How to create a Zone-of-Interest Tuning Cube in OpendTect.

This is a workflow to create a zone-of-interest tuning cube (a cube which represents local amplitude spectrum calculated using spectral decomposition along seismic horizon) as described by Greg Partyka in 1999.

How to create a Zone-of-Interest Tuning Cube in OpendTect. Step 1: Compute attribute grids on a horizon of interest. Step 2: Create a zone-of-interest tuning cube from horizon attribute grids. References Step 1: Compute attribute grids on a horizon of interest.

		Attribute Set 3D		- 🗆 🗙
File				
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Attribute set AmplSpectr_to_Cub	<all> •</all>	Spectral Decomposition -	?	
SD SD10 SD15 SD20 SD25 SD30 SD40 SD45 SD50 SD55 SD60 SD75 SD80 zindex Cube01 Cube03	Input Data Transform type Time gate (ms) Output frequency (Hz	4 Dip steered median filter ● FFT ○ CWT -28 28 Display Time/Frequency panel 10.0 ÷ Step 5.0 ÷	Select	
	Attribute Name	SD	Add as new	
Save on Close				Close Help

1. Define Spectral Decomposition attribute:

2. Go to Processing > Create Horizon Output > Attributes > 3D.

	Calculate Horizon Data from 3D	- 🗆 🗙
Quantity to output	SD	▼ 😑 Select
Attribute Name	SD10	
Fill undefined parts	⊖Yes ● No	
Calculate on Horizon 😽	Demo 6> FS8	✓
Batch execution	Single Process 🔹 🛟 Options	
	Run	Close 🕜 Help

- 3. Repeat these two steps to compute Spectral Decomposition grids on the horizon: for example, from 10 to 80 Hz with a step of 5.
- 4. To QC all components:
 - Add the horizon to the 3D scene
 - Right-click on it > Add > HorizonData
 - Choose all components

-	Horizon Data 🗕 🗖 🗙
Select on the and 'Pa Make s and tha	one or more attributes to be displayed horizon. After loading, use 'Page Up' age Down' buttons to scroll. sure the attribute treeitem is selected at the mouse pointer is in the scene.
• •	Filter *
🗆 sim	1
SD	10
SD	15
SD	20
I SD	25
I SD	30
	40
I SD	45
SD	50
SD	55
SD	60
SD	65
SD	70
SD	75
✓ SD	80
	OK 🛛 Cancel

• Use *PageUp*/*PageDown* to scroll through the grids

Step 2: Create a zone-of-interest tuning cube from horizon attribute grids.

		Attribute Set 3D		- 🗆 🗙
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Attribute set AmplSpectr_to_Cub	<all> •</all>	Horizon	- ?	
SD	Input Data	4 Dip steered median filter	- Select	
SD10 SD15	Horizon 🖶	Demo 6> FS8	✓ 😑 Select	
SD20 SD25	Output	Horizon Data -		
SD30 SD35	Select Horizon Data	SD10 •		
SD40 SD45				
SD50 SD55				
SD60 SD65				
SD70 SD75				
SD80				
Cube01				
Cube03				
	Attribute Name	SD10	Add as new	
Save on Close			Ci	ose 🕜 Help

1. For each horizon grid define *Horizon* attribute as such:

The attribute propagates attribute grid value along the whole trace. The seismic cube is provided for the geometry reference.

In this example attributes *SD10*, *SD15*, ..., *SD80* are defined based on the horizon data of *Demo 6 --> FS8* horizon (Note that the attributes are named the same way as the horizon data: don't be confused, those are not the same objects).

2. Define *Reference* attribute which at each sample is equal to *Z* index (sample number): 1,2,3,...

8		Attribute Set 3D		_ 🗆 🗙
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Attribute set AmplSpectr_to_Cub	<all> •</all>	Reference	- ?	
	Input Data	1 Din steered median filter	- Select	
SD 10	input Data	+ Dip steered median inter		
SD15	Desired Output	Z index 🔹		
SD20				
SD25				
SD30				
SD35				
SD40				
SD45				
SD50				
SD60				
SD65				
SD70				
SD75				
SD80				
zindex				
Cube01				
Cube02				
Cube03				
	Attribute Name	zindex	Add as new	
Save on Close				Close Hala
E Gave on Close				Ciuse Heip

- 3. Define a chain of *Mathematics* attributes (each *Mathematics* attribute can have the max of 8 variables) as shown below:
- **Cube01** = SD10 at sample 1, SD15 at sample 2, ... SD35 at sample 6, then **Cube02**

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tribute set AmplSpectr_to_Cube	<a >	- M	athematics	- ?	
D		/ MathFunctions · sqrt (S	quare root)	• Insert	t 🚆 🍧
D10					
D15	Formula (like 'nearstk + c0 * farstk')	Zi == 1 ? SD10 : (Zi == 2 ? SD1	15 : (Zi == 3 ? SD20 : (Zi ==4 ? SD25 : (Zi ==	=5 ? SD30 : (Zi == 6 ? SD35 : next)))))	Set
D20					
D25	For 'Zi' use	zindex	7		
D30					
D35	For 'SD10' use	SD10	•		
D40					
D45	For 'SD15' use	SD15	-		
DS0					
D55	For 'SD20' use	SD20	*		
D65					
D70	For 'SD25' use	SD25	-		
D75					
D80	For 'SD30' use	SD30	•		
ndex		0000			
ube01	ZT Eor SD35' use	SD35			
ube02		3033			
ube03	E an hand was	0.4-02	-		
	For next use	Cubeoz	•		
		0.1.01			
	Attribute Name	CubeU1		Add as ne	ew 📷

8		Attribute Set 3D	×
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Attribute set AmplSpectr_to_Cube	<all></all>	 Mathematics 	- ?
SD		/ MathFunctions sqrt (Square root)	🔹 Insert 🚆 🥌 🔒
SD10			
SD15	Formula (like 'nearstk + c0 * farstk')	Zi==7 ? SD40 : (Zi==8 ? SD45 : (Zi==9 ? SD50 : (Zi==10 ? SD55 : (Zi==11 ? SL	D60 : (ZI==12 ? SD65 : next))))) Set
SD20	For '7i' use	vindex.	
SD25	FOI ZI USE	LINGA	
SD35	For 'SD40' use	SD40 -	
SD40			
SD45	For 'SD45' use	SD45 -	
SD50			
SD55 SD60	For 'SD50' use	SD50 ·	
SD65			
SD70	Tor 'SD55' use	SD55 -	
SD75			
SD80	For 'SD60' use	SD60 -	
Zindex	2 V		
Cube01	For 'SD65' use	SD65 •	
Cube03	—		
	For 'next' use	Cube03	
	Attribute Name	Cube02	Add as new
	/ undule Name	e an e e a	
☑ Save on Close			Close 😢 Help

• Cube02 = SD40 at sample 7, SD45 at sample 8, ... SD65 at sample 12, then Cube03

• **Cube03** = SD70 at sample 13, SD75 at sample 14, SD80 at sample 15.

File Attribute set AmplSpectr_to_Cube SD SD10 SD15 SD20 SD25 SD30 SD35 SD45 For 'SD70' use SD75 For 'SD75' use SD75 SD55 For 'SD80' use SD80	
Attribute set AmpiSpectr_to_Cube <all> / Math=Functions • grtt (Square root) SD10 * SD15 * SD20 * SD25 * SD30 * SD45 * SD45 * SD50 * SD55 * For 'SD80' use SD80 *</all>	
Attribute set AmplSpectr_to_Cube <ali> ✓ Mathematics ✓ ? SD / MathFunctions • sqrt (Square root) • Insert ✓ SD10 SD15 Formula (like 'nearstk + c0 * farstk') Zi=13 ? SD70 : (Zi=15 ? SD80 . undef)) Set SD20 For 'Zi' use zindex • SD30 For 'SD70' use SD70 • SD45 For 'SD70' use SD75 • SD55 For 'SD80' use SD80 •</ali>	
SD / MathFunctions • sqrt (Square root) • Insert • SD 10 SD 10 • formula (like 'nearstk + c0 * farstk') [Zi=13 ? SD 70 : (Zi=15 ? SD 80 : undef)) • Insert • SD 20 For 'Zi' use zindex • • • Set SD 30 For 'SD 70' use SD 70 • • • • SD 45 For 'SD 70' use SD 75 • • • • SD 45 For 'SD 75' use SD 75 • • • • SD 55 For 'SD 80' use SD 80 • • • •	
SD10 Formula (like 'nearstk + c0 * farstk') Zi==13 ? SD70: (Zi==15 ? SD80. undef)) Set SD20 SD25 Zi==13 ? SD70: (Zi==15 ? SD80. undef)) Set SD30 For 'ZI' use zindex SD45 For 'SD70' use SD70 SD45 For 'SD70' use SD75 SD55 For 'SD80' use SD80	
SD15 Formula (like 'nearstk' + c0 * farstk') ZI==13 ? SD70 : (ZI==14 ? SD75 : (ZI==15 ? SD80 : undef)) Set SD20 SD20 For 'ZI' use zindex • SD30 SD40 • • SD45 • SD45 For 'SD70' use SD70 • • • SD40 For 'SD70' use SD75 • • • SD55 For 'SD80' use SD80 • • •	
SD20 For 'Zi' use zindex SD25 For 'SD 70' use SD70 SD40 SD45 SD45 For 'SD75' use SD75 SD55 For 'SD80' use SD80	
SD25 For 'Z1 use zindex SD30 SD35 For 'SD70' use SD70 SD40 S045 For 'SD75' use SD75 SD55 For 'SD80' use SD80	
SD30 For 'SD70' use SD70 • SD40 * * * SD45 For 'SD75' use SD75 • SD50 \$ * * SD55 \$ * * SD50 \$ \$ \$	
SD35 For SD70 use SD70 • SD40 • • • • SD45 For SD75 use SD75 • • SD55 • For SD80 use SD80 •	
SD40 SD45 SD50 SD55 SD60 For 'SD80' use SD80	
SU45 For SD75 • SD55 SD55 • • SD55 For SD80 use SD80 • •	
SD55 SD60 For 'SD80' use SD80	
SD60 For 'SD80' use SD80	
SD65	
SD70	
SD75	
SD80	
zindex	
Cube01	
Cubeu3	
Attribute Name Cube03 Add as new	
Save on Close	

This attribute consists of multiple nested **Statement ? Outcome_If_True : outcome_If_False** (OpendTect *Mathematics* attribute syntax for IF ... THEN ... ELSE ...).

- 4. QC the defined attribute *Cube01* by computing it on-the-fly along an *Inline*:
 - Add Inline to 3D scene: Inline > Add and Select Data
 - Choose *Cube01* from the *Attribute* list
 - Optionally, right-click on *Inline > Display > Properties* and in the *Texture* tab switch to *Classification* to see individual samples.
- 5. Create a seismic volume (physically stored on disk) via *Processing* > *Create Seismic Output* > *Attributes* > *Single Attribute* > *3D*

@	Create Volume Attribute		- 🗆 🗙
Quantity to output	Cube01	▼	
Volume subselection	100/300-750/1250 (26 samples)	Select	
Null traces	● Discard ○ Pass		
Scale values: Shift/Factor			
Output Cube	LocalAmplSpectrum_fromSD_FS8	✓	•
Batch execution	Single Process		
		OK Scancel	👔 Help

(optionally, limit Z range of the output cube via *Volume Subselection* for example, in this case it is limited to 0 - 100 ms as only samples 1-15 have actual data).

References

- 1. Greg Partyka, 1999, Interpretational Applications of Spectral Decomposition: <u>http://www.freeusp.org/RaceCarWebsite/TechTransfer/OnlineTraining/Spec_Tutorial/Sp</u> <u>ecDoc.html</u>
- Greg Partyka, 2001, Seismic Thickness Estimation: Three Approaches Pros and Cons: <u>http://www.freeusp.org/RaceCarWebsite/TechTransfer/OnlineTraining/Wedge_Thickness</u> <u>s/WedgeThick.html</u>