UNIVERSITÀ
DEGLI STUDI DI TRIESTE

dipartimento di matematica e geoscienze

The DMG Quick Reference Manuals

Ground shaking scenarios along 2D profiles

Hybrid technique, point-source approximation

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Document name: DMGQuick2Dprofile.pdf
Document Version: 1.6 - 30 July 2019
Date Issued: 25 September 2017 16:35
Author: Franco Vaccari

University of Trieste
Department of Mathematic and Geosciences
Group of Seismology
via Weiss, 4
34128 Trieste, Italy

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Ground shaking scenario along a 2D profile

In the following, the process of computing synthetic seismograms with the hybrid technique for a 2D laterally heterogeneous model is described. In the example, the model name is assumed to be **t1**, so all output filenames will have the t1 root.

Required input files

Required input files can be found in **/XDST/Examples/2DHybridExamples/Base**. Copy them into a directory dedicated to the computations.

Different computations should be performed in different directories. The root name of the run is defined in file pfdg13.par, and should be changed from run to run in order to better distinguish each execution.

Here is what you should have in the directory before you run *`pfdg13.out`*:

```
-rw-r--r--  1 vaccari  dstguest  1543148 17 Nov  2015 bedrock.spl
-rw-r--r--  1 vaccari  dstguest  1955525 17 Nov  2015 bedrock.spr
-rw-r--r--  1 vaccari  dstguest      939 17 Nov  2015 fdscale.par
-rw-r--r--  1 vaccari  dstguest      511 17 Nov  2015 gusev01.xy
-rw-r--r--  1 vaccari  dstguest      642 17 Nov  2015 gusev02.xy
-rw-r--r--  1 vaccari  dstguest      581 17 Nov  2015 gusev03.xy
-rw-r--r--  1 vaccari  dstguest      726 17 Nov  2015 gusev04.xy
-rw-r--r--  1 vaccari  dstguest      707 17 Nov  2015 gusev05.xy
-rw-r--r--  1 vaccari  dstguest      817 17 Nov  2015 gusev06.xy
-rw-r--r--  1 vaccari  dstguest      890 17 Nov  2015 gusev07.xy
-rw-r--r--  1 vaccari  dstguest     1094 17 Nov  2015 gusev08.xy
-rw-r--r--  1 vaccari  dstguest     1109 17 Nov  2015 gusev09.xy
-rw-r--r--  1 vaccari  dstguest      974 17 Nov  2015 gusev10.xy
-rw-r--r--  1 vaccari  dstguest     4734  1 Dec  2015 pfdg13.par
-rw-r--r--  1 vaccari  dstguest     1340  8 Feb 16:07 plr2rsp.par
-rw-r--r--  1 vaccari  dstguest    15415 17 Nov  2015 site.pof
-rw-r--r--  1 vaccari  dstguest     2317  3 Feb 15:53 siteanalysis.par
-rw-r--r--  1 vaccari  dstguest      134 17 Nov  2015 t1.sites
```

⚠️➡️It is highly suggested that you store in a dedicated directory (usually named `Base`) a copy of the input files used for each run , so that you can easily retrieve them later to repeat the computation or to use them as a starting point for a modified configuration of the modelling.⬅️⚠️

Files `bedrock.spl`, `bedrock.spr` and `site.pof` can be named according to your wishes, provided you do not modify file extensions.

Files `gusev*.xy` and `pfdg13.par` must not be renamed.

Description of input files

pfdg13.par

This file contains the information that will be used to properly generate the FD model and the scripts that will actually perform the computations. See the “Commands execution” section for a description of the scripts.

```
Parameters file for program pfdg13 (v0002)
--------------------------------------------------------------------------------
Modal summation model
--------------------------------------------------------------------------------
bedrock.spr                          Modes for 1D structure
0         First mode to use (1=fundamental, 0=all)
0         Last mode to use (0=all)
10.0      Low pass filter cutoff frequency (xcutof)
.50       Ratio between filter's max freq with unit response and xcutof
.02       Low pass filter amplitude at cutoff
1         High pass filter (0 no, 1 yes, 2 auto)
0.2       Lowest frequency in Hz with unit response
0.9       Ratio between cutoff and lowest freq with unit response
0.02      Amplitude at cutoff
0         Interpolation for modal summation part
12.       Source depth (km)
45.       Strike-receiver angle (SH modelling)
45.       Fault dip             (SH modelling)
90.       Fault rake            (SH modelling)
45.       Strike-receiver angle (P-SV modelling)
45.       Fault dip             (P-SV modelling)
90.       Fault rake            (P-SV modelling)
15.       Source-2D model origin distance (km)
5.0       Magnitude
1         Source (1=point, 2=extended)
none      File with source spectrum (only for extended source)
--------------------------------------------------------------------------------
Finite differences model
--------------------------------------------------------------------------------
t1                                Generated FD model
site.pof                          Polygons with 2D part definition
2800      Max number of grid points along x (max 2800)
2000      Max number of grind points along z (max 1000x1000)
0         Force an air layer of 5 grid points without topography (0=no, 1=yes)
0.0       Min velocity (km/s) for grid definition (0=auto -> look for min Vs)
0.000     FD model length from 1st column of seismograms (km) (0=auto)
0.0       FD model depth (km) (0=auto)
0.000     Grid spacing (km) (0=auto)
0         dz multiplier (0=auto)
0.000     Depth where step along z changes (0=auto)
0         Number of absorbing points along x (0=auto)
0         Number of absorbing zones (0=auto)
0         Lowest Q for absorbing zones (0=auto)
0         Highest Q for absorbing zones (0=auto)
1         Geom. spreading (0=no, 1=yes) for SH (suggested: 0 far/short,1 near/long)
1         Geom. spreading (0=no, 1=yes) for P-SV (suggested: 1)
15        Time window length (s) for 1D SH (0=auto)
15        Time window length (s) for 1D P-SV (0=auto)
15        Time window length (s) for 2D SH (0=auto)
15        Time window length (s) for 2D P-SV (0=auto)
3         Shift in origin time (SH)
3         Shift in origin time (P-SV)
--------------------------------------------------------------------------------
Seismograms
--------------------------------------------------------------------------------
0         Model origin-first calculated seismogram distance (*) (0=auto)
0         Grid points between seismograms (0=auto)
0         File with indexes of seismogram to plot (0=plot all seismograms)
0         Plots the seismogram of the bedorck (0=no, 1=yes)
0         File with ordinates of user's points to plot (0=no ,filename user's choice)
3         Computes aver and max spectra (0=no,1=only each comp, 2=only global, 3=both)
0         File name of the normalizing spectrum (0=no,filename=file with spectrum)
0         Index of user seismograms to use as ref spectrum (0=no, must be from 1 to 4)
--------------------------------------------------------------------------------
cntl files and scripts
--------------------------------------------------------------------------------
1         Write cntl files (1=yes, 0=no)
1         Write script files (1=yes, 0=no)
0         Grid
--------------------------------------------------------------------------------
programs used (in order: syl, syr, sylvdv, syndv, finit, finray)
--------------------------------------------------------------------------------
syl0048.out
syr0048.out
sylvdv80.out
syndv80.out
finit80.out
finray80.out
--------------------------------------------------------------------------------
Comments
--------------------------------------------------------------------------------
(*) D*** (km): distance of the first site from the model origin
```

```
             (D.20: .200 km from the model origin)
    P*** (-) : number of grid steps from the model origin to the
               first site
               (P20: grid step of .010 km --> distance of .20 km)

columns--->           ms  ms+1 ms+2
           *|    *     *     *    |*
 adsorbing *|    *     *     *    |*       2D model
   zone    *|    *     *     *    |*
           *|    *     *     *    |*

ms  : 1st column of input seismograms
ms+1: 2nd column of input seismograms
```

bedrock.spl, bedrock.spr

These are the files containing the modes already computed for the 1D reference bedrock model. File .spl contains the Love modes, file .spr contains the Rayleigh modes. See the manual “1D modal summation” for details about their generation.

site.pof

This file contains the description of the laterally heterogeneous model representative of the local site conditions along the profile. It may be prepared manually, but it is generally prepared using program XDigiMac. See XDigiMac manual for details about model preparation.

```
 3.012048193e-03         1.219512195e-03        0       0       716     236     33      54      f17.4,f9.4
44, 82, 52, 52, 55, 40, 40      Descr.  Rho     Vp      Qp      Vs      Qs      a22,f9.3,f9.3,f10.3,f9.3,f10.3
g/cm3   km/s            km/s            Digitized on Macintosh screen (Thursday, November 30, 2006, 09:26)
Recent deposits       p001 N0041    1.600    0.500    40.000    0.250    20.000 254 237 109     91 59
          1.9503   0.0165 1
          1.9503   0.0152 1
          1.9533   0.0152 1
          1.9533   0.0140 1
          …
          …
          0.0136   0.0140 7
          0.0136   0.0165 7
          1.9503   0.0165 1
Fluvial 1             p002 N0067    1.800    0.900    50.000    0.450    30.000 239 100 255     135 83
          1.8449   0.0457 1
          1.8449   0.0445 1
          1.8479   0.0445 1
          1.8479   0.0433 1
          …
          …
```

The red header shown above is a single long line generated by XDigiMac. Then the polygons defining the lateral heterogeneities along the profile follow. Each polygon has a header, with the properties of the rock or sediment, and a set of vertices whose coordinates are expressed in km from the beginning of the local profile.

gusev*.xy

Those files contain the scaled point source amplitude spectra, and should not be modified.

t1.sites

This file contains points along the profile where the user want to generate files for plotting seismograms (.plt), Fourier Spectra (.plf) and Response Spectra (.plr) files.

```
Digitized on Macintosh screen (Wednesday, 2 April 2014, 09:49)
0.0451807  0     254   237   109
0.6114458  0     254   237   109
1.981928   0     254   237   109
```

In the fifth column a name for site can be written. The name shouldn’t have space, for example:

```
Digitized on Macintosh screen (Wednesday, 2 April 2014, 09:49)
0.0451807  0     254   237   109
0.6114458  0     254   237   109     a_site
1.981928   0     254   237   109
```

The name will be reported in plots produced by *siteanalysis.sh*.

pfdg13.out reads this file and produces a new one named selplot that contains, for each selected point the index of seismograms, the distance from source, and, if defined in *t1.sites*, the name.

siteanalysis.par

This file describes the scaling options that the user wants to apply to the seismograms. This file is used by optional script *siteanalysis.sh*, that can scale in a single run the same seismograms for different rupture directivity angles (e.g.: 0-forward, 90-neutral, 180 backward), different magnitudes and different random realizations of the same source model. The script *siteanalysis.sh* can be used only if file *selplot* exists, and contains the list of sites selected for the analysis.

```
Parameter file for script siteanalysis.sh
----------------------------------
range and step of magnitude and directivity angles for different types of source (to be written in fdscale.par)
-------------------------------------------------------------------------------------------------
0 6.0 6.0 0.1   Scaled point source approx.   (0=no 1=yes,start,stop,step mag)
1 6.0 6.0 0.5 0 90  190  Unilateral source approx. (0=no 1=yes,  start,stop,step mag, start,stop,step dir)
1 6.0 6.0 0.5 0 90  190  Bilateral source approx. (0=no 1=yes,  start,stop,step mag,  start,stop,step dir)
0 6.0 6.0 0.2 0 180 90  Random nuc   source approx. (0=no 1=yes,  start,stop,step mag,  start,stop,step dir)
-------------------------------------------------------------------------------------------------
10                      number of realizations to be used for unilateral source (#nuni)
0                       number of realizations to be used for bilateral source (#nbil)
0                       number of realizations to be used for bilateral source (#nran)
-------------------------------------------------------------------------------------------------
./                      directory with 2D run (#base_dir)
/XDST/Examples/2DHybridExamples/Gusev83XY  directory with scaling curves for point source (#point_dir)
/XDST/Examples/2DHybridExamples/SourceUni  directory with scaling curves for unilateral (#uni_dir)
/XDST/Examples/2DHybridExamples/SourceBil  directory with scaling curves for bilateral (#bil_dir)
0                       directory with scaling curves for bilateral (#ran_dir)
```

plr2rsp.par

This file contains the list of scenarios that should be combine to produce the MCSI.

```
parameter file for plr2rsp (v0002)
-------------------------------------------------------------------------
test    root name of output file
1        use vertical component (0 no, 1 yes)
1        use res component (0 no, 1 yes)
1        use max component (0 no, 1 yes)
1        SD (0 no, 1 yes)
1        SV (0 no, 1 yes)
1        SA (0 no, 1 yes)
0        obs file (only when all blocks below are in format 2) (0=take from run)
-------------------------------------------------------------------------
1     format of input (informat) (1 - equal to Siteanalysis results)
SiteAnalysis/032/Plr/B000m60  path with scenario
13   lon of obs point
45   lat of obs point
-------------------------------------------------------------------------
1     format of input (1 - equal to Siteanalysis results)
SiteAnalysis/100/Plr/B000m60  path with scenario
13.1   lon of obs point
45.1   lat of obs point
-------------------------------------------------------------------------
1     format of input (informat) (1 - equal to Siteanalysis results)
SiteAnalysis/032/Plr/U000m60  path with scenario
13   lon of obs point
45   lat of obs point
-------------------------------------------------------------------------
1     format of input (1 - equal to Siteanalysis results)
SiteAnalysis/100/Plr/U000m60  path with scenario
13.1   lon of obs point
45.1   lat of obs point
-------------------------------------------------------------------------
```

Commands execution

Preliminary run

Program *pfdg13.out* must be run to produce all files required to run the hybrid job.

pfdg13.out will generate all files and scripts required to run the ground shaking scenario for a given profile

Program is initially executed asking for the automatic definition of some relevant model parameters: grid step, depth of the grid change, grid multiplying factor, model dimensions, time series duration.

The user must check that the automatic values decided by the program (printed onscreen and saved in file `pfdg13.pri`) are reasonable. Usually, some parameter changes are required, so the user should force the desired values in file `pfdg13.par` and run *pfdg13.out* again, until he is satisfied with the model.

Choice of signal duration

The CPU time required by the finite different computations is proportional to the size of the model and to the duration of the time series requested in input. Therefore it's important to reasonably estimate the time range of wave arrivals.

As epicentral distance increases, more time can be skipped before the arrival of the fastest phases. To estimate the reasonable amount of time to skip, a preliminary run of *pfdg13.out* should be made, asking to skip 0 seconds in `pfdg13.par` so that the full signal will be plotted.

pfdg13.out set to skip 0 seconds in `pfdg13.par`

jobtest the script that will generate and plot the first column of seismograms for the three components of motion.

jobtest will generate the PostScript plots of the signals, so that the user can visually choose the correct amount of time to be skipped, and properly update `pfdg13.par` before running the full job. Please note that the fastest arrivals will generally be located ad depth, where fastest layers are present and the path from the source is shorter.

```
-rw-r--r-- 1 vaccari dstguest 323974 Nov 11 14:40 t1.plotsDepthR.1.ps
-rw-r--r-- 1 vaccari dstguest  96203 Nov 11 14:40 t1.plotsDepthR.2.ps
-rw-r--r-- 1 vaccari dstguest 517917 Nov 11 14:40 t1.plotsDepthT.1.ps
-rw-r--r-- 1 vaccari dstguest 102243 Nov 11 14:40 t1.plotsDepthT.2.ps
-rw-r--r-- 1 vaccari dstguest 388714 Nov 11 14:40 t1.plotsDepthZ.1.ps
-rw-r--r-- 1 vaccari dstguest 107986 Nov 11 14:40 t1.plotsDepthZ.2.ps
```

Looking at the duration of the signal at the free surface, it will also be possible to roughly estimate the duration required by the FD computations. Of course the user has to take into account the profile length and the velocity of the sediments along the 2D profile to properly increase the duration shown by the seismogram computed in the bedrock at the beginning of the profile.

1D test

Before accepting the results obtained with the hybrid technique for the laterally heterogeneous model, the so called "1D test" is necessary to confirm that the FD model has been properly prepared.

In this test, synthetic seismograms are computed for a laterally homogeneous model both with the modal summation and the hybrid techniques. If an acceptable fit is obtained using the two techniques,

the results obtained with the hybrid technique for the laterally heterogeneous model can be generally trusted.

pfdg13.out with proper definition of skipped time and duration, updated in pfdg13.par

echo *job1d* | *at now* the script that will generate the seismograms for the 1D bedrock model with the modal summation and the finite difference technique. With the syntax shown, the job starts within a minute, runs in the background and the terminal session can be closed without killing the job execution.

The seismograms generated by *job1d* are scaled for the magnitude. Response spectra are generated, and response spectra ratios (1D modal/1D FD) to check that differences between FD and modal summation are negligible. PostScript plots are generated as well, for a visual check of the results.

2D run

After the "1D test" has been successfully passed, the FD job can be completed by running the next commands:

echo job2d | at now the script that will run the 2D part of the job, for Love and Rayleigh seismograms. Again launched in the background with the same syntax seen for the 1D test run.

Seismograms generated by *job1d* and *job2d* are scaled for the magnitude. Seismograms, response spectra and amplifications in term of response spectra ratios are generated and plotted.

Full run

If the "1D test" has been successfully done, and a 2D run as well, and modifications are applied either to the mechanism of the source, or to the inner geometry of the FD model, or to other parameters that should not break the 1D test, the full job can be run at once:

pfdg13.out will prepare the scripts that will actually perform the computations

echo jobfd | at now the script that will run the full job, generating 3-component seismograms and amplifications along the profile. Again launched in the background with the same syntax seen for the 1D test and 2D runs.

Seismograms generated by *jobfd* are scaled for the magnitude. Seismograms, response spectra and amplifications in term of response spectra ratios are generated and plotted.

⚠️➡️ *jobfd* includes the computation of the 1D test, but the execution does not stop if the 1D test fails, and 2D seismograms are computed anyway. This might be a waste of time in case the 1D test shows that the model has been improperly parameterized.⬅️⚠️

So a full run should be considered, with caution, only by experienced users.

Main PostScript files

After a run has been completed, either in a single step with *jobfd*, or with the sequence of *job1d* and *job2d*, several PostScript files are produced. They can be viewed with the *gs* command, or printed with the *lpr* command. Most important plots are marked in ***bold italic***.

For the check of signal duration:

t1.plotsDepthR.?.ps	***first column of seismograms with depth, rad component***
t1.plotsDepthT.?.ps	***first column of seismograms with depth, tra component***
t1.plotsDepthZ.?.ps	***first column of seismograms with depth, ver component***

For the 1D model:

t1.plots1dA.1.ps	1D seismograms, acceleration for the 3 components
t1.plots1dD.1.ps	1D seismograms, displacement for the 3 components
t1.plots1dV.1.ps	1D seismograms, velocity for the 3 components
t1.plots1dR.1.ps	1D seismograms, radial components (acc, vel, dis)
t1.plots1dT.1.ps	1D seismograms, transverse components (acc, vel, dis)
t1.plots1dZ.1.ps	1D seismograms, vertical components (acc, vel, dis)
t1.plott1dR.1.ps	***1D test seismograms, radial velocity (MS and FD)***
t1.plott1dT.1.ps	***1D test seismograms, transverse velocity (MS and FD)***
t1.plott1dZ.1.ps	***1D test seismograms, vertical velocity (MS and FD)***
t1.rsra1d.1.ps	***1D test response spectra ratios (RSR 1D MS/1D FD, acc)***
t1.rspa1df.1.ps	1D test response spectra for finite difference (acc)
t1.rspa1dm.1.ps	1D test response spectra for modal summation (acc)
t1.test1dr.peak.ps	% difference in peak values along the profile, scaled for M (rad)
t1.test1dr.upeak.ps	% difference in peak values along the profile (rad)
t1.test1dt.peak.ps	% difference in peak values along the profile, scaled for M (tra)
t1.test1dt.upeak.ps	% difference in peak values along the profile (tra)
t1.test1dz.peak.ps	% difference in peak values along the profile, scaled for M (ver)
t1.test1dz.upeak.ps	% difference in peak values along the profile (ver)

For the 2D model:

t1.plots2dA.1.ps	***2D seismograms, acceleration for the 3 components***
t1.plots2dD.1.ps	***2D seismograms, displacement for the 3 components***
t1.plots2dV.1.ps	***2D seismograms, velocity for the 3 components***
t1.plots2dR.1.ps	***2D seismograms, radial components (acc, vel, dis)***
t1.plots2dT.1.ps	***2D seismograms, transverse components (acc, vel, dis)***
t1.plots2dZ.1.ps	***2D seismograms, vertical components (acc, vel, dis)***
t1.rspa2d.1.ps	***2D response spectra (acceleration)***
t1.rsra2d.1.ps	***2D response spectra ratios (acceleration)***
t1.rsrd2d.1.ps	2D response spectra ratios (displacement)
t1.rsrv2d.1.ps	2D response spectra ratios (velocity)
t1.rsrpv2d.1.ps	2D response spectra ratios (pseudovelocity)

Scaling for multiple source models (*siteanalysis.sh*)

Once *jobfd* has been executed, it is possible to use script *siteanalysis.sh* to scale the 2D seismograms in a single run for several source models, taking into account three rupturing styles (unilateral and bilateral rupturing and rupture with random selection of the position of nucleation point), different directivity angles (e.g.: 0-forward, 90-neutral, 180 backward directivity), and properly defined magnitude ranges.

Parameter file `siteanalysis.par` has to be properly prepared before running the command. Also, the source time functions generated by pulsyn06.out program must exist in the directory specified in file `siteanalysis.par` before *`siteanalysis.sh`* is run.

`siteanalysis.sh`	applies the scaling to the seismograms

⚠️➡️A scaling made for a single rupturing style and a single magnitude can be run interactively from the terminal. When activating multiple scalings in `siteanalysis.par` it is strongly suggested to run the program in the background:⬅️⚠️

```
echo siteanalysis.sh | at now
```

siteanalysis.par

This file contains the information that will be used to properly generate to scale the 2D seismograms in a single run for several source models, taking into account three rupturing styles (unilateral and bilateral rupturing and rupture with random selection of the position of nucleation point), different directivity angles (e.g.: 0-forward, 90-neutral, 180 backward directivity), and properly defined magnitude ranges.

```
Parameter file for script siteanalysis.sh
-----------------------------------
range and step of magnitude and directivity angles for different types of source (to be written in fdscale.par)
-------------------------------------------------------------------------------------------------------------
0 6.0 6.0 0.1   Scaled point source approx.   (0=no 1=yes,start,stop,step mag)
1 6.0 6.0 0.5 0 90  190  Unilateral source approx. (0=no 1=yes,  start,stop,step mag, start,stop,step dir)
0 6.0 6.0 0.2 0 180 90  Bilateral source approx. (0=no 1=yes,  start,stop,step mag,  start,stop,step dir)
0 6.0 6.0 0.2 0 180 90  Random nuc   source approx. (0=no 1=yes,  start,stop,step mag,  start,stop,step dir)
-------------------------------------------------------------------------------------------------------------
10                      number of realizations to be used for unilateral source (#nuni)
0                       number of realizations to be used for bilateral source (#nbil)
0                       number of realizations to be used for source with random nucleation point (#nran)
-------------------------------------------------------------------------------------------------------------
./                      directory with 2D run (#base_dir)
/XDST/Par/Gusev/        directory with scaling curves for point source (#point_dir)
/XDST/Examples/2DHybridExamples/SourceUni   directory with scaling curves for unilateral (#uni_dir)
/XDST/Examples/2DHybridExamples/SourceBil   directory with scaling curves for bilateral (#bil_dir)
0                       directory with scaling curves for random nucleation point  (#ran_dir)
-------------------------------------------------------------------------------------------------------------
parameters for plot (to be written in plotxyrc.par)
-------------------------------------------------------------------------------------------------------------
0       start time for plot       (#t_start)
20      stop time for plot        (#t_stop)
-------------------------------------------------------------------------------------------------------------
compute max and res components of spectra
-------------------------------------------------------------------------------------------------------------
1       compute res component of response spectra  (#res)
1       compute max component of response spectra  (#max)
```

Order of the first 8 lines is mandatory. The script search the parameters in the other lines by the string that begins with #.

Es.: the directory with point source spectra is read by this line of the script

```
point_dir="$(grep '#point_dir' $parfile | awk '{ print $1 }')"
```

Directories created by siteanalysis.sh

Script *`siteanalysis.sh`* organizes its output in a separate directory, named `SiteAnalysis`. Inside this folder, it creates as many folders as the number of sites specified in file `selplot`, where the site results will be stored. Relevant output files are renamed so that from the filename it will be possible to recover the information about the scaling that was applied in the processing.

Inside the folder for each site, these folders are created:

`PlotsPS`	plot files in PostScript format
`Plt`	xy files of seismograms (time, amplitude)
`Plr`	xy files of response spectra (period, spectral acceleration)
`Plf`	xy files of Fourier spectra (freq., amplitude spectrum)

Inside each folder with xy files, there will be a directory for each considered rupture style, magnitude and directivity angles. For a run made with the `siteanalysis.par` shown in this manual, where only M=6.0 is considered for the scaling, and unilateral rupture stile is taken into account, the only directory created is:

`U000m60`	scaled seismograms for unilateral, forward

If ranges of magnitudes are defined in file `siteanalysis.par`, a directory for each considered magnitude will be created for scaled seismograms (e.g. U000m65, U000m70 etc). Properly renamed .ps, .plt, .plr and .plf files will be placed in the PlotsPs, Plt, Plr and Plf respectively.

Graphic files (in PlotPS directory)

PostScript files will be all stored in a common directory named `PlotsPS` for each site. Files collected in the `PlotsPS` directory are renamed according to the scheme

`nnnrdddmxx.rl.plotType.1.ps`

where

`nnn`	index of random realization
`r`	rupturing style (b=bilateral, u=unilateral, p=point, r=random nucleation point)
`ddd`	directivity (e.g.: 000=forward, 090=neutral, 180=backward)
`m`	prefix for magnitude (fixed!)
`xx`	magnitude*10
`rl`	run label (t1 in the example)
`plotType`	plot type (accmed05.rsp = acceleration response spectrum, velmed05.rsp = velocity response spectrum, dismed05.rsp = displacement response spectrum, sis = accelerograms)

Seismogram files in xy format (in Plt directory)

Mainly for importing in other, generic, software (for plotting, reprocessing etc), seismogram files in xy format (time, amplitude in cm, cm/s or cm/s^2) are stored in the `Plt` directory and are renamed according to the scheme

`nnnrdddmxx.rlf0.rty.mty.iiiiii.plt`

where

`nnn`	index of random realization
`r`	rupturing style (b=bilateral, u=unilateral, p=point, r=random nucleation point)
`ddd`	directivity (e.g.: 000=forward, 090=neutral, 180=backward)
`m`	prefix for magnitude (fixed!)
`xx`	magnitude*10
`rl`	run label (t1 in the example)
`f0`	fixed
`rty`	run type (l1d, l2d, r1d, r2d; l=Love, r=Rayleigh, 1d or 2d case)
`mty`	motion type (rac, rdi, rve; tac, tdi, tve; zac, zdi, zve; r=radial, t=transverse, z=vertical; ac=acceleration, di=displacement, ve=velocity)
`iiiiii`	index of seismogram along the profile (usually between 000001 and 000100)
`plt`	fixed

Response spectra files in xy format (in Plr directory)

Mainly for importing in generic plotting software, response spectra files (5% damping) in xy format (period in s, 2 unused columns, spectral acceleration in cm/s^2, 4 unused columns, spectral velocity in

cm/s, 4 unused columns, spectral displacement in cm, 4 unused columns, spectral pseudovelocity in cm/s, 2 unused columns) are collected in the `Plr` directory and are renamed according to the scheme

`nnnrdddmxx.rlf0.rty.mty.iiiiii.plr`

where

`nnn`	index of random realization
`r`	rupturing style (b=bilateral, u=unilateral, p=point, r=random nucleation point)
`ddd`	directivity (e.g.: 000=forward, 090=neutral, 180=backward)
`m`	prefix for magnitude (fixed!)
`xx`	magnitude*10
`rl`	run label (t1 in the example)
`f0`	fixed
`rty`	run type (l1d, l2d, r1d, r2d; l=Love, r=Rayleigh, 1d or 2d case)
`mty`	motion type (rac, rdi, rve; tac, tdi, tve; zac, zdi, zve; r=radial, t=transverse, z=vertical; ac=acceleration, di=displacement, ve=velocity)
`iiiiii`	index of seismogram along the profile (usually between 000001 and 000100)
`plr`	fixed

Fourier spectra ratio files in xy format (in Plf directory)

Mainly for importing in generic plotting software Fourier spectra are stored in xy format (frequency in Hz, amplitude spectrum, real part of the spectrum, imaginary part of the spectrum) in the `Plf` directory and are renamed according to the scheme

`nnnrdddmxx.rlf0.rty.mty.iiiiii.plf`

where

`nnn`	index of random realization
`r`	rupturing style (b=bilateral, u=unilateral, p=point, r=random nucleation point)
`ddd`	directivity (e.g.: 000=forward, 090=neutral, 180=backward)
`m`	prefix for magnitude (fixed!)
`xx`	magnitude*10
`rl`	run label (t1 in the example)
`f0`	fixed
`rty`	run type (l1d, l2d, r1d, r2d; l=Love, r=Rayleigh, 1d or 2d case)
`mty`	motion type (rac, rdi, rve; tac, tdi, tve; zac, zdi, zve; r=radial, t=transverse, z=vertical; ac=acceleration, di=displacement, ve=velocity)
`iiiiii`	index of seismogram along the profile (usually between 000001 and 000100)
`plf`	fixed

Computation of MCSI (*plr2mcsi.sh*)

After *siteanalysis.sh* has been run for several realizations of the source rupturing process, or even for different profiles crossing each other at a site of interest, the Maximum Credible Seismic Input (MCSI) for the site of interest can be obtained by running the script *plr2mcsi.sh*.

Parameter file `plr2rsp.par` has to be properly prepared before running the command.

plr2mcsi.sh	generates the MCSI for the selected site(s)

plr2rsp.par

This file contains the information that will be used to properly generate the MCSI. The first block of parameters defines which components and which response spectra (Displacement, Velocity, Acceleration) should be considered in the computations.

Then as many blocks as the scenarios to be considered for the MCSI generation must be present. Each block is associated with a specific scaling applied to the seismograms obtained at a given site. It consists of the format expected for the input files, followed by the path pointing to the response spectra generated by for the site considered, and the longitude and latitude of the site.

In the given example, two sites are considered (site 32 and site 100), and two source rupturing styles (Unilateral and Bilateral, both with directivity angle 0°) for a M=6.0 event.

The coordinates written into each block identify the site, rather than the site index which appears in the path. This is required since in the case of two profiles crossing each other at the site of interest, site index will be different for the two profiles, while the coordinates uniquely identify the site and therefore can be used for the site-specific response spectra selection needed for the MCSI computation.

```
parameter file for plr2rsp (v0002)
-------------------------------------------------------------------------
test    root name of output file
1        use vertical component (0 no, 1 yes)
1        use res component (0 no, 1 yes)
1        use max component (0 no, 1 yes)
1        SD (0 no, 1 yes)
1        SV (0 no, 1 yes)
1        SA (0 no, 1 yes)
0        obs file (only when all blocks below are in format 2) (0=take from run)
-------------------------------------------------------------------------
1     format of input (informat) (1 - equal to Siteanalysis results)
SiteAnalysis/032/Plr/B000m60  path with scenario
13   lon of obs point
45   lat of obs point
-------------------------------------------------------------------------
1     format of input (1 - equal to Siteanalysis results)
SiteAnalysis/100/Plr/B000m60  path with scenario
13.1   lon of obs point
45.1   lat of obs point
-------------------------------------------------------------------------
1     format of input (informat) (1 - equal to Siteanalysis results)
SiteAnalysis/032/Plr/U000m60  path with scenario
13   lon of obs point
45   lat of obs point
-------------------------------------------------------------------------
1     format of input (1 - equal to Siteanalysis results)
SiteAnalysis/100/Plr/U000m60  path with scenario
13.1   lon of obs point
45.1   lat of obs point
-------------------------------------------------------------------------
```

⚠➡The names of files and directories previously generated by sitenalysis.sh must not be changed, or plr2mcsi.sh will fail.⬅⚠

Directories and files created by plr2mcsi.sh

Script *`plr2mcsi.sh`* organizes its output in a separate directory, named `Mcsi`. Inside this folder, it creates a `Results` folder and a `PlotPs` folder with the PostScript files of the MCSI at each site, for each of the requested components and type of response spectra requested in `plr2rsp.par`.

The naming of the postScript files looks like

```
testf2max.05.rspamf.1.ps
```

where the relevant parts are:

`test`	is the label chosen by the user in file plr2rsp.par
`max`	identify the component (could be max, res, rzz for maximum, resultant and vertical, respectively)
`05`	is the damping used in the response spectra computations (05=5%, cant't be anything else at the moment)
`amf`	type of response (could be amf, vmf or dmf for acceleration, velocity or displacement, respectively).
`1`	the site index, corresponding to the coordinates listed in the `.obs` file found in the `Results` folder

The `Results` folder inside `Mcsi` contains:

`.par`	the parameter files used to generate the MCSI

`.obs` the file with extension .obs with the coordinates of the considered sites.

`.rsp[avd]m` the files with statistical information (mean, standard deviation, median, ...) for each scenario for maximum (max), resultant (res) and vertical (rzz) components; there is one record for each scenario. The header record describes each column's content.

`.rsp[avd]mf` the files with MCSI for maximum (max), resultant (res) and vertical (rzz) components; there is one record for each site and each period of the spectrum.