UNIVERSITÀ
DEGLI STUDI DI TRIESTE

dipartimento di matematica e geoscienze

The DMG Quick Reference Manuals

Simple Earthquake Scenario (1D)

Computation of synthetic seismograms for a single earthquake, to quickly produce a simplified ground shaking scenario in a laterally homogeneous stratified model.

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Computation of a simple ground shaking scenario

You have to be familiar with computations explained in the DSTXQuick1Dmodes.pdf manual before proceeding. Here we use a special configuration of `eparatest.par` where loops are made over distance and azimuth to compute a ground shaking scenario in the area around the epicenter of a hypothetic earthquake.

Example input files

Required input files can be found in **/XDST/Examples/1DScenarioExamples/Base**. The example input dataset is configured for computations carried on with 1 Hz cutoff frequency in the modes files.

Here is the content of the **Base** directory:

```
-rw-r--r--  1 vaccari  dstguest   1.2K Oct  9 16:00 eparatest.par
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.50
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.51
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.52
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.53
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.54
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.55
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.56
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.57
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.58
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.59
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.60
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.61
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.62
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.63
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.64
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.65
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.66
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.67
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.68
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.69
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.70
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.71
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.72
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.73
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.74
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.75
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.76
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.77
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.78
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.79
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.80
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.81
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.82
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.83
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.84
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.85
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.86
-rw-r--r--  1 vaccari  dstguest   416K Oct  9 16:00 guphas090.87
-rw-r--r--  1 vaccari  dstguest   511B Oct  9 16:00 gusev01.xy
-rw-r--r--  1 vaccari  dstguest   642B Oct  9 16:00 gusev02.xy
-rw-r--r--  1 vaccari  dstguest   581B Oct  9 16:00 gusev03.xy
-rw-r--r--  1 vaccari  dstguest   726B Oct  9 16:00 gusev04.xy
-rw-r--r--  1 vaccari  dstguest   707B Oct  9 16:00 gusev05.xy
-rw-r--r--  1 vaccari  dstguest   817B Oct  9 16:00 gusev06.xy
-rw-r--r--  1 vaccari  dstguest   890B Oct  9 16:00 gusev07.xy
-rw-r--r--  1 vaccari  dstguest   1.1K Oct  9 16:00 gusev08.xy
-rw-r--r--  1 vaccari  dstguest   1.1K Oct  9 16:00 gusev09.xy
-rw-r--r--  1 vaccari  dstguest   974B Oct  9 16:00 gusev10.xy
-rw-r--r--  1 vaccari  dstguest   475B Oct  9 16:00 haz_compare.par
-rw-r--r--  1 vaccari  dstguest   2.2M Oct  9 16:00 z1d0014.spl
-rw-r--r--  1 vaccari  dstguest   2.7M Oct  9 16:00 z1d0014.spr
```

All the above files are required and should be copied into a new directory dedicated to your own computations.

Steps for the generation of the scenario

1) Scenario configuration

Both source and structural properties can be changed to explore the influence of the model properties on the ground shaking scenario. Below are the properties set in the example files.

Original configuration

In the original example, `eparatest.par` file is configured like this:

```
Parameter file for program eparatest
--------------------------------------------------------------------------------
s14                    Test label (root for output filenames - 13 chars max)
0                      Ref. box for values not listed below (0=no, 13 chars max)
z1d0014.spl            Love spectrum file
z1d0014.spr            Rayleigh spectrum file
2                      Motion (1=displ, 2=vel, 3=acc)
100                    Time length for plot seismograms (s)
1  13.0 46.2 289       Source (1=point, 2=extended), lon, lat, strike (North)
SRE 1   0 360 15       Strike/rec (loop 0=no,1=yes, start, stop, step) (Degrees)
DIP 0  23  90 10       Dip (loop 0=no,1=yes, start, stop, step) (Degrees)
RAK 0 140  40 10       Rake (loop 0=no,1=yes, start, stop, step) (Degrees)
SDE 0  10   9  1       Source Depth (loop 0=no/1=yes, start, stop, step) (km)
EDI 2  15 120 15       Epic. Distance (loop 0=no/1=yes, start, stop, step) (km)
RDE 0   0   3  1       Receiver Depth (loop 0=no/1=yes, start, stop, step) (km)
MOD 0   0   0  1       Modes (loop 0=no/1=yes, start, stop (step must be 1) )
INT 0   0  30  1       Interpolation (0-9) (flag 0=no,1=yes, start, stop, step)
MAG 0 6.7 7.0 .1       Magnitude (flag 0=no,1=yes, start, stop, step)
```

Source and maximum considered epicentral distance

An earthquake source is placed at the coordinates (13.0E, 46.2N), with hypocentral depth of 10 km. The strike of the fault is 289° , dip is 23° and rake is 140°. Point source approximation will be used.

Two parameters are varied in the experiment: strike/receiver angle (from 0° to 360° with steps of 15°) and distance (from 15 km to 120 km with steps of 15 km), so that the synthetic seismograms will be generated all around the epicentre up to a distance of 120 km.

Structural properties

The user can modify the structural properties considered in the experiment by simply referencing different files containing Love (.spl) and Rayleigh (.spr) modes

2) Computation of the scenario

The two commands to be run in sequence are:

```
eparatest.out
eparajob
```

The first command will quickly prepare all the required input files, based on the content of file `eparatest.par`.

The second command will generate the synthetic seismograms required for the scenario, and will prepare the PostScript files with the plots of the ground shaking scenario.

3) Plotting

PostScript files generated by the `eparajob` script can be:

- visualized on screen with the *`gs`* or *`gv`* commands
- converted to pdf format with the *`ps2pdf`* command
- printed with the *`lpr`* command

In this example, with the input parameters specified in Step 1), multiple plots of peak velocities as a function of distance and azimuth are saved in file

```
s14.ps
```

while maps with peak velocity values distributed around the epicentre are plotted in files

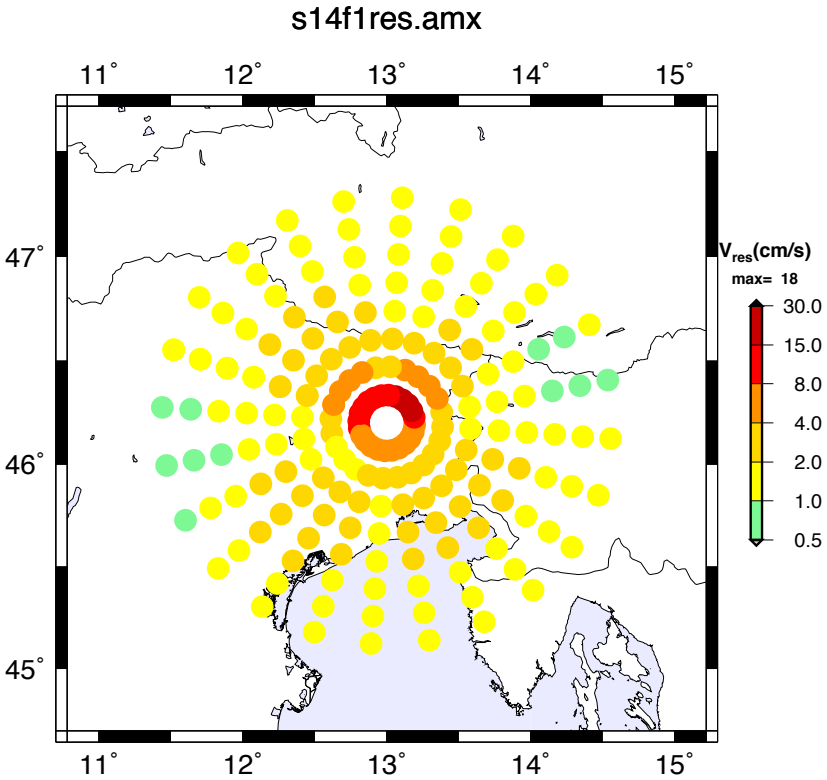
```
s14f1rad.amx.ps
s14f1tra.amx.ps
s14f1ver.amx.ps
```

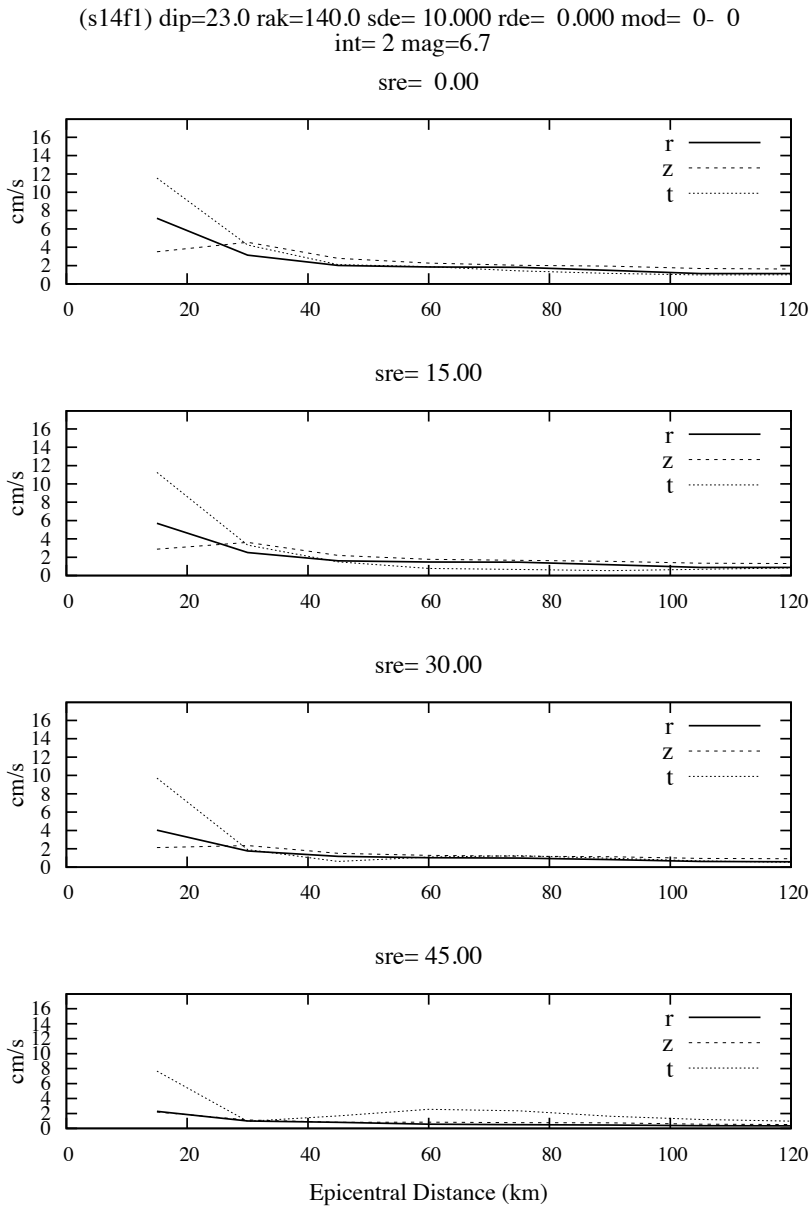
for the three components of motion (radial, transverse and vertical, respectively) and in files

```
s14f1res.amx.ps
s14f1sew.amx.ps
s14f1sns.amx.ps
```

for the resultant horizontal component and for the EW and NS components, respectively. To quickly view all the maps with peak values you can type

```
gs s14*amx.ps
```





4) Parametric tests

Try a couple of scenarios changing some source properties, or using the modes generated for a different structural model. ⚠️➡️Name differently each execution!⬅️⚠️ That is, change the **s14** label in file `eparatest.par` to something different for each new run. In such a way, output files of each run will not overwrite previous results.

For the structural models, pre-computed files with modes generated for the cutoff frequency of 10 Hz can be found in

/XDST/Examples/Soils/Modes/10.0Hz

for soils of type A, B, C, D, E, as defined by the Italian seismic code. For soil B, two models have been considered, B1 and B2, with velocities close to the upper (B1) and lower (B2) range limits for Vs.

For each soil, two variants of the structural model have been prepared, hq and lq, characterized by high and low Q values (slight and strong attenuation respectively).

The files with the structure layers (.stp), Love modes (.spl) and Rayleigh modes (.spr) are:

Layers	Love modes	Rayleigh modes
Ahq.stp	Ahq.spl	Ahq.spr
Alq.stp	Alq.spl	Alq.spr
B1hq.stp	B1hq.spl	B1hq.spr
B1lq.stp	B1lq.spl	B1lq.spr
B2hq.stp	B2hq.spl	B2hq.spr
B2lq.stp	B2lq.spl	B2lq.spr
Chq.stp	Chq.spl	Chq.spr
Clq.stp	Clq.spl	Clq.spr
Dhq.stp	Dhq.spl	Dhq.spr
Dlq.stp	Dlq.spl	Dlq.spr
Ehq.stp	Ehq.spl	Ehq.spr
Elq.stp	Elq.spl	Elq.spr