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## Operator DEFI\_SPEC\_TURB

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### 1 Drank

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To define an excitation spectrum turbulent. Various types of spectrums are available:

- for the “tube bundles under transverse flow”, spectrums of type “correlation length”,
- for established uniform flows, parallel with plane or cylindrical structures circular, spectrums of turbulence of boundary layer,
- excitation spectrum defined by its decomposition on a family of shape functions by providing an interspectral matrix and a list of associated shape functions. The concepts `tabl_intsp` and `function` must then be generated upstream,
- preset spectrum of turbulence, identified on model `GRAPPE1` or `GRAPPE2`,
- excitation spectrum associated with one or more forces and specific moments by providing an interspectral matrix with excitations (concept `tabl_intsp` in front of being generated upstream), the list of the nodes of application of these excitations, the nature of the excitation applied of each one of these nodes (force or moment) and the directions of application of the excitations thus defined.
- excitation spectrum defined by a set of complex analytical functions.

Product a concept of type `spectrum`.

## 2 Syntax

```

spe [spectrum] = DEFI_SPEC_TURB (
    ♦ / SPEC_LONG_COR_1 =_F (
        ♦ LONG_COR=lc , [R]
        ♦PROFESSEUR_VITE_FLUI=profv , [function,
formula]
        ♦ VISC_CINE=eps , [R]
        ),
    /SPEC_LONG_COR_2 =_F (
        ♦ LONG_COR=lc , [R]
        ♦PROFESSEUR_VITE_FLUI=profv , [function,
formula]
        ◇/FREQ_COUP=0.1 [DEFAULT]
        PHI0=1.5D-3 [DEFAULT]
        BETA=2.7 [DEFAULT]
        /FREQ_COUP =frc [R]
        PHI0=phi0 [R]
        BETA=beta , [R]
        ),
    / SPEC_LONG_COR_3 =_F (
        ♦ LONG_COR=lc , [R]
        ♦PROFESSEUR_VITE_FLUI=profv , [function,
formula]
        ◇/FREQ_COUP=0.2 [DEFAULT]
        PHI0_1=5.D-3 [DEFAULT]
        BETA_1=0.5 [DEFAULT]
        PHI0_2=4.D-5 [DEFAULT]
        BETA_2=3.5 [DEFAULT]
        /FREQ_COUP =frc [R]
        PHI0_1=phi01 [R]
        BETA_1=beta1 [R]
        PHI0_2=phi02 [R]
        BETA_2=beta2 , [R]
        ),
    / SPEC_LONG_COR_4 =_F (
        ♦ LONG_COR=lc , [R]
        ♦PROFESSEUR_VITE_FLUI=profv , [function,
formula]
        ♦TAUX_VIDE=tv , [R]
        ◇/BETA=2 . [DEFAULT]
        GAMMA=4 . , [DEFAULT]
        /BETA =beta [R]
        GAMMA=gamma , [R]
        ),
    /SPEC_CORR_CONV_1 =_F (
        ♦ LONG_COR_1=lc1 , [R]
        ◇ LONG_COR_2=lc2 , [R]
        ♦VITE_FLUI=vflui , [R]
        ◇FREQ_COUP=fc , [R]
        ◇K=/5.8D-3 [DEFAULT]
        /k , [R]
        ♦D_FLUI=dhyd , [R]
        ♦RHO_FLUI=rho_f , [R]
        ◇COEF_VITE_FLUI_A=alpha , [R]
        ◇COEF_VITE_FLUI_O=beta [R]
        ◇METHODE=/ "GENERALE" [DEFAULT]
    / "CORCOS"

```

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

) , / "AU\_YANG" ,

```

/SPEC_CORR_CONV_2 =_F (
    ♦FONCTION=fonc , [function,
formula]
    ♦VITE_FLUI=vflui , [R]
    ♦FREQ_COUP=fc , [R]
    ♦COEF_VITE_FLUI_A=alpha , [R]
    ♦COEF_VITE_FLUI_O=beta , [R]
    ♦METHODE=/ "GENERALE" [DEFAULT]
    / "CORCOS"
    / "AU_YANG",
),

/SPEC_CORR_CONV_3 =_F (
    ♦TABLE_FONCTION=fonc ,
[table_fonction]
),

/SPEC_FONC_FORME =_F (
    ♦/INTE_SPEC=int_spec , [interspectrum]
    FONCTION=l_tab_fonc , [l_table_fonction]
    /GRAPPE_1 = "DEBIT_180"
    / "DEBIT_300",
    ♦NOEUD=no , [node]
will ♦CARA_ELEM=cara ,
[cara_elem]
    ♦MODELE=modele , [model]
),

/SPEC_EXCI_POINT =_F (
    ♦/INTE_SPEC=int_spec , [interspectrum]
    NATURE=l_nat , [l_TXM]
    ANGLE=l_theta , [l_R]
    NOEUD=l_no , [l_noeud]
    /GRAPPE_2 = "ASC_CEN"
    / "ASC_EXC"
    / "DES_CEN"
    / "DES_EXC",
    RHO_FLUI=rho_f , [R]
    NOEUD=no , [l_noeud]
    ♦ CARA_ELEM=cara , [cara_elem]
    ♦ MODELE=modele , [model]
),

♦ TITER= titrate, [TXM]
)

```

## 3 Operands

### 3.1 Key words SPEC\_LONG\_COR\_n

the definition of an excitation spectrum of type “correlation length” can be done only by only one occurrence of one of the key words SPEC\_LONG\_COR\_n factors, corresponding to a zone of the tube defined beforehand by the function indicated in operand PROF\_VITE\_FLUI of the command DEFI\_FLUI\_STRU [U4.25.01]. The profile velocity associated with this zone, recalled here under operand PROF\_VITE\_FLUI, must be identical to that indicated in DEFI\_FLUI\_STRU [U4.25.01]. The use of excitation spectrums of type “correlation length” is restricted with the configuration “tube bundle under transverse flow” (factor key word FAISCEAU\_TRANS of operator DEFI\_FLUI\_STRU [U4.25.01]).

To carry out a computation with several excitation zones, it is necessary to define as many spectrums as there are zones. The contributions of the various spectrums can be then added when the excitation is projected on modal base by the command PROJ\_SPEC\_BASE [U4.63.14]. However, it is not possible in this command to combine spectrums of type “correlation length” with spectrums of another type (SPEC\_CORR\_CONV\_n, SPEC\_FONC\_FORME or SPEC\_EXCI\_POINT).

The four spectrums of standard “correlation length” have definite values by default. The definition of new coefficients is delicate, in particular with regard to the model 3 for which there exist conditions of connection between the lines determined by the coefficients.

The general analytical form of models 1 to 4 is the following one:

$$S(s_1, s_2, f_r) = S(f_r) \cdot \exp\left(\frac{-|s_2 - s_1|}{\lambda_c}\right)$$

with:

$S(s_1, s_2, f_r)$       adimensional interspectrum of turbulence between two points of curvilinear abscisses  $(s_1, s_2)$  ;

$S(f_r)$                 autospectrum of turbulence;

$\exp\left(\frac{-|s_2 - s_1|}{\lambda_c}\right)$       function of spatial correlation and  $\lambda_c$  correlation length.

The spectrum is defined according to a reduced frequency  $f_r$  (Strouhal number). For a tube under transverse flow, the statement of  $f_r$  is the following one:

$$f_r = \frac{f \cdot de}{V_g}$$

$f$  is the dimensioned frequency,  $de$  the diameter external of the tube  $V_g$  and the average transverse velocity of the fluid along the structure, which will be recovered in operator PROJ\_SPEC\_BASE [U4.63.14] via the concept [melasflu] produced by the operator CALC\_FLUI\_STRU [U4.66.02].

## 3.1.1 Analytical statement of the spectrums of the type SPEC\_LONG\_COR\_1

◆ /SPEC\_LONG\_COR\_1

Factor key word corresponding to the first model of spectrum with correlation length.

◆LONG\_COR = lc

Correlation length.

◆PROFESSEUR\_VITE\_FLUI = profv

Name of the profile velocity corresponding to the zone where is applied the turbulent excitation.

Kinematical ◆VISC\_CINE =

eps Viscosity of the fluid.

$$S(f_r) = \frac{\Phi_0}{\left[1 - \left[\frac{f_r}{f_{rc}}\right]^{\beta/2}\right]^2 + 4e^2 \left[\frac{f_r}{f_{rc}}\right]^{\beta/2}}$$

with:  $\Phi_0 = \Phi_0(R_e)$  polynomial of the 5th degree.

$$\beta = \beta(R_e)$$

$$\varepsilon = \varepsilon(R_e)$$

$$f_{rc} = 0,2$$

If  $1,5 \cdot 10^4 < R_e \leq 5 \cdot 10^4$  :

$$\Phi_0 = 1,3 \cdot 10^{-4} \left[ 20,42 - 14 \cdot 10^{-4} R_e - 9,81 \cdot 10^{-8} R_e^2 + 11,97 \cdot 10^{-12} R_e^3 - 35,95 \cdot 10^{-17} R_e^4 + 34,69 \cdot 10^{-22} R_e^5 \right]$$

If  $R_e > 5 \cdot 10^4$  :  $\Phi_0 = 38,6075$

If  $R_e \leq 3,5 \cdot 10^4$   $\varepsilon = 0,7$   $\beta = 3$

If not if  $3,5 \cdot 10^4 < R_e \leq 5,5 \cdot 10^4$   $\varepsilon = 0,3$   $\beta = 4$

If not  $\varepsilon = 0,6$   $\beta = 4$

## 3.1.2 Analytical statement of the spectrums of the type SPEC\_LONG\_COR\_2

/ SPEC\_LONG\_COR\_2

Factor key word corresponding to the second model of spectrum with correlation length.

◆LONG\_COR = lc

Correlation length.

◆PROFESSEUR\_VITE\_FLUI = profv

Name of the profile velocity corresponding to the zone where is applied the turbulent excitation.

◇/FREQ\_COUP = frc

reduced Frequency of cut.

PHI0 = phi0

BETA = beta

Coefficients of the spectrum.

**Note:**

*If the user informs one of these operands, it must obligatorily inform the two others, in order to have coherent values.  
If the user does not inform any of the three operands, the values by default are used.*

$$S(f_r) = \frac{\Phi_0}{1 + \left[ \frac{f_r}{f_{rc}} \right]^\beta}$$

The values of the parameters by default are:  $\Phi_0 = 1,5 \cdot 10^{-3}$   $\beta = 2,7$  ,  $f_{rc} = 0,1$

### 3.1.3 Analytical statement of the spectrums of the type SPEC\_LONG\_COR\_3

/ SPEC\_LONG\_COR\_3

Factor key word corresponding to the third model of spectrum with correlation length.

◆LONG\_COR = lc

Correlation length.

◆PROFESSEUR\_VITE\_FLUI = profv

Name of the profile velocity corresponding to the zone where is applied the turbulent excitation.

◇/FREQ\_COUP = frc

reduced Frequency of cut.

PHI0\_1 = phi01

BETA\_1 = beta1

PHI0\_2 = phi02

BETA\_2 = beta2

Coefficients of the spectrum.

**Note:**

*The five operands must be used simultaneously. If one is indicated, the others also owe the being.  
The values by default are used when the user did not inform any of the five operands.*

$$S(f_r) = \frac{\Phi_0}{f_r^\beta} \text{ avec où } \begin{cases} \Phi_0 = \Phi_0(f_{rc}) \\ \beta = \beta(f_{rc}) \end{cases} f_{rc} = 0,2$$

If  $f_r \leq f_{rc}$   $\Phi_0 = 5.10^{-3}$   $\beta = 0,5$   
If not  $\Phi_0 = 4.10^{-5}$   $\beta = 3,5$

### 3.1.4 Analytical statement of the spectrums of the type SPEC\_LONG\_COR\_4

/ SPEC\_LONG\_COR\_4

Factor key word corresponding to the fourth model of spectrum with correlation length.

◆LONG\_COR = lc

Correlation length.

◆PROFESSEUR\_VITE\_FLUI = profv

Name of the profile velocity corresponding to the zone where is applied the turbulent excitation.

◆TAUX\_VIDE = TV

Rate of vacuum (diphasic flow).

◇ /BETA = beta

GAMMA = gamma

Coefficients of the spectrum.

#### Note:

*If the user informs one of these two operands, it must obligatorily inform the other.*

*If none of the two operands is indicated, the values by default are used.*

$$S(f_r) = \frac{\Phi_0}{(f_r)^\beta (\rho_v)^\gamma} \text{ with } \begin{cases} \Phi_0 = \frac{1}{6,8 \cdot 10^{-2}} \cdot 10^\phi \\ \Phi = A \cdot \tau_v^{0,5} - B \cdot \tau_v^{1,5} + C \cdot \tau_v^{2,5} - D \cdot \tau_v^{3,5} \end{cases}$$

$\tau_v$  the rate of vacuum indicates;

$A = 24,042$ ;  $B = -50,421$ ;  $C = 63,483$ ;  $D = 33,284$

The values by default of the exhibitors are  $\beta = 2$  and  $\gamma = 4$ .

$$\rho_v \text{ is the volume throughput: } \rho_v = \rho_m \times V = \sum_{i=N_f}^{N_f} \rho_e \frac{(x_i)}{N_n} \times V$$

where  $V$  the velocity of the fluid indicates for which the fluid study of interaction - structure was conducted and  $N_n$  the number of points taken into account over the excited length. The velocity of the fluid will be recovered in operator PROJ\_SPEC\_BASE [U4.63.14] via the concept [melasflu] produced by the operator CALC\_FLUI\_STRU [U4.66.02].



## 3.2 SPEC\_CORR\_CONV\_n key words

the key words factors SPEC\_CORR\_CONV\_1 and SPEC\_CORR\_CONV\_2 make it possible respectively to define spectrums of turbulence of boundary layer and a function of the unspecified frequency. SPEC\_CORR\_CONV\_3 leaves to the user the whole control of the definition of the inter-spectrum, by means of the analytical functions gathered in an array.

### Theoretical precise details:

- Into the case of a plane structure subjected to a parallel turbulent flow, in which one wishes to know the spectral response with this excitation, the model of correlation of CORCOS introduces a function of correlation between two points  $x$  and  $x'$  on the structure planes, of the type

$$r(\omega, x, x') = \exp\left(\frac{-|x-x'|}{\lambda_1}\right) \times \exp\left(\frac{-|y-y'|}{\lambda_2}\right) \times \cos\left(\frac{\omega(x-x')}{U_c}\right)$$

In the model basic of CORCOS, one has

$$\begin{cases} \lambda_1 = \frac{1}{k_L} \text{ avec } k_L = 0,1 \cdot \frac{\omega}{U_c} \\ \lambda_2 = \frac{1}{k_T} \text{ avec } k_T = 0,55 \cdot \frac{\omega}{U_c} \end{cases}$$

$x$  is the axis parallel with flow.

$y$  is the axis perpendicular to flow.

$U_c$  is the convective velocity of the vortexes. It is allowed that it represents between 60 and 70% velocity of the fluid. By default, one goes it equal to 65% faster of the fluid.

- Into the case of a circular cylindrical structure subjected to an axial flow, the model of correlation of AU\_YANG a function of correlation between two points introduces defined by:

$$r(\omega, x, x') = \exp\left(\frac{-|x-x'|}{\lambda_1}\right) \times \cos\left(\frac{\omega(x-x')}{U_c}\right) \times \exp\left(-R \frac{|\theta-\theta'|}{\lambda'}\right) \times \cos\left(\frac{\omega R(\theta-\theta')}{U'_c}\right)$$

- $\theta$  and  $\theta'$  correspond to the angular positions of the two points of the cylinder to correlate,
- $x$  and  $x'$  indicate the dimensions of the points to be correlated,
- $R$  is the radius of the cylinder,
- $U_c$  is the axial convective velocity of the vortexes: it is equal to the product of the coefficient axial velocity by the velocity of the fluid,
- $U'_c$  is the convective velocity orthoradiale vortexes: it is equal to the product of the coefficient orthoradial velocity by the velocity of the fluid,
- $\lambda$  and  $\lambda'$  are correlation lengths according to the axis and the orthoradial direction respectively.
- Correlation GENERALE is a function of the type

$$r(\omega, \mathbf{x}, \mathbf{x}') = \exp\left(\frac{-\|\mathbf{x}-\mathbf{x}'\|}{\lambda}\right) \times \cos\left(\frac{\omega\|\mathbf{x}-\mathbf{x}'\|}{U_c}\right)$$

- $\mathbf{x}$  and  $\mathbf{x}'$  are the vectors locating the positions of the two points to be correlated,
- $U_c$  is the convective velocity of the vortexes,
- $\lambda$  is correlation length.

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## 3.2.1 Definition of a spectrum of turbulence of boundary layer

/SPEC\_CORR\_CONV\_1

Factor key word corresponding to the first model of spectrum of pressure with correlation length and velocity of convection of the vortexes in the fluid.

◆LONG\_COR\_1 = lc1

the First correlation length (along the axis parallel with flow) for the method of AU\_YANG.  
Correlation length of method GENERALE.

◇LONG\_COR\_2 = lc2

the Second correlation length for the method of AU\_YANG.

◆VITE\_FLUI = vflui

Velocity of the fluid skirting studied structure.

◇FREQ\_COUP = FC

Cut-off frequency of the spectrum. In the case of the method of CORCOS, one uses the value  $f_c = 10 \frac{U}{d}$  (see notations below) by default.

◇K = K

Constant giving the amplitude of the spectrum of pressure.  
By default,  $k$  is worth  $5,8 \cdot 10^{-3}$  in units IF.

◆D\_FLUI = dhyd

Hydraulic diamtere entering the statement of the amplitude of the spectrum of pressure.

◆ RHO\_FLUI = rho\_f

Density of the fluid.

◇COEF\_VITE\_FLUI\_A = alpha

Coefficient convective velocity of the vortexes in the axial direction (direction of flow) for the methods of CORCOS, AU\_YANG.

◇COEF\_VITE\_FLUI\_O = beta

Coefficient convective velocity of the vortexes in the orthoradial direction with the cylinder, for the method of AU\_YANG.

◇METHODE = "GENERALE" or "CORCOS" or "AU\_YANG"

Method of correlation determined by the type of the structure which one wants to study the vibrations generated by turbulence.  
By default, method GENERALE is used.

### Note:

*In the case of the method of CORCOS, one uses for LONG\_COR\_1 and LONG\_COR\_2 correlation lengths of the basic model (see [§3.2]).*

*The spectrum of pressure used is of the type  $S_p(\omega) = K^2 (\rho U^2)^2 d^3$  if  $f \leq f_c$  and 0 pour  $f > f_c$ .*

*$K$  indicate the constant of the model, well informed under the operand  $K$ . For the model of CORCOS,  $K$  is in experiments given and is worth  $K = 5,8 \cdot 10^{-3} s^{1/2} m^{-3/2}$ ;*

*$\rho$  is the density of the fluid, well informed under operand RHO\_FLUI ;*

*$U$  is the velocity of the fluid, well informed under operand VITE\_FLUI ;*

*$D$  is the hydraulic diamtere, well informed under operand D\_FLUI.*

## 3.2.2 Definition of a spectrum of turbulence of a function of the unspecified frequency

/SPEC\_CORR\_CONV\_2

Factor key word allowing to define a spectrum of unspecified pressure function of the frequency.

◆FONCTION = *fonc*

Concept of type function defining the spectrum of pressure according to the frequency, produced by one of operators DEFI\_FONCTION [U4.31.02], CALC\_FONCTION [U4.32.04] or CALC\_FONC\_INTERP [U4.32.01].

◆VITE\_FLUI = *vflui*

Velocity of the fluid skirting studied structure.

◇FREQ\_COUP = *FC*

Cut-off frequency beyond which the function defining the spectrum of pressure is regarded as null.

◇COEF\_VITE\_FLUI\_A = *alpha*

Coefficient convective velocity of the vortexes in the axial direction (direction of flow).

◇COEF\_VITE\_FLUI\_O = *beta*

Coefficient convective velocity of the vortexes in the orthoradial direction with the cylinder, for the method of AU\_YANG.

◇METHODE = "GENERALE" or "CORCOS" or "AU\_YANG"

Method of correlation determined by the type of the structure which one wants to study the vibrations generated by turbulence.  
By default, method GENERALE is used.

## 3.2.3 SPEC\_CORR\_CONV\_3 : definite unspecified spectrum analytically

/SPEC\_CORR\_CONV\_3

Factor key word allowing to define a spectrum on the basis of analytical function.

◆TABLE\_FONCTION = *array*

Concept of the function table type containing the analytical formulas defining the spectrum.

Example of use: one wishes to describe the forces of pressure induced by an axial flow along a fuel pin in the form of a spectrum of type "correlation length" and describing:

- on the one hand decrease of turbulent energy downstream from the grid,
- on the other hand phase shift of with the convection of turbulence with flow.

Correlation length, and the auto-spectrum depend on the frequency. The analytical formulation suggested is the following one:

$$S_f(\underline{r}_1, \underline{r}_2, \omega) = \begin{cases} S_x = \exp\left(-\frac{|\underline{r}_2 - \underline{r}_1|}{\lambda_{cx}(\omega)}\right) \cdot \exp\left(j\omega \frac{z_2 - z_1}{U_c}\right) S_f(\underline{r}_1, \underline{r}_1, \omega) \\ S_y = \exp\left(-\frac{|\underline{r}_2 - \underline{r}_1|}{\lambda_{cy}(\omega)}\right) \cdot \exp\left(j\omega \frac{z_2 - z_1}{U_c}\right) S_f(\underline{r}_1, \underline{r}_1, \omega) \end{cases}$$

$\underline{r}_1$  and  $\underline{r}_2$  is the vectors locating the positions of the two points to be correlated,  $z$  is the direction parallel with the axis of the pencil. One can also add, if it is wished, a term of correlation between the forces according to  $x$  and  $y$ .

The spectrum above is defined in the sdll148b benchmark with correlated forces. One proposes the modelization with uncorrelated forces here (not of term cross  $S_{XY}$  and  $S_{YX}$ ). In this benchmark the pencil is directed according to direction  $Y$ .

```
SXX = FORMULA (NOM_PARA= ("X1", "Y1", "Z1", "X2", "Y2", "Z2",
"FREQ"),
              VALE_C=' exp (- FREQ/freq0) *
                        exp (distance (X1, Y1, Z1, X2, Y2, Z2) /correl
(FREQ)) *
                        complex (cos (2*pi*FREQ* (Y2 there 1) /Uc),
                                sin (2*pi*FREQ* (Y2 there 1) /Uc))',)

SYY =...

# INTER-SPECTER AVEC FORCES X AND Y UNCORRELATED
INTESPEC=CRÉA_TABLE (LISTE= (_F (LISTE_K= ("SXX", "SYY"),
                                PARA=' FONCTION_C'),
                              _F (LISTE_K= ("DX", "DY"),
                                PARA=' NUMÉRIQUE_ORDRE_I'),
                              _F (LISTE_K= ("DX", "DY"),
                                PARA=' NUMÉRIQUE_ORDRE_J')),)
TYPE_TABLE=' TABLE_FONCTION',
TITER=' EXCITATION FLUIDE TURBULENTE');

SPECTRE1=DEFI_SPEC_TURB (SPEC_CORR_CONV_3=_F (TABLE_FONCTION =
                                             INTESPEC),);
```

The function outdistances was defined in python and gives the distance between two points of respective coordinates  $(x_1, y_1, z_1)$  and  $(x_2, y_2, z_2)$ . The function `correl` depends exponentially on the frequency.

### 3.3 Key word SPEC\_FONC\_FORME

/SPEC\_FONC\_FORME

Factor key word allowing to define an excitation spectrum by its decomposition on a family of shape functions.

◆/INTE\_SPEC = int\_spec

Concept of type interspectrum defining an interspectral matrix of excitation. This concept can be produced by the operator `LIRE_INTE_SPEC` [U4.36.01] after reading of the interspectral matrix on external file.

FONCTION = l\_tab\_fonc

List of concepts of the type `table_function` defining the family of shape functions associated with each mode. For each mode, one informs an array containing 2 shape functions in the 2 orthogonal directions with the axis of telegraphic structure.

`/GRAPPE_1 = "DEBIT_180" or "DEBIT_300"`

Two possible choices corresponding to the flows for which excitation `GRAPPE1` was identified.

◆`NOEUD = No`

Node of application of the excitation.

◆`CARA_ELEM = will cara`

Concept of the `cara_elem` type by the operator produced `AFFE_CARA_ELEM` [U4.42.01], defines the affected geometrical characteristics in the elements of structure.

The geometrical characteristics are necessary to the estimate of the hydraulic diameters. Moreover, the concept of the `cara_elem` type brings the relative information to the directional senses of the elements.

◆`MODELE = model`

Concept of the `model` type produces `AFFE_MODELE` [U4.41.01] by the operator, defines the element types affected ones in meshes of structure.

#### Note:

- 1) *The length of application  $L$  is characterized in an intrinsic way by the field of definition of the shape functions associated with the excitation. The enforcement zone is centered around the node of application.*
- 2) *The turbulent excitation being able to be developed in a way correlated in the two orthogonal directions with the axis of telegraphic structure (axis  $x$ ), the shape functions are a priori vectors with two components (according to  $y$  and  $z$ ).*

*One thus defines, for each mode, two shape functions (a following  $y$  and a following  $z$ ) on the interval  $(0; L)$ . The functions then passed in a `table_fonction` to operator `DEFI_SPEC_TURB`. (cf `sdll116a` benchmark)*

## 3.4 Key word `SPEC_EXCI_POINT`

`/SPEC_EXCI_POINT`

Factor key word allowing to define an excitation spectrum associated with one or more specific forces and moments.

◆`INTE_SPEC = int_spec`

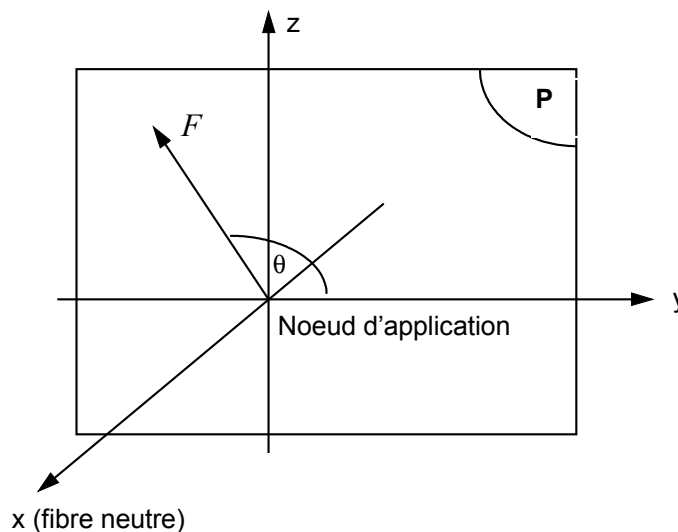
Concept of type `interspectrum` defining an interspectral matrix of specific excitations. This concept can be produced by the operator `LIRE_INTE_SPEC` [U4.56.01] after reading of the interspectral matrix on external file.

`NATURE = l_nat`

List of arguments of type text defining the nature of the excitation of each node of application. The licit arguments are "FORCE" or "MOMENT".

`ANGLE = l_theta`

List of the angles defining the directions of the vectors forces and moments of each node of application (see diagram).



The vector force is directed in the orthogonal  $P$  plane with neutral fiber. In this plane, the azimuth  $\theta$  gives the direction of the vector. The angles must be given in **degrees**.

NOEUD = l\_no

List of the nodes of application of the specific excitations.

**Note:**

*The interspectral matrix has as a dimension the number of forces and specific moments applied. The diagonal terms of this matrix characterize the autospectrums of these excitations.  
The lists defining the nodes of application, the nature and the direction of the imposed excitations must thus be ordered in accordance with structure of the interspectral matrix of excitations.*

/GRAPPE\_2 = "ASC\_CEN" or "ASC\_EXC" or "DES\_CEN" or "DES\_EXC"

Four possible choices corresponding to the various experimental configurations for which excitation GRAPPE2 was identified:

- ascending flow rod of Centered command,
- Ascending flow rod of Offset command,
- flow Descending rod from Centered command,
- flow Descending rod from Offset command.

Excitation GRAPPE2 is characterized by a specific force and a moment applied in the same node, in a homogeneous way in the two orthogonal directions with the axis of telegraphic structure.

RHO\_FLUI = rho\_f

Density of the fluid surrounding structure.

NOEUD = No

Node of application of excitation GRAPPE2.

**Note:**

*When one resorts to a preset spectrum GRAPPE2, nodes list waited under the operand NOEUD is reduced to only one element (only one node of application).*

◆CARA\_ELEM = will cara

Concept of the `cara_elem` type by the operator produced `AFFE_CARA_ELEM` [U4.42.01], defines the affected geometrical characteristics in the elements of structure.

The geometrical characteristics are necessary to the estimate of the hydraulic diamtere. Moreover, the concept of the `cara_elem` type brings the relative information to the directional senses of the elements.

◆MODELE = model

Concept of the `model` type produces `AFFE_MODELE` [ U4.41.01] by the operator, defines the element types affected ones in meshes of structure.

## 4 GAY

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- 1) bibliography N., T. FRIOU: Resorption of software FLUSTRU in *Aster* HT-32/93/002/B
- 2) L. PEROTIN, Mr. LAINET: Integration of a general model of turbulent excitation in *the Code\_Aster* : specifications HT-32/96/003/A