

## Operator INFO\_FONCTION

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### 1 Drank

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To carry out mathematical operations on data structures of type function.

The following operations are currently available:

- the search of the maxima of a function,
- the computation of the norm  $L_2$  of a function,
- the standard deviation of a function,
- value RMS of a function,
- the value of the indicator of harmfulness of seisme.

Product a data structure `counts`.

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## 2 Syntax

```
Fr      = INFO_FONCTION

      ( ♦/MAX      =_F      ( ♦fonction = F,
[function]
              ♦ INTERVALLE = inter,
                                      [l_R]
              ),
      /NORME =_F ( ♦FONCTION = F ,
[function]
              ),
      /ECART_TYPE = ( identical to the key word RMS)
[function]
      /RMS      =_F      ( ♦fonction =f,
                                      [function]
              ♦METHODE = "TRAPEZE",
                                      [DEFAULT]
              / "SIMPSON",
              ♦INST_INIT=tdeb ,
                                      [R]
              ♦INST_FIN =TFIN ,
                                      [R]
              ♦CRITERE = / "RELATIF",
                                      [DEFAULT]
              / "ABSOLUTE",
              ♦PRECISION=/0.001 ,
[DEFAULT]
              /PREC ,
                                      [R]
      ),
```

```
/NOCI_SEISME = _F (
  ◆/FONCTION=          F ,          [function]
  ◇ OPTION=
  | " TOUT " ,          [DEFAULT]
  | " MAXI " ,
  ◇ COEF = 0 ,          [DEFAULT]
  /r1 ,                [R]
  ◇ ◇ INST_INIT = tdeb, [R]
  ◇ INST_FIN = tfin,   [R]
  ◇ CRITERE =/ " RELATIF " , [DEFAULT]
  / " ABSOLU " ,
  ◇ accuracy =/0.001, [DEFAULT]
  / prec,             [R]
  | " INTE_ARIAS " ,
  ◇ ◇ INST_INIT = tdeb, [R]
  ◇ INST_FIN = tfin,   [R]
  ◇ CRITERE =/ " RELATIF " , [DEFAULT]
  / " ABSOLU " ,
  ◇ accuracy =/0.001, [DEFAULT]
  /prec,             [R]
  | " POUV_DEST " ,
  ◇ COEF= / 0,          [DEFAULT]
  /r1 ,                [R]
  ◇ ◇ INST_INIT = tdeb, [R]
  ◇ INST_FIN = tfin,   [R]
  ◇ CRITERE =/ " RELATIF " , [DEFAULT]
  / " ABSOLU " ,
  ◇ accuracy =/0.001, [DEFAULT]
  / prec,             [R]
  ◆ PESANTEUR = sea-green [R]
  | " VITE_ABSO_CUMU " ,
  ◇ ◇ INST_INIT = tdeb, [R]
  ◇ INST_FIN = tfin,   [R]
  ◇ CRITERE =/ " RELATIF " , [DEFAULT]
  / "ABSOLU",
  ◇PRECISION =/0.001, [DEFAULT]
  /prec,             [R]
  I'DUREE_PHAS_FORT',
  ◇◇INST_INIT = tdeb, [R]
  ◇INST_FIN = tfin, [R]
  ◇CRITERE =/ "RELATIF", [DEFAULT]
  / "ABSOLU",
  ◇PRECISION =/0.001, [DEFAULT]
  /prec,             [R]
  ◇BORNE_INF =/0.05, [DEFAULT]
  /binf,            [R]
  ◇BORNE_SUP =/0.95, [DEFAULT]
  /bsup,            [R]
  | " INTE_SPEC " ,
  ◆ AMOR_REDUIT= amndt, [R]
  ◇ ◇ FREQ_INIT= /0.4, [DEFAULT]
  /fdeb,           [R]
  ◇FREQ_FIN= /10. , [DEFAULT]
  /fine,          [R]
```

```

                                ◇CRITERE      =/ "RELATIF", [DEFAULT]
                                    / "ABSOLU",
                                ◇PRECISION      =/0.001, [DEFAULT]
                                    /prec, [R]
                                ◇ NORME=       /1. , [DEFAULT]
                                    /r2 , [R]
                                | " ACCE_SUR_VITE " ,
                                ◇ COEF=        /0, [DEFAULT]
                                    /r1 , [R]
/SPEC_OSCI = sro ,
[function]
                                ◇ OPTION=
                                | " INTE_SPEC " , [DEFAULT]
                                ◆ AMOR_REDUIT= amndt, [R]
                                ◇NATURE=      /"ACCE", [DEFAULT]
                                    /"QUICKLY",
                                    /"DEPL",
                                ◇ NORME=       /1. , [DEFAULT]
                                    /r2 , [R]
                                ◇ ◇ FREQ_INIT= /0.4, [DEFAULT]
                                    /fdeb, [R]
                                ◇FREQ_FIN=    /10. , [DEFAULT]
                                    /fine, [R]
                                ◇CRITERE      =/ "RELATIF", [DEFAULT]
                                    / "ABSOLU",
                                ◇PRECISION      =/0.001, [DEFAULT]
                                    /prec, [R]
                                ◇ FREQ=        lfrequ, [l_R]
                                ◇ LIST_FREQ=   lfrequ, [listr8]
                                    ),
                                ◇ TITER =t , [ L_K N ]
                                ◇ INFO =/1 , [DEFAULT]
                                    / 2,
)

```

## 3 Operands

### 3.1 Key word MAX

/MAX =

Search of the X-coordinates where the maximum and the minimum are reached.

This operation is available on functions of natural function or three-dimensions function.

◆ FONCTION = F

Name of the function or the functions of which one seeks the maxima.

If F is a function, the product concept is an array whose parameters of access are:

FONCTION , TYPE , the NOM\_PARA of the function, the NOM\_RESU of the function.

where one respectively finds the name of the function, MAXI or MINI, the X-coordinate of the minimum, the value of maximum/minimum maximum/.

When several factors are provided, the array contains the max of the max, and the min of the min.

If F is a three-dimensions function, the product concept is an array whose parameters of access are:

FONCTION , TYPE , the NOM\_PARA of the three-dimensions function, the name of the parameter of functions ( NOM\_PARA\_FONC ), the NOM\_RESU of the functions.

◇ INTERVALLE = inter

List of realities defining the limits of the intervals on which will be sought the min and the max of the functions.

inter is composed of couples of realities of which the first corresponds to the limit inferior of the first interval, the second corresponds to the limit superior of first interval, and so on for the other intervals.

inter is thus composed of an even number of elements.

This key word is not taken into account for the three-dimensions functions.

### 3.2 Key word NORMALIZES

This key word makes it possible to follow convergence in accordance with the standard  $L_2$  of a continuation of function  $f_N$  given in the form of a three-dimensions function. The array result comprises one by function line, the parameters of entry are NORM and FONCTION.

◆ FONCTION = F

Name of the three-dimensions function whose norm must be evaluated.

### 3.3 Key word ECART\_TYPE

/ECART\_TYPE =

One calculates the standard deviation of the function  $f(t)$  which is defined by:

$$\sigma = \sqrt{\frac{1}{(t_{fin} - t_{deb})} \int_{t_{deb}}^{t_{fin}} (f(t) - \bar{f})^2 dt} \text{ where } \bar{f} \text{ is the average on } [t_{deb}, t_{fin}]$$

the key keys are identical to those provided under the key word factor RMS.

The product concept is an array whose parameters of access are:

FONCTION, METHODE, MOYENNE, INST\_INIT, INST\_FIN, ECART\_TYPE.

## 3.4 Key word RMS

/RMS =

One calculates value RMS of the function  $f(t)$  which is defined by:

$$RMS = \sqrt{\frac{1}{(t_{fin} - t_{deb})} \int_{t_{deb}}^{t_{fin}} f^2(t) dt}$$

◆ FONCTION = F

Name of the function which one calculates value RMS.

Does not apply to the concepts of type `three-dimensions` function.

◇ METHODE =

Name of THE METHODE which one uses to compute: the integral.

Two methods are available: method of the "TRAPEZE" (by default) and method of "SIMPSON".

◇ INST\_INIT = tdeb,

◇ INST\_FIN = tfin,

Limits lower and higher of the interval of integration.

If these values are not indicated, the points of discretization inferior and superior (the relation of order being defined compared to the parameter in X-coordinate) are taken as limits interval of integration.

◇ PRECISION = /0.001 ,  
/prec ,

◇ CRITERE = / "ABSOLU",  
/ "RELATIF", [DEFAULT]

One seeks a point of discretization of the function in an interval defined by the absolute or relative position around a value of the parameter of the X-coordinates for which the function must be estimated:

- [inst (1-prec), inst (1+prec)] if CRITERE = "RELATIF"
- [inst - prec, inst + prec] if CRITERE = "ABSOLU"

the product concept is an array whose parameters of access are:

FONCTION, METHODE, INST\_INIT, INST\_FIN, RMS.

## 3.5 Key word NOCI\_SEISME

/NOCI\_SEISME =

◆ /FONCTION = F,

/SPEC\_OSCI = sro,

Name of the function (signal in acceleration  $\Gamma(t)$ ) or of the three-dimensions function considered which must be defined in `DEFI_FONCTION` [U4.31.02] with `NOM_RESU='ACCE'`.

If a three-dimensions function is considered, only the computation of spectral intensity is available.

◇ /OPTION =

Makes it possible to choose one or more of the six following indices of harmfulness:

| "TOUT"

all six index gives gives of harmfulness,

| "MAXI"

gives the maximum of acceleration  $\Gamma(t)$ , the velocity  $v(t)$  and of displacement (obtained by integration)

$$PGA = \max_{t \in [t_i, t_f]} \left[ |\Gamma(t)| \right] \quad PGV = \max_{t \in [t_i, t_f]} \left[ |v(t)| \right], \quad PGD = \max_{t \in [t_i, t_f]} \left[ |x(t)| \right]$$

| "INTE\_ARIAS"

gives the intensity of Arias  $I_A = \frac{\pi}{2g} \int_{t_i}^{t_f} \Gamma^2(t) dt$

where  $g$  is the acceleration of gravity. This value must be taught via key word PESANTEUR.

| "POUV\_DEST"

gives the destroying power  $P_d = \frac{I_A}{v_0^c} = \frac{\pi^3}{2g} \int_{t_i}^{t_f} v^2(t) dt$

where  $g$  by the key word PESANTEUR must be indicated

| "VITE\_ABSO\_CUMU"

gives the cumulated absolute value velocity  $CAV = \int_{t_i}^{t_f} |\Gamma(t)| dt$

| "DUREE\_PHAS\_FORT" lasted of strong phase (intensity of Arias being an increasing monotonous function):

Minimum duration  $t_{sup} - t_{inf}$  such as, for the limits  $b_{inf}$ ,  $b_{sup}$  :

$$b_{inf} \times I_A \leq \frac{\pi}{2g} \int_{t_{inf}}^{t_{sup}} \Gamma^2(f) dt \leq b_{sup} \times I_A$$

where  $g$  must be well informed by key word PESANTEUR

| "INTE\_SPEC" spectral intensity of Housner, between the frequencies  $f_{deb}$ ,  $f_{fin}$ ,  $S_V(f, \eta)$  indicating the Response spectrum of Oscillator in pseudovelocities for reduced damping  $\eta$  :

$$I_H = \int_{f_{deb}}^{f_{fin}} \frac{S_V(f, \eta)}{f^2} df$$

| "ACCE\_SUR\_VITE" ratio  $A_{max}/V_{max}$

$$ACCE\_SUR\_VITE = \frac{\max_{t \in [t_i, t_f]} \left[ |\Gamma(t)| \right]}{\max_{t \in [t_i, t_f]} \left[ |v(t)| \right]}$$

Following the option, one must inform certain parameters, if one does not indicate an option, by default, one thus calculates all the indices it is necessary all to inform. The integration method is the method of the "TRAPEZE".

INST\_INIT = tdeb,  
INST\_FIN = tfin,

Limits lower and higher of the interval of time considered.

If these values are not indicated, the points of discretization inferior and superior (the relation of order being defined compared to the parameter in X-coordinate) are taken as limits interval.

```
accuracy = /0.001 ,  
          /prec ,
```

```
CRITERE = / "ABSOLU",  
          / "RELATIF", [DEFAULT]
```

One seeks a point of discretization of the function in an interval defined by the absolute or relative position around a value of the parameter of the X-coordinates for which the function must be estimated:

- [inst\* (1-PREC), inst\* (1+prec)] if CRITERE = "RELATIF"
- [inst - prec, inst + prec] if CRITERE = "ABSOLU"
- [freq\* (1-PREC), freq\* (1+prec)] if CRITERE = "RELATIF"
- [freq - prec, freq + prec] if CRITERE = "ABSOLU"

```
COEF = r1
```

Constante of integration, by default 0. In option "MAXI", one calculates the velocity and displacement by two successive integrations of damping, it thus should be informed COEF if one does not want to take it by default.

```
FREQ_INIT = fdeb,  
FREQ_FIN = fine,
```

Frequencies representing the two limits of integration for the computation of the spectral intensity of Housner. Those must be understood between the extrema of the base of frequencies defining three-dimensions function SRO, if not poses a problem of interpolation. By defaults, these two frequencies are worth 0,4 Hz and 10Hz .

```
AMOR_REDUIT = amndt
```

Reduced damping, for the computation of the Response spectrum of Oscillator in that of the spectral intensity of Housner.

```
FREQ = lfre
```

fre = ( $\Phi_1, \dots, \Phi_i, \dots$ ) . List frequencies.

```
LIST_FREQ = lfreq
```

List of the frequencies provided under a concept listr8.

```
= r2 NORMALIZES
```

the oscillator spectrum will be normalized with the value r2 (value of pseudo-acceleration).

```
BORNE_INF = binf,  
BORNE_SUP = bsup,
```

Limits limiting the share of intensity Arias defining times initial and final of the strong phase (enters ( $b_{inf}$ )% and ( $b_{sup}$ )% of ( $I_A$ )<sub>max</sub>) of the seisme (one often takes 5% and 95%).

```
PESANTEUR
```

Acceleration of Gravity. Its value depending on the units on the model, this key word is compulsory for indices INTE\_ARIAS, POUV\_DEST, DUREE\_PHAS\_FORT.

## 3.6 Operand TITER

```
◇TITER = T
```

Titrate attached to the product concept by this operator [U4.03.01].

## 3.7 Operand INFO

◇ INFO

If INFO=2, one prints function (IMPR\_FONCTION format TABLEAU) in the message file .

## 4 Examples

---

### 4.1 Searches extrema of a function

#### 4.1.1 Without interval

```
A5=DEFI_FONCTION (
  NOM_RESU=' SIGM',
  NOM_PARA=' EPSI',
  VALE= (0.002, 400.0,
         0.003, 500.0,
         0.0045, 550.0,
         0.0065, 580.0,
         0.008, 590.0,
         0.01, 600.0,
         0.02, 600.0,
  ),
  PROL_DROITE=' CONSTANT',
  PROL_GAUCHE=' LINEAIRE',
)
= INFO_FONCTION (MAX=_F (FONCTION=A5),)

IMPR_TABLE (TABLE=tab)
```

gives on file "RESULTAT" .

```
#
#ASTER 8.02.00 CONCEPT CALCULE LE 1/24/2006 A 16:14: 04 OF TYPE
#TABLE_SDASTER
FONCTION TYPE EPSI SIGM
A5 MINI 2.00000E-03 4.00000E+02
A5 MAXI 1.00000E-02 6.00000E+02
A5 MAXI 2.00000E-02 6.00000E+02
```

#### 4.1.2 With intervals

```
tab2 = INFO_FONCTION (MAX=_F (FONCTION=A5),
                      INTERVALLE= (0.002, 0.005,
                                    0.006, 0, 02),),)

IMPR_TABLE (TABLE=tab2)
```

gives on file "RESULTAT" .

```
#
#ASTER 8.02.00 CONCEPT tab2 CALCULE LE 1/24/2006 A 16:14: 04 OF TYPE
#TABLE_SDASTER
#Calcul of the extremas on function A5 on each interval
FONCTION TYPE INTERVALLE EPSI_MIN EPSI_MAX EPSI SIGM
A5 MINI 1 2.00000E-03 5.00000E-03 2.00000E-03 4.00000E+02
A5 MAXI 1 2.00000E-03 5.00000E-03 2.00000E-03 5.50000E+02
A5 MINI 2 6.00000E-03 2.00000E-03 6.00000E-03 5.80000E+02
A5 MAXI 2 6.00000E-03 2.00000E-03 1.00000E-02 6.00000E+02
A5 MAXI 2 6.00000E-03 2.00000E-03 2.00000E-02 6.00000E+02
```