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## Operator CALC\_INTE\_SPEC

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### 1 Goal

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To calculate a function of spectral concentration starting from a temporal signal (function of time). The spectral concentration (or autospectre) is the arithmetic mean of a certain number of spectra calculated on various temporal blocks of the signal. If several signals are given a matrix of spectral concentration is obtained (or interspectre).

Product a concept of the type `interspectre`.

## 2 Syntax

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```
int [interspectre] = CALC_INTE_SPEC  
  
  (  ◇ INST_INIT = / II [R]  
      / 0 [DEFECT]  
  
      ◆ INST_FIN = yew [R]  
  
      ◇ DUREE_ANALYSE = da [R]  
  
      ◇ DUREE_DECALAGE = dd [R]  
  
      ◆ NB_POIN = Np [I]  
  
      ◆ FUNCTION = fo [function, tablecloth,  
formula]  
  
      ◇ TITLE = title [l_Kn]  
  
      ◇ INFORMATION = / 1 [DEFECT]  
      / 2  
  
  );
```

## 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 calculation of the matrix interspectrale (urgent initial).

◆ INST\_FIN = yew

Last value of the parameter for which the signals will be used for the calculation of the matrix interspectrale (urgent final).

**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.*

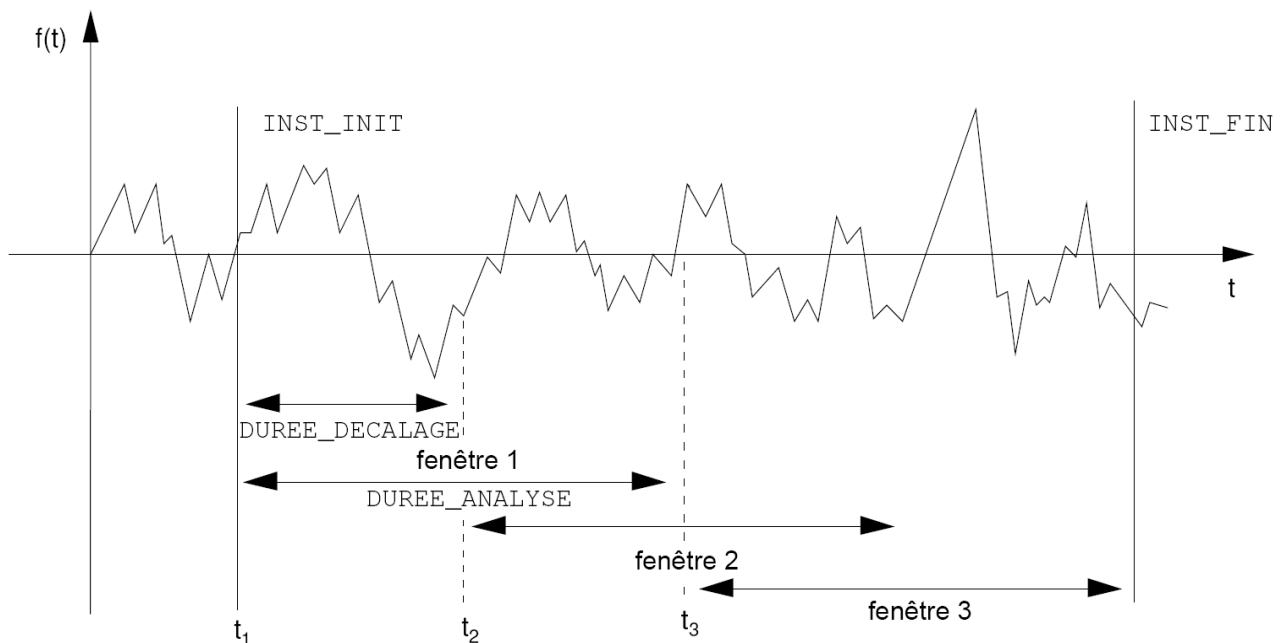


Figure 3.1-a: Analysis and calculation on 3 windows with covering

### 3.2 Operands DUREE\_ANALYSE / DUREE\_DECALAGE

◇ DUREE\_ANALYSE = da

The functions will be cut out in several windows of duration of analysis  $da$ . For each one of these windows a matrix interspectrale is calculated. The matrix interspectrale result of the operator will be the arithmetic mean of the calculated matrices.

◇ DUREE\_DECALAGE = dd

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

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

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

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

where

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

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

where  $n$  is the number of points per block,

$p$  is the number of blocks.

**Caution:**

*This average adapted perfectly to the signals "real" 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 the operator GENE\_FONC\_ALEA via possibly the calculation 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 durations of analysis and shift equal to the duration of each pulling of GENE\_FONC\_ALEA (cf. GENE\_FONC\_ALEA [U4.36.05]).*

### 3.3 Operand NB\_POIN

- ◆ NB\_POIN = Np

Many points of the parameter for one duration 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 (calculation 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 artifacts. In particular, if the treated signals come from the operator GENE\_FONC\_ALEA via possibly the calculation of a dynamic response (operator DYNA\_TRAN\_MODAL for example), this number will correspond to the double amongst points informed in GENE\_FONC\_ALEA keyword NB\_POIN or obtained by INFO=2 in GENE\_FONC\_ALEA (cf. GENE\_FONC\_ALEA [U4.36.05]).*

### 3.4 Operand FUNCTION

- ◆ FUNCTION =

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

## 3.5 Operand TITLE

◇ TITLE =

title is the title of the concept `interspectre` to print at the top of the results [U4.03.01].

## 3.6 Operand INFORMATION

◇ INFORMATION =

Specify the options of impression on the file MESSAGE.

- 1 print the initial frequency, the final frequency and the step in frequency.
- 2 like 1 more for each autospectre and interspectre, convergence criteria according to the number of random pullings. (a random pulling corresponds to a window of analysis).

## 4 Phase of checking

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It is checked if the number of points `Np` is a power of 2.

## 5 Remarks of use

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The operator creates a concept of the type `interspectre` who constitute the matrix `interspectrale`. This square 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 the operator `RECU_FONCTION` [U4.32.03].

## 6 Example

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```
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,
                    NUME_ORDRE_I = 1,
                    )
```

## 7 Bibliography

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[bib1] Note DER HP-61/93-067 - Generation of random signals of spectral concentration given -  
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