Operator CALC_INTE_SPEC

1 Drank

Compute a function of spectral concentration from a temporal signal (function of time). The spectral concentration (or autospectrum) is the arithmetic mean of a certain number of spectrums calculated on various temporal blocks of the signal. If several signals are given a matrix of spectral concentration is obtained (or interspectrum).

Product a concept of type `interspectrum`.

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2 Syntax

```
int [interspectrum] = CALC_INTE_SPEC

    (  ◊ INST_INIT =/ii                                    [R]
                    /0                                  [DEFAULT]

       ♦ INST_FIN =if                                   [R]

       ◊ DUREE_ANALYSE =da                               [R]

       ◊ DUREE_DECALAGE =dd                              [R]

       ♦ NB_POIN=np                                      [I]

       ♦FONCTION=fo                                [function, three-
      dimensions function, formula]

       ◊TITER=titer                                      [l_Kn]

       ◊INFO=/1                                          [DEFAULT]
             /2

    );
```

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3 Operands

3.1 Operands INST_INIT / INST_FIN

◊INST_INIT = II

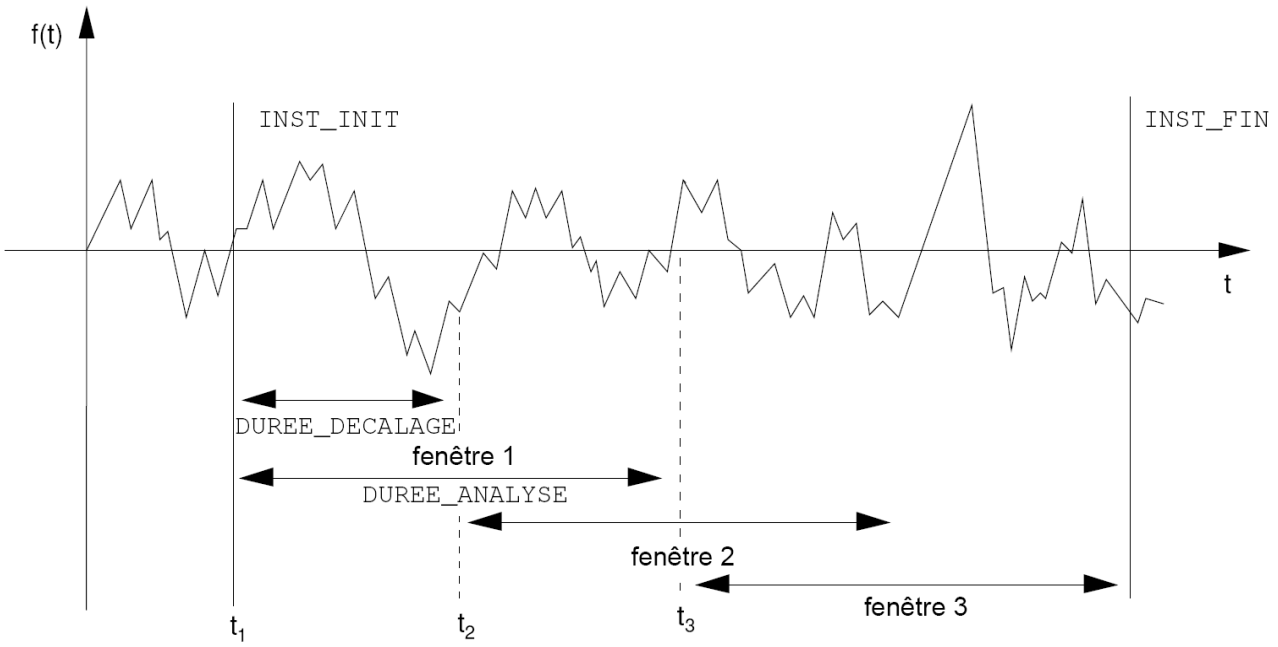
First value of the parameter for which the signals will be used for the computation of the interspectral matrix (urgent initial).

♦ INST_FIN = yew

Last value of the parameter for which the signals will be used for the computation of the interspectral matrix (final moment).

Note:

The functions will be calculated with the mode of interpolation which was associated to them. It is advised not to have a problem of discretization which the functions have an authorized linear interpolation.



Appear 3.1-a: Analyzes and computation on 3 windows with covering

3.2 Operands DUREE_ANALYSE / DUREE_DECALAGE

◊DUREE_ANALYZE = da

the functions will be cut out in several windows of period of analysis da. For each one of these windows an interspectral matrix is calculated. The interspectral matrix result of the operator will be the arithmetic mean of the calculated matrixes.

◊DUREE_DECALAGE = dd

Permet during function division according to the period of analysis in windows, to shift each window one compared to the other of a dd period. If t_k is the initial time of $k^{\text{ième}}$ the window, the initial time of $(k+1)^{\text{ième}}$ the window will be t_k+dd.

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Are $x[k]$ and $y[k]$ two discrete temporal signals and $x_p[k]$ the $y_p[k]$ respective temporal windows obtained by cutting.

If $X[k]$ and $Y[k]$ their discrete FOURIER transforms indicate, then the interspectral matrix is written [bib1]:

$$S[k] \text{ vaut } \begin{pmatrix} S_{xx}[k] & S_{xy}[k] \\ S^*_{xy}[k] & S_{yy}[k] \end{pmatrix}$$

where

$$S_{xx}[k] = \frac{1}{p.n\Delta t} \sum_{i=1}^{p} X_p[k].X^*_p[k]$$

$$S_{xy}[k] = \frac{1}{p.n\Delta t} \sum_{i=1}^{p} X_p[k].Y^*_p[k]$$

where n is the number of points per block,

p is the number of blocks.

Caution:

This average adapted perfectly to the "real" signals results of a measurement is not appropriate without precaution for functions close to a sine (the frequency of the average must be much higher than the frequency of the signal.

Note:

If the treated signals come from operator GENE_FONC_ALEA *via possibly the computation of a dynamic response (operator* DYNA_TRAN_MODAL *for example), then it is advised to treat each pulling of* GENE_FONC_ALEA *independently. In this case, it is necessary to choose periods of analysis and shift equal to the period of each pulling of* GENE_FONC_ALEA *(cf* GENE_FONC_ALEA [U4.36.05]*).*

3.3 Operand NB_POIN

♦NB_POIN = Np

Number of points of the parameter for a period of analysis. For each point the functions will be calculated according to the type of definite interpolation and prolongation. The number of points must be a power of 2 (computation of the fast transform of Fourier).

Note:

If the signals consist of a number (power of two) sufficient of points with a constant step, it is preferable to choose this number to avoid interpolations which can generate artefacts. In particular, if the treated signals come from operator GENE_FONC_ALEA *via possibly the computation of a dynamic response (operator* DYNA_TRAN_MODAL *for example), this number will correspond to the double amongst points informed in* GENE_FONC_ALEA *key word* NB_POIN *or obtained by* INFO=2 *in* GENE_FONC_ALEA *(cf* GENE_FONC_ALEA [U4.36.05]*).*

3.4 Operand FONCTION

♦FONCTION =

List of the names of the functions (temporal signals) of concept of type function, which one wishes to calculate the interspectral matrix.

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3.5 Operand TITER

◊TITER =

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

3.6 Operand INFO

◊INFO =

Specifies the options of printing on the message file .

1 prints the initial frequency, the final frequency and the step in frequency.

2 like 1 more for each autospectrum and interspectrum, a convergence criterion according to the number of random pullings. (a random pulling corresponds to a window of analysis).

4 Phase of checking

One checks if the number of points Np is a power of 2.

5 Remarks of use

the operator creates a concept of type interspectrum which constitute the interspectral matrix. This hermitian matrix being, definite positive, the functions are of real type for the diagonal terms and of complex type for the extra-diagonal terms. One stores only the higher triangular part of the matrix.

These functions can be extracted using operator RECU_FONCTION [U4.32.03].

6 Example

```
FONC1=RECU_FONCTION (  RESU_GENE=DYNAMODE,
                       NOM_CHAM=' DEPL',
                       NOEUD=' N51',
                       NOM_CMP=' DY',
                       INTERPOL=' LIN'
                    )

FONC2=RECU_FONCTION (  RESU_GENE=DYNAMODE,
                       NOM_CHAM=' DEPL',
                       NOEUD=' N52',
                       NOM_CMP=' DY',
                       INTERPOL=' LIN'
                    )

INTERS=CALC_INTE_SPEC (INST_INIT=0.,
                       INST_FIN=10.24,
                       DUREE_ANALYSE=1.024,
                       DUREE_DECALAGE=1.024,
                       NB_POIN=1024,
                       FONCTION= (FONCT1,  FONCT2,)
                    )

REP1=RECU_FONCTION (   INTE_SPEC=INTERS,
```

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```
                    NUME_ORDRE_I = 1,
                    )
```

7 Bibliography

[bib1] Notes DER HP-61/93-067 - Generation of random signals of spectral concentration given - G. JACQUART

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