Computing seismic QC attributes, fold and offset sampling in RadExPro software

In this manual we will show how to compute the seismic QC attributes (amplitude and frequency characteristics, signal/noise ratio) as well as the fold and offset sampling (the latter being understood as the number of non-empty offset bins in each individual CDP bin) in RadExPro software.

If you want to recreate all the steps described in this document on your own, you should download the AttributesAndFoldDemo project. The project was specially designed to demonstrate only those steps that we need:

- Several auxiliary header fields which are absent by default were added to the project using the **Database/Edit header fields...** menu command: OFF_SMPL, AMP, AMP_N, FREQ, SNR and Q.
- A 3D onshore seismi survey data fragment was loaded into the project and had geometry assigned to it;
- The data were binned by CDP using the **3D CDP Binning** tool;

Only a small fragment consisting of just 20 shots was used in order to save space. However, we will be treating it as if it was an actual full-scale survey: the processing flows will be run in the *framed mode*, and instead of resorting the data in the **Trace Input** module at the flow input stage, we will use the specialized **Resort** module optimized for large data volumes (which is really unnecessary for such a small amount of data).

The computed attributes and fold values will be saved to the trace headers. The next step – mapping – is covered in the tutorial on <u>Working with crossplots in RadExPro – seismic survey map, fold and offset</u> <u>sampling maps, and signal-to-noise ratio map</u>.

Viewing the source data

Open the AttributesAndFoldDemo project. The main project window should look like this:



Open the already created **010 data view** flow. Add the Trace Input module to the flow, and select the 3Ddemo_raw_200ffids input data set (it is located on the **survey 1** level). Select the **Get all** options to load the data in the order in which they are stored without resorting:

	Trace Input
Data Sets	Sort Fields
3Ddemo_raw_20ffids	Image: Second state of the second s
Add Delete	Add Delete
OK Cancel	C Select from file File C Database object Choose C Get all

Press **OK** and add the Screen Display module to the flow. Select the **Grey** display mode and set the **Number of traces** per screen to 1000:

	Display parameters		×
From t= 0.0 to 0.0 to t Scale 10 Number of traces 1000 X Scale 10 Rotate Ensemble boundaries	WT/VA display mode C WT/VA C WT C VA C None	Normalizing factor C None C Entire screen C Individual	Gain 0.3 Bias(%) 0 Show every N-th trace 1
 □ Variable spacing	Variable density display mod Grey R/B Custom Define None Data/velocity	e Normalizing factor None Entire screen Individual	Gain 0.3 Bias(%) 0 I Show palette
Axis Show headers Plot headers Header mark Picks/polygons settings Save Template	O Display data O Display velocity	et velocity Palette Min.ve Max.ve	e range I (m/s) 500.0 el (m/s) 1500.0

Press the **Axis...** button and set up the horizontal axis labels. We want to display the shot (FFID) numbers every time their value changes as well as the number of each channel which is a multiple of 50:

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		Axis Parameters
Primary lines	Time dt Values 1000.0 🔽	Traces • Different dx Values FFID • Interval • Multiple 10.0 ✓
Secondary lines	100.0	CHAN C Different CHAN Interval 50.0 C Multiple
Font 15	Cancel	Margins Left axis 20 mm Top axis 20 mm margin 20 mm

The flow should look like this:

<u>/</u>	AttributesAndFoldDemo/area 1/survey	1/010 data view	- 🗆 🗙
Help Options Database Tools Run Trace Input <- 3Ddemo_raw_20ffids Screen Display	Flow mode Exit Trace Input SEG-Y Input SEG-D Input SEG-B Input SEG-2 Input SEG-3 Input	Trace Output SEG-Y Output RAMAC/GPR JOFUC GSSI Input Super Gather	Data I/O 🔺
	Load Text Trace Data Input Trace Header Math	Text Output Data Output Header<->Dataset Transfer	Geometry/Headers
MB1 - Drag module; Ctrl+MB1 - Copy modu	le; MB1 DblClick - Module Parameters; MB2 - Tog	gle module; Ctrl+MB2 DblClick - Delet	te // v

We could already run it as it is, but we should treat it as if we were dealing with a large 3D survey which exceeds the computer's RAM capacity – that is, enable the framed flow mode. To do this, select the **Flow mode...** menu command and set the **Framed** flow mode in the dialog box. You can set the **Frame** width to, for example, 5000 traces.

Flow I	Flow Mode				
Flow data processing mode C All at once (all in memory) © Framed					
VO mode Image: Constraint of the state					
Frame Selection	Frame Selection Honor ensemble boundaries				
Frame width	Cancel				

Important: Do not forget to uncheck the **Honor ensemble boundaries** box. In RadExPro, the ensembles are created by the Trace Input module, and an ensemble is considered to include all traces with matching values of the headers selected as the first N Sort Fields (N is specified in the **Number of**

Ensemble Fields field). Since we skipped sorting in our example (by enabling the **Get all** option), the software doesn't know where the ensemble boundaries are, and an attempt to honor the ensemble boundaries will lead to the program trying to read all the data into the RAM (and in case of an actually large survey, this will eventually result in an error since the program will run out of memory).

After setting the framed flow mode, a blue framed mode indicator will appear in the lower left corner of the flow editor window:

Z	AttributesAndFoldDemo/area 1/survey 1	/010 data view	- 🗆 🗙
Help Options Database Tools Run	Flow mode E <u>x</u> it		
Trace Input <- 3Ddemo_raw_20ffids Screen Display	Trace Input SEG-Y Input SEG-D Input SEG-B Input SEG-2 Input SCS-3 Input Load Text Trace	Trace Output SEG-Y Output RAMAC/GPR ЛОГИС GSSI Input Super Gather Text Output	Data I/O 🔺
	Data Input	Data Output	Company literation
Framed mode	Trace Header Math	Header<->Dataset Transfer	-Geometry/Headers
MB1 - Drag module; Ctrl+MB1 - Copy module	; MB1_DblClick - Module Parameters; MB2 - Togg	le module; Ctrl+MB2 DblClick - Dele	te // v

Now you can run the flow by pressing **Run** in the editor menu. The data for the first frame (5000 traces) will be shown in the **Screen Display** window.

				AttributesAnd	FoldDemo/area	1/survey 1/01	0 data view [18:55:37]				×
Zoom	Common parameters	View Tools	Exit/Stop flow Exit									Help
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FFID	1						2		-1.0	0e-04 0	1.00e-04	
CHAN	50	150	250	350	450	550	50	150	250	350	450	
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1000-												
2000-												
4000-												
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button on the toolbar and then click on any trace to

You can see that the data are displayed in the same order as they are stored on the disk, and are sorted

Н

by FFID: CHAN (shot: channel). Press the view the headers associated with it:

				AttributesAndF	oldDemo/area 1/su	vey 1/010 data view [14:38:56]		- 🗆 🗙
Zoom	<u>C</u> ommon parameters	View <u>T</u> ools E	xit/ <u>S</u> top flow E <u>x</u> it			-		~	<u>H</u> elp
A							Headers Display		^
		R) 🕘 🍙		50000		View			
						3Ddemo_raw_20ffids		^	-
						AAXFILT	0.00000		
FFID	1					AAXSLOP	0.00000		1.00e-04
CHAN	50	150	250	350	450	AMP	0.00000		450
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					*	BLOCKSHIFT1	0.0000		*
-		1	10.8		1. Ale 1.	BLOCKSHIFTZ	0.00000		
+	1100				A	CCP Y	108305		
+							0.00000		
t t						CDP	650/92		1
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1000	- The -	1/10253		//注意		CDP Y	70123 37500		
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-	23.12.		*		*	FBPICK	0.00000		
+	-2- 33				31	FFID	1		
+	10 m		1	1		FREQ	0.00000		
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+			8			MATRIX H1Y	0.00000		
1			1	19		MATRIX_H1Z	0.00000		
1			Ň		1	MATRIX_H2X	0.00000		
4000	1. 1. 1. 1.		2 A A A A A A A A A A A A A A A A A A A	8%	14	MATRIX_H2Y	0.00000		
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T 100 -						MATRIX_PITCH	0.00000	~	
Tr:489 S	am:2/1 Amp:-7.9e-00	5 t:542.0ms		1					//. ♥
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Here you can make sure that geometry is assigned to the data and that CDP numbers are properly calculated.

Since the flow is running in the framed mode, when you exit the Screen Display module by selecting **Exit** from the menu, the next frame will be launched, and its contents will be shown in the new module window. To exit the module and stop the execution of the flow, press **Exit/Stop flow** (a **Stop Flow Break** message will appear on the screen – this is normal program behavior).

Data resorting

To compute the CSP seismogram quality attributes, we'll first need to resort the data to the FFID:OFFSET domain – this will allow us to interactively define the space-time windows for various wave types.

Let us create a new processing flow named **020 resort FFID OFFSET**.

RadExPro 2014.2 >>> AttributesAndFoldDemo	- 🗆 🗙
<u>H</u> elp <u>O</u> ptions <u>D</u> atabase Tools <u>Ex</u> it	
-area 1-survey 1 010 data view 020 resort FFID OFFSET	
MB1 DblClick - Default action; MB2 - Context menu; MB1 - Drag flow	v to line to cc 🥢 🗸

Open the flow and add the Resort* module to it (asterisk after the module name means that it should be the only module in the flow). This is a specialized module for quick sorting of large amounts of data.

Specify the **Input dataset** in the module parameter window – 3Ddemo_raw_20ffids.

Enter the name of the resorted **Output dataset**– for example, 3Ddemo_FFID_OFFSET (we'll place it at the **survey 1** database level, where our input data are stored):

Choose dataset				
Object <u>n</u> ame 3Dden	no_FFID_OFFSET			
Objects 3Ddemo_raw_20ffids		Location □- area 1 □- survey 1 □- 010 data view □- 020 resort FFID OFFSET		
Rename De	elete	Ok Cance	el	

Define the Sort Fields: **Primary sort** – FFID, **Secondary sort** – OFFSET, and enter the maximum RAM buffer size to be used by the module. The buffer size should not exceed half of the installed memory capacity. In our example we'll use a 2048 Mb buffer.

The module	parameter	window	should	look like	this:
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	Resort params	×
Input dataset Output dataset	area 1\survey 1\3Ddemo_raw_20ffids area 1\survey 1\3Ddemo_FFID_OFFSET	
Primary sort Secondary sort	FFID Memory buffer 2048 OFFSET	мв
	OK Cancel	

Press **OK**. Since the Resort module processes the input dataset independently, the framed flow mode won't be needed in this case. The resulting flow can be run immediately:

<u>/</u>	Attri	butesAnd	Fold	IDemo/area 1/survey 1	/020 resort FFID OFFSET		×	
<u>H</u> elp	<u>O</u> ptions	<u>D</u> atabase	Тос	ols Run Flow mode E	cit			
Resor	t*					——Data I	/0 /	5
				Trace Input	Trace Output			
				SEG-Y Input	SEG-Y Output			
				SEG-D Input	RAMAC/GPR			
				SEG-B Input	ЛОГИС			
				SEG-2 Input	GSSI Input			
				SCS-3 Input	Super Gather			
				Load Text Trace	Text Output			
				Data Input	Data Output			
MB1 - I	Drag modu	ıle; Ctrl+ME	31 - C	opy module; MB1 DblClick -	Module Parameters; MB2 - Toggle	e module; Ctrl	+ // 、	/

Defining the attribute computation windows

We want to evaluate the RMS amplitude of the signal in the target reflection zone, apparent frequency in the target reflection zone, and RMS amplitude of the microseism for each CSP seismogram. For this, we'll first need to define the space-time windows corresponding to the target reflections and the microseism. We will do it interactively in the Screen Display module.

Create a new flow – 030 attributes:

RadExPro 2014.2 >>>	AttributesAndFoldDemo – 🗖 🗙
<u>H</u> elp <u>O</u> ptions <u>D</u> atabase Tools	Exit
-area 1 - survey 1 - 010 c - 020 r - 030 a	lata view esort FFID OFFSET httributes
MB1 DblClick - Default action; MB2 -	Context menu; MB1 - Drag flow to line to copy 🏑 🗸

Open the flow and add the Trace Input module to it. Select the resorted data set and specify FFID and OFFSET as the Sort Fields. Since the input data are already sorted in this manner, no additional sorting and, therefore, no associated time losses will occur when reading the data.

The space-time windows for attribute computation are associated with time and offsets only; therefore, they can be defined interactively without reading all the data. Let us read the first 10 CSP seismograms and the entire offset range contained in them. To do this, specify the following trace selection mask in the **Selection** field:

1-10:*

This selection mask means that only traces with the values of 1 to 10 will be selected from the **Sorting fields** list for the first header (FFID), and all traces will be selected for the second header (OFFSET).

The Trace Input window should look like this:

Data Sets Sort Fields SDdemo FFID OFFSET Image: Sort Fields Image: Sort Fields Image: Sort Fields Image: Add Delete Image: Add Delete Image: Add Delete Image: Sort Fields Image: Sort Fields Image: Add Delete Image: Sort Fields Image: Sort Fields Image: Add Delete Image: Sort Fields Image: Sort Fields Image: Sort Fields		Trace Input
SDdemo_FFID_OFFSET Image: Strength of the strength o	Data Sets	Sort Fields
Add Delete Add Delete From batch list	3Ddemo_FFID_OFFSET	FFID Image: Second system OFFSET Image: Second system Image: Second system Image:
1-10:* C Select from file File O Database object Ok Cancel O Get all	Add Delete	Add Delete
OK Cancel OK Cancel		C Select from file File
OK Cancel OK Cancel		
OK Cancel C Get all		O Database object Choose
	OK Cancel	C Get all

Add the Screen Display module to the flow. Set the horizontal scale (**Number of traces**) to 1000 traces per screen and check the **Ensemble boundaries** box to have the module display the gaps between the ensembles. Since the **Number of Ensemble Fields** is set equal to 1 in the Trace Input module, and the first Sort Field in the list is FFID, the software will consider each set of traces with the same FFID header value as a separate ensemble (i.e. the ensembles will correspond to the CSP seismograms in this case).

	Display parameters	×
From t= 0.0 to 0.0 r t Scale 10 Number of traces 1000 r X Scale 10 Rotate Ensemble boundaries	WT/VA display mode Norm WT/VA Norm WT/VA Norm WT E VA In None None	Gain 0.3 Gain 0.3 Gain 0.3 Bias(%) 0 Show every 1 N-th trace
 Variable spacing field Space to maximum ensemble width Ensembles' gap 2 Muliple panels 0 Use excursion 2.0 traces 	Variable density display mode Grey C R/B C Custom Define Data/velocity	nalizing factor Gain 0.3 one Bias(%) 0 dividual V Show palette
Axis Show headers Plot headers Header mark Picks/polygons settings Save Template	O Display data O Display velocity Set veloc	ity Palette range Min.vel (m/s) 500.0 Max.vel (m/s) 1500.0

The module parameter window should look like this:

Press the **Axis...** button to set up the horizontal axis labels. We want to display the FFID values every time they change as well as the OFFSET values with the interval of 100 traces:

	Axis Parameters
Time dt ¥alues Primary lines 1000.0 ☑	Traces
Secondary lines 100.0	C Different ○ Interval ○ Multiple
Font 15 Ok Cancel	Margins Left axis 20 mm Top axis 20 mm margin 20 mm

Since only a few seismograms are added to the flow, we will not enable the framed mode, and will run the flow as it is:

Z Att	tributesAndFoldDemo/area 1/survey	1/030 attributes	- 🗆 🗙		
Help Options Database Tools Run Trace Input <- 3Ddemo_FFID_OFFSET Screen Display	Flow mode Exit Trace Input	Trace Output	—Data I/O	^	
	SEG-Y Input SEG-D Input SEG-B Input SEG-2 Input	SEG-Y Output RAMAC/GPR ЛОГИС GSSI Input			
	SCS-3 Input Load Text Trace Data Input	Super Gather Text Output Data Output	- (1) I		
	Trace Header Math	Header<->Dataset Transfer	y/Headers		
MB1 - Drag module; Ctrl+MB1 - Copy module; MB1 DblClick - Module Parameters; MB2 - Toggle module; Ctrl+MB2 DblClick - Delete 🏾 🖉 🗸 🗸					

AttributesAndFoldDemo/area 1/survey 1/030 attributes [16:15:24] Zoom non parameters.. View <u>Tools</u> Exit/Stop flow Exit Help ⊕ (OS) (ک ا B FFID -1.00e-04 ò 1.00e-04 1 2 OFFSET 35 683 1005 1365 1755 2241 531 870 1202 1591 1993 1000-2000-3000-4000 Tr:237 Sam:319 Amp:-1.59e-005 t:638.0ms

The Screen Display module window will open. Note that there are gaps between the seismograms:

Open the **Tools/QC polygons** menu and select the **New polygon** command to create a new attribute computation window (new polygon):



A window with the list of polygons will pop up. The polygon highlighted in the list (the newly created Polygon 0) can be interactively defined and edited on the screen:



Draw the polygon around the target reflection area by left-clicking consecutively on the screen. You can define the polygon using any seismogram – it will be displayed identically on all of them:



When you are done creating the polygon, right-click its name in the polygon list and select **Save as** from the pop-up menu. Let us save the polygon to the database at the current flow level:

Choose Po	olygon 🛛 🗙
Object <u>n</u> ame reflections	
<u>O</u> bjects	Location → area 1 → survey 1 → 010 data view → 020 resort FFID OFFSET → 030 attributes
Rename Delete	Ok Cancel

Now let us create another polygon in the microseism zone, above the first arrival, in a similar manner:



Let us save it to the same location under the name **noise**.

The window creation step is now complete. If you want, you can scroll through the Screen Display window to view other seismograms and make sure that the **reflections** and **noise** polygons are defined correctly and identically for all of them before exiting.

Attribute computation in the windows

Now that we have the polygons for attribute computation, we can start actually computing the attributes. We will continue working with the same flow.

First of all, right-click the Screen Display module to deactivate it ("comment it out"). This way, the module will be skipped when the flow is run:

<u>/</u>				At	tributesAndFo	oldDe	emo/area 1/survey 1/030 attributes		×
<u>H</u> elp	<u>O</u> ptions	<u>D</u> atabase	Tools	Run	Flow mode	E <u>x</u> it			
Trace	Innut <-	RDdemo F		FESET				Data I/	0 ^
***50	reen Disn	lav			Trace Input		Trace Output		
	i cen biop				SEG-Y Input		SEG-Y Output		
					SEG-D Input		RAMAC/GPR		
					SEG-B Input		ЛОГИС		
					SEG-2 Input		GSSI Input		
					SCS-3 Input		Super Gather		
					Load Text Tr	ace	Text Output		
					Data Input		Data Output		
								-Geometry/Heade	rs
					Trace Heade	r Mat	th Header<->Dataset Transfer		
MB1 - I	//B1 - Drag module; Ctrl+MB1 - Copy module; MB1 DblClick - Module Parameters; MB2 - Toggle module; Ctrl+MB2 DblClick - Delete								

Now let us add the Ensemble QC module to the flow. This module allows evaluating several quality attributes for the seismograms:

		Ensemble QC Co	ompute		
Window Polygonal area 1\su C Square Min offset 10 Min 0	l urvey 1\030 : 000	Load polygon attributes\reflections Max offset 2000 Max 2000	Amplitude Mean 2D RMS Mean 1D I	Trace Header AMP ▼ RMS	
Signal / Noise Compute S Min 0 Max 12 Max 10	: ratio Gignal/Noise 25 D	Ratio REC_H2OD Mode: • Normal ○ Use mo ○ Treat mo ○ Treat fire	▼ del trace odel trace as signal st trace in each ens	l semble as model	
Resolution Compute resolution SOU_H2OD Max time of ACF to 50 Mode: Use mean ACF Use mean ACF Use mean CCF Use separate CCFs Normalize CF (affects Apparent Frequency estimation also) Apparent frequency Compute apparent frequency FREQ					
		OK	Cancel		

Set the parameters as shown in the screenshot above: select the target reflections polygon – **reflections** as the computation **Window** (as an alternative, you can define a rectangular window by entering the time and offset ranges). We will compute the 2D RMS amplitude values within the window and save them to the AMP header for each trace.

Since we are going to skip the signal-to-noise correlation ratio and resolution computation for now, uncheck the **Compute Signal/Noise Ratio** and **Compute resolution** boxes.

The apparent signal frequency will be evaluated based on the number of zero transients and saved to the FREQ header field.

Z Att	tributesAndFoldDemo/area 1/survey	1/030 attributes – 🗖 🗖	×
Help Options Database Tools Run Trace Input <- 3Ddemo_FFID_OFFSET ***Screen Display Ensemble QC <- reflections	Flow mode Exit Trace Input SEG-Y Input SEG-D Input SEG-B Input SEG-2 Input SCS-3 Input Load Text Trace Data Input Trace Header Math	Data I/O Trace Output SEG-Y Output RAMAC/GPR JOFIC GSSI Input Super Gather Text Output Data Output Geometry/Headers Header<->Dataset Transfer	^
MB1 - Drag module; Ctrl+MB1 - Copy modu	le; MB1 DblClick - Module Parameters; MB2 -	Toggle module; Ctrl+MB2 DblClick - Delete	<u>/</u> ~

Now our flow should look like this:

Let us add another instance of the Ensemble QC module to compute the amplitude in the microseism window. The easiest way to do it is to copy the module already added to the flow (Ctrl+click).

Z Att	tributesAndFoldDemo/area 1/survey	1/030 attributes	- • ×			
<u>Help Options Database Tools Run</u> Trace Input <- 3Ddemo_FFID_OFFSET ***Screen Display Ensemble QC <- reflections Ensemble QC <- reflections	Flow mode Exit Trace Input SEG-Y Input SEG-D Input SEG-B Input SEG-2 Input SCS-3 Input Load Text Trace Data Input Trace Header Math	Trace Output SEG-Y Output RAMAC/GPR JOFIC GSSI Input Super Gather Text Output Data Output Geomet Header<->Dataset Transfer	— Data I/O try/Headers	^		
MB1 - Drag module; Ctrl+MB1 - Copy modu	MB1 - Drag module; Ctrl+MB1 - Copy module; MB1 DblClick - Module Parameters; MB2 - Toggle module; Ctrl+MB2 DblClick - Delete 🏸 🗸 🗸					

Now open the second module instance and change the parameters: replace the polygon defining the attribute computation window with the microseism polygon – **noise**. Select AMP_N as the header where the RMS amplitude values will be saved. Uncheck the apparent frequency computation box:

	Ensemble QC Comp	ute	×			
Window Polygonal area 1\survey 1\0 Square Min offset 1000 Min 0	Load polygon 30 attributes\noise Max offset 2000 Max 2000	Amplitude ○ Mean ● 2D RMS ○ Mean 1D	Trace Header AMP_N 💌 RMS			
Signal / Noise ratio Compute Signal/No Min 0 Max 125 Max 10	ise Ratio REC_H2OD Mode: • Normal O Use model t O Treat model C Treat first tra	race trace as signa ace in each ens	l semble as model			
Resolution Compute resolution SOU_H2OD Max time of ACF to 50 Mode: Use mean ACF Use mean CCF Use separate CCFs Normalize CF (affects Apparent Frequency estimation also) Apparent frequency Compute apparent frequency FREQ Mode: Number of sign changes ACF Mean ACF						
	OK Cancel					

Now our flow should look like this:

Z Att	tributesAndFoldDemo/area 1/survey	1/030 attributes – 🗖 🗙
Help Options Database Tools Run Trace Input <- 3Ddemo_FFID_OFFSET ***Screen Display Ensemble QC <- reflections Ensemble QC <- noise	Flow mode Exit Trace Input SEG-Y Input SEG-D Input SEG-B Input SEG-2 Input SCS-3 Input Load Text Trace Data Input Trace Header Math	Data I/O A Trace Output SEG-Y Output RAMAC/GPR JOINC GSSI Input Super Gather Text Output Data Output Geometry/Headers Header<->Dataset Transfer
MB1 - Drag module; Ctrl+MB1 - Copy modu	le; MB1 DblClick - Module Parameters; MB2 -	Toggle module; Ctrl+MB2 DblClick - Delete // ♥

Add the Trace Header Math module to compute the derivative attributes: signal-to-noise ratio and summary quality attribute Q which will enable quick identification of defective seismograms:

Trace Header Math	×
\$NR = [AMP]/[AMP_N] Q=cond([SNR] <5 [FREQ] < 20, 0, 1)	^
	~
Line 1 Pos 1 OK Cancel Check syntax Load template Save template	e

Enter the following expressions in the module editing window:

SNR = [AMP]/[AMP_N] Q = cond([SNR] < 5 | [FREQ] < 20, 0, 1)

In the first line, the signal-to-noise ratio (SNR) is calculated as the ratio of the target reflection amplitude to the microseism amplitude.

In the second line, if the signal/noise ratio is less than 5 or the apparent frequency is less than 20 Hz, the Q header value is set to 0 (i.e. defective), otherwise it is set to 1. This is just a simplest example of how summary quality factors can be freely defined in the software. Of course, you can make such factors more sophisticated – for instance, by defining a score-based quality assessment system which best suits the survey area and the customer's requirements.

Next, we need to save the resulting attribute values (for now they exist only in the data headers within the flow). We could export them to a new dataset using Trace Output, but creating another copy of the source data just because of the changed headers appears impractical.

Another method that can be useful in some cases is to insert the Trace Length module before saving the data and specify the new trace length of 0. This way the traces will be truncated, and the resulting dataset will essentially contain nothing but headers. This technique can be employed if some further intensive operations involving headers only are planned – such as header smoothing, computation of derivative attributes etc.

In our example we will save the modified headers using the most convenient and universal method – by overwriting the source dataset headers with the help of the Header<->Dataset Transfer module designed for header exchange between the flow and the data stored on disk.

Add the Header<->Dataset Transfer module to the flow. Specify the processing direction (**FROM header TO dataset**) and select the target dataset where the headers from the flow will be written (3Ddemo_FFID_OFFSET).

Specify the headers by which the module will determine the correct trace (**Match by fields**). In this case, since the attributes were evaluated for each CSP seismogram as a whole, a single FFID header should be sufficient.

List the headers to be overwritten (**Assign fields**). These are all the attributes that we've just computed: AMP, AMP_N, FREQ, SNR, Q:

Header<->Dataset Transfer				
Header transfer direction C FROM dataset TO header Image: C FROM dataset TO header				
Dataset 3Ddemo_FFID_OFFSET Match by fields				
FFID				
Assign fields				
AMP, AMP_N, FREQ, SNR, Q		·		
OK Cancel				

Our flow is now ready. Before running it, open the Trace Input module and disable the seismogram input restrictions since we will need all the data. Replace the selection mask with *:* (as shown below):

	Trace Input ×
Data Sets 3Ddemo_FFID_OFFSET	Sort Fields FFID Image: Sort Fields OFFSET Image: Sort Fields Image: Sort Fields Image: Sort Fields
Add Delete	Add Delete C Selection *:*
OK Cancel	C Select from file File C Database object Choose C Get all

Before running the flow, don't forget to enable the framed execution mode in the **Flow mode...** menu (we are treating the data as if we were dealing with a full-scale 3D survey):

Flow Mode ×			
Flow data processing mode C All at once (all in memory) © Framed			
I/O mode © Normal © Batch Edit batch			
Frame Selection Honor ensemble boundaries Frame width 5000			
OK Cancel			

IMPORTANT! This time make sure that the **Honor ensemble boundaries** box is checked. We don't want the seismogram to be split in the middle along the frame boundary in the process of attribute computation!

Run the final flow:

	AttributesAndFoldDemo/	/area 1/survey 1/030 attributes	- 🗆 🗙
Help Options Database Tools Run Flow mode Exit			
Trace Input <- 3Ddemo_FFID_OFFSET ***Screen Display Ensemble QC <- reflections Ensemble QC <- noise Trace Header Math Header<>Dataset Transfer -> 3Ddemo_FFID_OFFSET Framed mode	Trace Input SEG-Y Input SEG-D Input SEG-B Input SEG-2 Input SCS-3 Input Load Text Trace	Trace Output SEG-Y Output RAMAC/GPR ЛОГИС GSSI Input Super Gather Text Output	Data I/O 🔺
Trace Input <- 3Ddemo_FFID_OFFSET Data I/O #**Screen Display Trace Input Trace Output Ensemble QC <- reflections			1.*

After the flow is executed, you can view the completed header fields using the Geometry Spreadsheet tool if you like.

Fold computation

Before computing the fold, we need to resort the data to generate CDP seismograms. Let us create a new flow – the easiest way to do it is to copy the existing sorting flow and change its parameters. Click and hold the flow with the mouse cursor and drag it onto the **survey 1** box:



A dialog box will open, prompting you to enter the new flow name. Let us name it **040 resort CDP OFFSET**:

New line name	
040 resort CDP OFFSET	
ок	Cancel

A new flow should appear in the project tree:

RadExPro 2014.2 >>> AttributesAndFoldDemo	- 🗆 🗙
<u>H</u> elp <u>O</u> ptions <u>D</u> atabase Tools <u>Ex</u> it	
 area 1survey 1 = 010 data view - 020 resort FFID OFFSET - 030 attributes - 040 resort CDP OFFSET 	
MB1 DblClick - Default action; MB2 - Context menu; MB1 - Drag flow to lir	ne to copy 🥢 🗸

Open it and change the Resort module parameters – input and output dataset name and primary Sort Field:

	Resort params	×	
Input dataset Output dataset	area 1\survey 1\3Ddemo_FFID_OFFSET area 1\survey 1\3Ddemo_CDP_OFFSET		
Primary sort Secondary sort	CDP Memory buffer 2048 OFFSET	мв	
	OK Cancel		

Run the flow to generate the new dataset sorted by CDP: OFFSET.

Now let us move on to the fold computation itself. Let us create a new **050 compute fold** flow for this purpose:

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7	RadExPro 2014.2 >>> AttributesAndFoldDemo	- 🗆 🗙
<u>H</u> elp <u>Options</u> <u>D</u> atabas	se Tools Exit 1 010 data view 020 resort FFID OFFSET 030 attributes 040 resort CDP OFFSET 050 compute fold	NEW ^
MB1 DblClick - Default act	ion; MB2 - Context menu; MB1 - Drag flow to line to copy	//. *

Add the Trace Input module to the flow (specify 3Ddemo_CDP_OFFSET as the input dataset and select its current CDP: OFFSET sorting in the **Sort Fields** field to generate the CDP seismograms):

	Trace Input
Data Sets	Sort Fields CDP OFFSET Number of Ensemble Fields 1 Note: Ensembles will be defined
	by this number of sort fields.
Add Delete	Add Delete
☐ From batch list	**
	Select from file File
OK Cancel	C Get all

Now add the Compute Fold module. This module allows computing both the Total fold – the number of traces in each input CDP ensemble, and Offset sampling – the number of non-empty offset bins in each CDP ensemble.

Specify the following module parameters:

	QC Fold	Count	×
Offset binning parame Min offset: -6000 Min azimuth: 0	ters: Max offset: Max azimuth:	6000 Range: 100	
Outputs: Offset sampling: OFF Total fold: TR_	_SMPL V	Mininum offset PICK1 Maximum offset PICK2	~
	OK	Cancel	

In this case the offset binning range selected for the offset sampling computation is a priori larger than the actual range available in the data, the offset bin size is set to 100 m, and the full azimuth range from 0 to 360° is taken into account.

The offset sampling values will be saved to the OFF_SMPL header, and the total fold values – to the TR_FOLD header.

In addition, the module saves the maximum and minimum offset values encountered in the ensemble for each ensemble. Specify any 2 unused headers for this purpose – for example, PICK1 and PICK2.

Finally, let us save the total fold and offset sampling computation results to the input dataset header. We'll use the already familiar Header<->Dataset Transfer module for this:

Header<->Dataset Transfer		
Header transfer direction O FROM dataset TO header Image: Construction for the state of		
Dataset Datase		
CDP		
OFF_SMPL, TR_FOLD		
OK Cancel		

The flow is ready. Don't forget to enable the **Framed mode** before running the flow. The **Honor ensemble boundaries** box should be checked, since each CDP seismogram is to be processed in full:

Flow Mode 🛛 🗙				
Flow data processing mode C All at once (all in memory) © Framed				
l/O mode ⊙ Normal ○ Batch	Edit batch			
Frame Selection Honor ensemble boundaries Frame width 5000				
ОК	Cancel			

The final flow should look like this:

Z	AttributesAndFoldDemo/area 1/survey 1/050 compute fold		
Help Options Database Tools Run Flow mode Exit			
Trace Input <- 3Ddemo_CDP_OFFSET Compute Fold Header<->Dataset Transfer -> 3Ddemo_CDP_OFFSET	Trace Input SEG-Y Input SEG-D Input	Trace Output SEG-Y Output RAMAC/GPR	— Data I/O \land
Framed mode	SEG-B Input SEG-2 Input	ЛОГИС GSSI Input	
MB1 - Drag module; Ctrl+MB1 - Copy module; MB1 DblClick - Mo	dule Parameters; MB2 - Toggle module; Ctrl+MB2 DblClick - Delete		//. *

After the flow is executed, you can view the completed header fields using the Geometry Spreadsheet tool if you like.

The next step – mapping – is covered in the tutorial on <u>Working with crossplots in RadExPro – seismic</u> <u>survey map, fold and offset sampling maps, and signal-to-noise ratio map</u>.