip_components parameters for subsequent Workflow

Save parameters and return to Workflow GUI

AASPI - program similarity3d (Release Date: March 12, 2015)

similarity3d - calculate 3d similarity-type attributes

Seismic Input Filename (*.H): stack_cropped_test_3500_aa.H

Inline Dip Filename (*.H): inline_dip_lum_filt_cropped_test_3500_aa.H

Crossline Dip Filename (*.H): crossline_dip_lum_filt_cropped_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 vectors before computing covariance matrix? ☐

Analysis Window Definition Parameters

Use data-adaptive analysis windows? ☐ Use a fixed height window

Fixed Covariance Window Half Height (unit1): 0.01

Taper applied to vertical analysis window (Percent): 20

Reference frequency, f_ref (Percentile of average power spectrum): 80 (Used to define data-adaptive windows)

Inline Window Radius (unit2): 165

Crossline Window Radius (unit2): 165

Use rectangular analysis window? ☒

Results

Want Energy Ratio Similarity Attribute? ☒

Want Outer Product Similarity Attribute? ☒

Want Sobel Filter Similarity Attribute? ☒

Want Gradient Components Attribute? ☒

Want Total Energy Attribute? ☐

Want Coherent Energy Attribute? ☐

Save similarity3d parameters for subsequent workflow

Save parameters and 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 (*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.

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AASPI - program sof_prestack (Release Date: March 12, 2015)

File

Prestack structure-oriented filtering
Filters migrated data along structural dip and across flattened offset bins

Input 4D or 5D Volume (*.H): D:\AASPI_GIT\aaapi_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: 1

Rectangular Window? OFF

Window height (s): 0.01

Inline_window radius (ft): 165

Crossline_window radius (ft): 165

Offset window radius (no. of traces): 1

Azimuth window radius (no. of traces): 0

Search overlapping lateral windows? ON

Search overlapping vertical windows? ON

Retain DC bias? OFF

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? ☐ Number of Eigenvectors: 1

Want alpha-trimmed mean filtered data? ☐ Percentile bounds on each end of LUM filter: 20

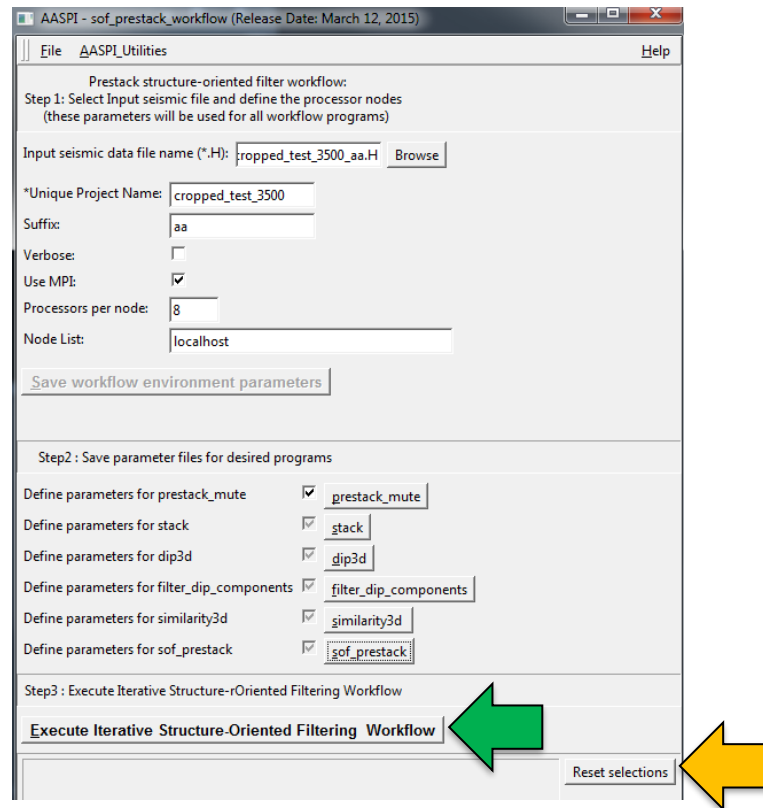
Want LUM-filtered filtered data? ☒ Percent rejected on each end: 20 **2**

Want mean-filtered data? ☐

Save parameters and return to workflow **3**

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*).

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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.