Operator GENE_ACCE_SEISME

1 Drank

This operator allows to generate artificial seismic accelerograms for transient dynamic computations.

The seisme is modelled by a nonsteady stochastic process. Power spectral densities (DSP) evolutionary make it possible to take account of a nonsteady phenomenon in amplitude and frequential contents like the seisme. The variation of the amplitude is taken into account by a function of modulation whereas the evolution of the frequential contents is modelled by the DSP of Kanai-Tajimi evolutionary. The DSP of Kanai-Tajimi moreover is filtered in order to remove the frequential contents in very low frequencies which can lead to numerical problems (non-zero drifts for the integrated signals).
The parameters related to the variation of the amplitude are the intensity of Arias, the period of the strong phase and the time of beginning of the strong phase. The parameters related to the DSP and the evolution of the frequential contents are the damping and the fundamental frequency of the DSP of Kanai-Tajimi as well as the slope describing the evolution of the latter in the course of time. These parameters can be given from a given acélérogramme, and/or of a SRO (response sprectrum of oscillator) and/or by calling on the available data in the literature. Moreover, the model being parameterized, it is possible to take account of the variability and the uncertainty of these parameters using random pullings.
The algorithm of simulation and the model are described with more detail in R4.06.04 documentation of reference.

Product a concept of the table_fonction `type` .

2 Syntax

```
acce    [table_fonction] = GENE_ACCE_SEISME

                      (   ♦DSP=_F                    (
                          ◊/♦AMOR_REDUIT=amo                          [R]
                                ♦FREQ_FOND      =ff           [R]
                                ♦FREQ_PENTE     =fp           [R])

                          ♦MODULATION=_F             (

                                ♦TYPE=JENNINGS_HOUSNER             [TXM]
                                          GAMMA
                                           CONSTANT

                                ◊INT_ARIAS         =arias        [R]
                                ◊ACCE_MAX       =pga             [R]
                                ◊ECART_TYPE        =ect             [R]

                            % if  TYPE =CONSTANT
                                ◊DUREE_PHASE_FORTE=TSM           [R]
                            % if  TYPE =GAMMA
                                ♦DUREE_PHASE_FORTE=TSM           [R]
                                ♦INST_INIT               =t_ini      [R]
                            % if  TYPE =JENNINGS_HOUSNER
                                ♦DUREE_PHASE_FORTE=TSM             [R]
                                ♦INST_INIT               =t_ini       [R]
                                ♦   PARA        =    (alpha, beta)  [R])

                          ◊NB_POIN=nb_poin                        [I]

                           ♦  PESANTEUR            =g              [R]

                          ♦PAS_INST=dt                           [R]

                          ◊INIT_ALEA=ni                              [I]

                          ◊INFO=/1                                   [DEFAULT]
                                           /2

                          ◊TITER=titer                               [l_Kn]

           )   ;
```

3 Operands

3.1 Key words DSP

3.1.1 Operands AMOR_REDUIT, FREQ_FOND and FREQ_PENTE

♦AMOR_REDUIT = amo [R]

Value of the reduced damping of the DSP of Kanai-Tajimi.

♦FREQ_FOND = f_0 [R]

fundamental Frequency of the DSP of Kanai-Tajimi.

◊FREQ_PENTE = f_p [R]

Slope for the evolution of the fundamental frequency: $f(t)=f_0+f_p(t_{ini}-t)$. It is observed that, generally, the fundamental frequency drops with time. It is necessary in this case to give a negative slope: $f_p<0$. It should be taken care that the function $f(t)$ does not produce negative frequencies on the interval of simulation $[0,T]$. If FREQ_PENTE is not indicated, one takes a constant fundamental frequency equalizes with f_0.
If FREQ_PENTE is not informed and if one chooses a function of constant modulation, one obtains a steady process. This process corresponds to the classical DSP of Kanai-Tajimi (but filtered low frequency).

3.2 Key words MODULATION

3.2.1 Operand TYPE

```
♦TYPE=JENNINGS_HOUSNER              [TXM]
                 GAMMA
                 CONSTANT           [DEFAULT]
```

Definition of the type of modulation (cf also R4.06.04).
The CONSTANT modulation corresponds to a signal without amplitude modulation. If one supposes moreover than the fundamental frequency of the DSP of Kanai-Tajimi is constant, then one brings back oneself to a steady process.

3.2.2 Operand INT_ARIAS, ACCE_MAX, ECART_TYPE

It is necessary to inform one of the three parameters intensity of Arias, PGA (maximum acceleration on the ground) or standard deviation.

◊INT_ARIAS=arias [R]

average Intensity of Arias: $Arias=\mathbf{E}\left(\frac{\pi}{2g}\int_0^\infty X^2(t)\,dt\right)$ with X the process modelling seismic motion (acce) and g is gravity.

◊ACCE_MAX =pga [R]

maximum Acceleration on ground (PGA). One associates this value to the median maximum of the signals to be generated. The standard deviation corresponding is given starting from the factor of peak and for phase strong TSM.
It is necessary to inform ACCE_MAX (PGA) in g . The value of g is with being informed PESANTEUR by the key word. Thus, ACCE_MAX= 0.2 corresponds to a PGA of $0.2\mathrm{g}$ with $g=9.81 \mathrm{m}/s^2$.
The generated accelerograms will be then accelerations in m/s^2 .

◊ ECART_TYPE =ect [R]
Standard deviation of the subjacent steady stochastic process. One applies then the amplitude modulation (GAMMA or JENNINGS_HOUSNER).
It is necessary to inform ECART_TYPE in g (confer also above). The value of g is with being informed PESANTEUR by the key word . One must take PESANTEUR =9.81 (m/s^2) to obtain accelerations in m/s^2 .

3.2.3 Operands DUREE_PHAS_FORT, INST_INIT

♦/◊DUREE_PHAS_FORT=TSM [R]

Lasted of the strong phase of the signal to generate (cf also R4.06.04).
For the function of modulation GAMMA, the strong phase is defined from the intensity of Arias like $TSM=T_2-T_1$ where T_1 and T_2 are respectively times of time when 5% and 95% of the intensity of Arias (total energy) are carried out. Time T_1 corresponds to the beginning of the strong phase t_{ini} . The parameters of the function of modulation GAMMA are identified (by least squares) so that TSM and t_{ini} are respected.
For the function of modulation of Jennings & Housner (JENNINGS_HOUSNER), the value of TSM corresponds to the width of the plate. Time T_INI corresponds to the beginning of the plate.
For a CONSTANT modulation (not of modulation), the period of the simulated signals corresponds to TSM if NB_POIN is not indicated. If NB_POIN is given, then the period corresponds to (NB_POIN-1) *PAS_INST .

♦/◊INST_INIT=t_ini [R]

Urgent of beginning of the strong phase. If TYPE=CONSTANT, t_ini is not used.

3.2.4 Operand PARA

◊ **P** MACAW = (alpha, beta) [R]

alpha and beta are the parameters of the function of modulation of Jennings & Housner. Their information is compulsory if TYPE=JENNINGS_HOUSNER . They determine the pace of the slope after the plate (see [R4.06.04] for more details).

3.3 Operand NB_POIN

◊ NB_POIN = nb_poin [I]

Number of points of discretization of the interspectrum to be used in the algorithm of generation. nb_point must be an even number.

If NB_POIN is indicated, then the period of simulation is determined by this value: $T=dt(N-1)$ and the point of temporal discretization are: $t_j=j\,dt,\quad j=0,\ldots,N-1$.

If key word NB_POIN is not indicated, one takes the period of simulation equalizes with 4 times the period of the strong phase more t_{ini} : $T=4\text{TSM}+t_{ini}$. This makes it possible to simulate the accelerogram over all its length if the variation of the signal is defined by a function of modulation Gamma or Jennings & Housner. The number of points NB_POIN is then calculated from this value. In the case of a constant modulation (TYPE=CONSTANT), one takes $T=TSM$

3.4 Operand PAS_INST

♦ PAS_INST = dt [R]

Time step of the seismic signals. This value is used to determine the cut-off frequency for simulations by the formula $F=1/(2dt)$ (Shannon). It should be taken care that the cut-off frequency is sufficiently large for modelling the phenomenon well.

3.5 Operand INIT_ALEA

◊INIT_ALEA=ni [I]

If key word INIT_ALEA is indicated, one initializes the germ of the random continuations by this value. Two computations consecutive with the same initialization produce the same seismic signal then

3.6 Operand NORMALIZES

♦PESANTEUR=g In general [R

], one takes PESANTEUR =9.81 (m/s^2) (confer also §3.2.2). It is necessary to inform ACCE_MAX (PGA) and ECART_TYPE in g . By way of an example, to give ACCE_MAX= 0.2 corresponds to a PGA of 0.2g with $g=9.81\text{m}/s^2$. The generated accelerograms will be then accelerations in m/s^2 .

3.7 Operand INFO

◊INFO =

/1 : no printing.

/2 : printing of the relative information to the model and the discretization (processing of the signal).

3.8 Operand TITER

◊TITER = title

title is the title of computation to be printed at the top of the results [U4.03.01].

4 Count produced

the parameters of the produced array are the PARAMETRETYPEDESCRIPTIONNUME_ORDREInuméros

following		
		of ordreFONCTIONK24nom
		generated functions

5 Examples

One can consult the case test zzzz317.