

Regional modelling for DAS

(a) Geometry for DAS cable locations for regional events

- (i) Extraction of azimuth information for cable locations
cable-azim1

Input required – station locations (latitude longitude)

Output: Azimuths of cable, northings and eastings

Sample input:

TID-cab.in ! coordinate file
TID-cabazp.lis ! azimuth file

- (ii) Range azimuth information for synthetics
sta-dasrt

Sample input:

TID-cabazp.lis ! cable-azim file
TID-sta1.in ! distance list
TID-J1.drs ! output file for synthetics
-36.45 148.47 ! source lat, lon
RE ! regional/telseismic (RE/TE)

Sample files:

Coordinate file: TID-cab.in - positions in metres along cable + latitude, longitude

TIDB		
165.0	-35.40058	148.98166
250.0	-35.40033	148.98168
300.0	-35.39999	148.98126
400.0	-35.39955	148.98088
500.0	-35.39894	148.98091
600.0	-35.39859	148.98076
700.0	-35.39811	148.97969
800.0	-35.39707	148.97926
900.0	-35.39677	148.97912
1000.0	-35.39667	148.97918
1100.0	-35.39662	148.97896
1200.0	-35.39665	148.97880
1300.0	-35.39620	148.97861
1400.0	-35.39505	148.97823

Azimuth file: TID-cabazp.lis

14					
165.000000	-35.400581	148.981659	0.000000	0.0000	0.0000
193.029678	-35.400330	148.981674	2.828197	0.0280	0.0014
246.129456	-35.399990	148.981262	315.312683	0.0657	-0.0360
305.920654	-35.399551	148.980881	324.670593	0.1145	-0.0705
373.844971	-35.398941	148.980911	2.333908	0.1824	-0.0678
415.247406	-35.398590	148.980759	340.485168	0.2214	-0.0816
525.834290	-35.398109	148.979691	298.900787	0.2749	-0.1784
647.535706	-35.397072	148.979263	341.445526	0.3902	-0.2171
683.282776	-35.396770	148.979126	339.621704	0.4238	-0.2296
695.621155	-35.396671	148.979187	26.640076	0.4348	-0.2241
717.087769	-35.396622	148.978958	284.884827	0.4403	-0.2448
731.233765	-35.396648	148.978806	257.883575	0.4373	-0.2586
784.417908	-35.396198	148.978607	340.240387	0.4874	-0.2766
916.693970	-35.395050	148.978226	344.846466	0.6151	-0.3112

Station file: TID-sta1.in

40
400.700012
410.909546
421.119080
431.328613
441.538147
451.747681
461.957214
472.166748
482.376282
492.585815

.....

Output file for synthetics: TID-J1.drs

Epicentral distance [km], azimuth from source, position on cable, cable azimuth, latitude, longitude, epicentral distance [deg]

40						
125.4208	21.7184	400.7000	79.7286	-35.39882	148.98087	1.12793
125.4132	21.7212	410.9095	79.3403	-35.39890	148.98090	1.12786
125.4545	21.6628	421.1191	279.7437	-35.39814	148.97975	1.12823
125.4531	21.6671	431.3286	283.5786	-35.39818	148.97984	1.12822
125.4520	21.6721	441.5381	287.4128	-35.39822	148.97995	1.12821
125.4503	21.6764	451.7477	291.2476	-35.39827	148.98004	1.12819
125.4490	21.6807	461.9572	295.0825	-35.39831	148.98013	1.12818
125.4478	21.6857	472.1667	298.9167	-35.39836	148.98024	1.12817
125.4465	21.6900	482.3763	302.7516	-35.39840	148.98033	1.12816
125.4453	21.6950	492.5858	306.5858	-35.39845	148.98044	1.12815

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This style of file is used by the synthetics programs when flag "DR" or "DV" are used.

(b) Modelling of DAS response by frequency-slowness integration

Uses the same program as for local modelling but different range/azimuth information

Erzslr--das:

Calculates synthetic seismograms for DAS for a stratified wavespeed model and configuration file for cable geometry for a surface force or a moment tensor source. Also includes options for seismometer response with and without free surface effects. Takes range and azimuth file from step (a).

The surface condition options are as in DASL.

Response options:

“DR” calculates DAS strain rate

“DV” calculates ground velocity along DAS cable

Sample DR input to erzslr-dasr:

```
"ERZSLR-das  ck140 DR"      # Title
"jdr-ck-2h.txz"            # File for T-X seismogram output
YE                          # Adaptive slowness
"ck140ft.mod"              # Velocity model file
"DR"                       # Response (GD,GV,GA,DL,DR,DV)
"HS"                       # Surface Condition (HS,H1,WF,WS)
    1200                   # Number of slownesses (<2500)
    0.00                   # Minimum slowness
    0.33                   # Maximum slowness
20                          # Slowness taper plo (n samples)
20                          # Slowness taper phi (n samples)
"WA"                       # Wavelet input or Ricker (WA/RI)
"ewd.wav"                  # Wavelet file
"YE"                       # Exponential damping? (YE/NO)
    4096                   # Number of time points
    0.02                   # Time step
    0.05    0.10          # Frequency taper (low)
    8.0    12.0           # Frequency taper (high)
    5.0                   # Dominant frequency [RI]
"MT"                       # Moment tensor or Force (MT/SF)
    -0.1531    0.5161    0.1230    0.00    # Moment tensor & Force Components
    0.5161    -0.5449    0.5611    0.00
    0.1230    0.5611    0.6980    0.00
    4.00
    0.001    125.000      # Depth of source
"TID-J1.drs"               # Cable depth, (DL) source offset
    0.00                   # Range and azimuth file
    10.0                   # Reduction slowness
"NO"                       # Start time (reduced)
"NO"                       # Debug/frequency-wavenumber (YE/NO)
"NO"                       # Debug/waveform (YE/NO)
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Sample model file: ewg4.mod

<i>Nr</i>	<i>Vp</i> [km/s]	<i>Vs</i> [km/s]	<i>Rho</i> [Mg/m3]	<i>Thickness</i> km	<i>Qp-1</i>	<i>Qs-1</i>
ewg4a						
6		0				
3	0.580	0.280	2.35	0.008	0.01	0.02
3	0.750	0.375	2.48	0.012	0.01	0.02
3	0.800	0.400	2.50	0.050	0.01	0.02
3	1.000	0.550	2.60	0.100	0.01	0.02
3	1.500	0.833	2.65	0.500	0.01	0.02
3	2.000	1.100	2.70	5.000	0.01	0.02

Sample wavelet file: ewd.wav

3			# of points in waveform /waveform
1.0	-1.00	0.00	

(c) Seismogram output and display

The seismogram file structure and the display routine is the same as used for the local case.

The seismograms are written out by **erzslr-das** in a simple ascii format in a loop over stations (index JX):

XD(JX), AZD(JX), CDC, DELT, NT, PR, TCAL, SMP, (FR(LK),LK=1,NT)

XD – distance along cable

AZD – azimuth

CDC – type identifier

DELT – time increment

NT – number of time points

PR – reduction slowness

TCAL – starting reduced time

SMP – maximum amplitude

FR – time series

Example showing first few time points:

-4.30000015E-02	90.0000000	DASL	5.00000024E-04	4096	0.00000000
-0.100000001	2.13151979		-3.98850441E-03	-3.68603622E-03	-3.41499783E-03
-3.22220637E-03	-3.14382929E-03				

Display zsyd

The zsyd routine displays seismograms with the distance axis vertical and time horizontally, a style suitable for comparison with DAS records.

Travel times will normally be suppressed for the regional case

A sample input file for a regional event is:

YE	Plot seismograms? (YE/NO)
DA	<se> Plot components (DA,ZC,RC,TC,3C)
1	<se> Number of files for seismograms(<5)
jdr-ck-2h.txz	<se> Name of file
40	<se> Number of distances to plot
0.0	<se> Reduction slowness for plot
0.0 0.00	<se> Minimum red time for seismograms, time shift
0.5 5.0	<se> Component offset, polarisation window
2 10 4	<se> Pen colours for seismic components
NO	<se> Trace normalisation? (YE/NO)
0.25 1.0 0.0 0.01 0.0	<se> Amp,b1,b2,xr,eps amp*(b1+b2/xr)**eps
NO	Plot travel times? (YE/NO)
1	<tt> number of files for travel times (<5)
ewh4d-p.tim	<tt> Name of file
LI	<tt> line or symbol mode (LI/SY)

11		<tt> Pen colour	
FR		Frame: FR - full frame , NL - no labels	
3		<fr> font choice	
390.0	810.0	<fr> Rmin, Rmax	
21.00		<fr> length of R-axis	
10.0	60.0	<fr> Trmin,Trmax	
25.00		<fr> length of T-axis	
50.0	10.0	<fr> Large Tic spacing R,T	
10.0	5.0	<fr> Small Tic spacing R,T	
1	1	<fr> # of dec. in label R,T	
0.5000	0.47500	<fr> character size text,title	
Distance [m]			X-txt
Time [s]			Y-txt
DR - Jindabyne			Title

The product is a Postscript file **zsy.ps** in landscape format

DR - Jindabyne 2 ck140 40 km crust

