

Operator DYNA_ALEA_MODAL

1 Drank

This operator allows to calculate the matrix of spectral concentration of the response of a linear structure under an excitation which one knows the matrix of spectral concentration (one says also interspectrum of excitation).

The operator then provides the modal response in the form of his spectral concentration (the interspectrum of the response).

The product concept is of standard `interspectrum`.

2 Syntax

```

dyalea [interspectrum] = DYNA_ALEA_MODAL
(
  ◆BASE_MODAL= _F          (
    ◆MODE_MECA=modemec          [mode_meca]
    ◆/◆NUMÉRIQUE_ORDRE=ordre    [l_I]
      ◆ AMOR_REDUIT=lamor        [l_R]
    /◆BANDE=                    (f1, f2) [l_R]
      ◆ AMOR_UNIF=amor          [R]
    )
  ◆MODE_STAT=mosta          [mode_meca]
  ◆EXCIT= _F                (
    # Order of derivative of excitation
    ◆DERIVATION = /0          [DEFAULT]
      /1
      /2
    ◆GRANDEUR = / "DEPL_R"    [DEFAULT]
      / "EFFO"
      / "SOUR_DEBI_VOLU"
      / "SOUR_DEBI_MASS"
      / "SOUR_PRESS"
      / "SOUR_FORCE"
    # interspectrum excitation
    ◆INTE_SPEC=interexc
  [interspectrum]
    ◆NUMÉRIQUE_VITE_FLUI=liste_ind [l_I]
    ◆OPTION=/ "TOUT" [DEFAULT]
      /"DIAG"
    # place of application of the excitation
    ◆MODAL = ' OUI '
      = 'NON'
    ◆/◆NUMÉRIQUE_ORDRE_I=      noi [l_I]
      ◆NUMÉRIQUE_ORDRE_J=      noj [l_I]
    ◆/◆NOEUD= list_noe [l_noeud]
      ◆NOM_CMP= list_comp [l_cmp]
      ◆ MODAL= "NON" [DEFAULT]
    /◆ CHAM_NO= list_vass [l_cham_no_*]
      ◆ MODAL= "NON" [DEFAULT]
    / ◆ MODAL= "OUI"
    /◆ NOEUD_I= noeudi [l_noeud]
      ◆ NOEUD_J= noeudj [l_noeud]
      ◆ NOM_CMP_I= cmpi [l_cmp]
      ◆ NOM_CMP_J= cmpj [l_cmp]
      ◆ NOEUD= list_noe [l_noeud]
      ◆ NOM_CMP= list_comp [l_cmp]
      ◆ MODAL= "NON" [DEFAULT]

```

)

```
◆REPONSE=_F
# order of derivative of the response

◇DERIVATION = /0 [DEFAULT]
              /1
              /2

# possible limitation of computation to the diagonal

◇OPTION = "TOUT" [DEFAULT]
         / "DIAG"

# frequential discretisation for the response

◇ ◆ FREQ_MIN =fmin [R]
  ◆ FREQ_MAX =fmax [R]
◇PAS = not [R]
◇FREQ_EXCIT = /"AVEC" [DEFAULT]
              /"SANS"
◇NB_POIN_MODE = /50 [DEFAULT]
                /N [I]

)

◇TITER=titer [1_Kn]

◇INFO=/1 [DEFAULT]
        /2

);
```

3 Features

operator `DYNA_ALEA_MODAL` allows to calculate the response in the frequential field, on modal base, of a structure subjected to an excitation represented by an interspectral matrix (confer `DEFI_INTE_SPEC` [U4.36.02]).

The quantity excitation can be of d.o.f. type imposed or force associated with a deliberté degree. It can also correspond to sources of fluid excitation [R4.05.02].

The excitation can be given in form derived of a nature equal to 0,1 or 2 (displacement, velocity or acceleration).

L`operator `REST_SPEC_PHYS` [U4.63.22] makes it possible to restore the response in displacement or force the degrees of freedom "of observation" (couples node, component).

The interspectral matrix of modal response thus calculated can be reintroduced in a new computation.

4 Operands

4.1 Key word `BASE_MODAL`

◆`BASE_MODAL` = `_F` (

Key word factor for the definition of the parameters of selection of the modal base of computation.

4.1.1 Operand `MODE_MECA`

◆`MODE_MECA` = `modemec`

`modemec` is the concept of the `mode_meca` type containing the dynamic modes.

4.1.2 Operands `NUME_ORDRE` / `AMOR_REDUIT`

`/NUME_ORDRE` = `lordre`

`lordre` is the list of the sequence numbers of the modes of the concept `modemec` actually taken into account in computation. Example: (2,3,4).

`AMOR_REDUIT` = `lamor`

`lamor` is the list of reduced modal dampings corresponding to the modes selected. The number of elements of the list is equal to the number of elements of `lordre`. Example: (0.05, 0.05, 0.02). This key word is usable only with `NUME_ORDRE`.

4.1.3 Operands `BANDAGES` / `AMOR_UNIF`

`/BANDE` = (f1 f2)

the dynamic modes taken into account will be those of `modemec` of which the frequency is in the tape (f1 f2)

`AMOR_UNIF` = `amor`

For each mode selected, damping is equal to `amor`. This key word is usable only with `TAPE`.

4.2 Operand `MODE_STAT`

◇`MODE_STAT` = `mosta`

Concept of the `mode_meca` type containing the static modes necessary to computation.

This key word is necessary only in the case of a seismic computation multi-bearings where the excitation is done on degrees of freedom (I. E. when the key word `QUANTITY` under factor key word the `EXCIT` is worth "`DEPL_R`").

4.3 Key word `EXCIT`

◆`EXCIT` = `_F` (

Factor key word defining all the parameters relating to the excitation.

Key words `derivative`, `QUANTITY` and `MODAL` define the type of excitation.

Key words `INTE_SPEC`, `NUME_VITE_FLUI`, `NUME_ORDRE_I`, `NUME_ORDRE_J`, `NOEUD_I`, `NOEUD_J`, `NOM_CMP_I` and `NOM_CMP_J` define the interspectrum of excitation.

4.3.1 Operand `derivative`

◇`DERIVATION` =

When the quantity of the excitation is of imposed d.o.f. type ("`DEPL_R`"), this key word makes it possible to describe if the interspectrum of excitation must be regarded as a displacement, a velocity or an acceleration imposed. The user specifies 0, 1 or 2 then.

This key word is optional. By default, it is equal to 0.

Note:

In the case of a seismic computation, the excitation is often an acceleration. This key word must then be equal to 2.

4.3.2 Operand `QUANTITY`

◇`GRANDEUR` =

This key word makes it possible to say if the excitation is of imposed d.o.f. type ("`DEPL_R`"), imposed force ("`EFFO`"), source of flow-volume ("`SOUR_DEBI_VOLU`"), source of flow - mass ("`SOUR_DEBI_MASS`"), source of pressure ("`SOUR_PRESS`") or fluid source of force ("`SOUR_FORCE`").

This key word is optional. By default, it is equal to "`DEPL_R`" and the excitation is of d.o.f. type of displacement imposed in all the safe cases in the case of bearings represented by assembled vectors (key word `CHAM_NO`).

4.3.3 Operands `INTE_SPEC` and `NUME_VITE_FLUI`

These key words define L (be) interspectrum (S) of excitation.

◆`INTE_SPEC` = `interexc`

`interexc` is the concept of type `interspectrum` containing all the interspectral matrixes (matrixes of spectral concentration) of excitation. He is taken into account such as he is defined in the function associated with the concept, i.e. in particular which one does not interpret a possible folding up of spectrum.

For a function defined by:

$$f \in [f_1, f_2] : \tilde{S}(f) \text{ given}$$

One will interpret:

$$f < f_1 : S(f) = 0$$

$$f \in [f_1, f_2] : S(f) = \tilde{S}(f) \text{ donné}$$

$$f > f_2 : S(f) = 0$$

If the loop of frequency $[f_1, f_2]$ must be reproduced for the negative frequencies, it is necessary:

- either to give the group of the spectrum on the axis of realities,
- or to apply a coefficient 2 to the value of the DSP, possible skirting, since the spectral concentrations are supposed to be symmetric in computations carried out by the command DYNA_ALEA_MODAL.

The parameters necessary of the array are:

- 1) if one index parameters of the array by sequence numbers: "NUME_ORDRE_I" [I], "NUME_ORDRE_J" [I], "FONCTION" [K24]
- 2) if not: "NEUD_I" [K8], "NEUD_J" [K8], "NOM_CMP_I" [K8], "NOM_CMP_J" [K8], "FONCTION" [K24].

. This array can be generated by the operators: DEFI_SPEC_MODAL , LIRE_INTE_SPEC or CALC_INTE_SPEC . The reader is invited to consult of the command documentation TEST_FONCTION [U4.92.02] for more information on the meaning of the parameters .

◇ NUMÉRIQUE_VITE_FLUI = nk

nk is the sequence number velocity of the fluid associated with interexc.

4.3.4 Operands NUME_ORDRE_I, NUME_ORDRE_J, NOEUD, NOM_CMP, CHAM_NO and MODAL

These key words and the bind the terms of () the interspectrum (S) of excitation points of excitation for a modal excitation or when the parameters of the array were subscripted by sequence numbers.

```
◆/◆ . NUMÉRIQUE_ORDRE_I= noi1, noi2.  
◆ . NUMÉRIQUE_ORDRE_J= noj1, noj2,...
```

These lists of sequence number are paired two by two in order to determine the term of the interspectral matrix given.

```
◆ / ◆ NOEUD = list_noe
```

This key word makes it possible to specify the nodes where the multispectral excitation will be applied. Example ("N1", "N5", "N7").

For all the types of quantities of excitation, except for the sources of pressure and the sources of force, list_noe contains as many terms as there are couples of indices defining of the interspectrums of excitation.

In the case of sources of pressure or sources of force, with each source is associated a dipole, i.e. two points of application. list_noe then has twice more terms than there are couples of indices defining of the interspectrums.

```
◆ . NOM_CMP = list_cmp
```

This key word makes it possible to specify the components to which the spectral excitation multi - will be applied. Example ("NEAR" "DRZ" "PHI").

These components must of course correspond to degrees of freedom of the nodes of bearings.

In all the cases, `list_cmp` has the same number of elements as `list_noe`.

For the fluid sources, it is the degree of freedom "NEAR" which is excited.

◇ MODAL = "NON" [DEFAULT]

the excitation is not modal in this case.

/ ♦ CHAM_NO = `list_vass`

When this key word is present, each bearing of excitation is a definite vector before assembled in the command file. `list_vass` contains the list of the assembled vectors holding place of bearings. The associated exciting quantity is "EFFF". It is recommended that the intensity associated with the force which one imposes by this skew is given by the interspectrum: the assembled vector is primarily used to define a shape function support of a spectrum of power in force. It is thus standardized.

This option makes it possible to affect a spectrum of power of force on a shape function.

In all the cases, `list_vass` contains as many terms as there are couples of indices defining of the interspectrums.

/♦MODAL = "OUI"

the presence of "OUI" under this key word implies that the interspectrum of excitation is regarded as a modal excitation.

4.3.5 Operands NOEUD_I, NOEUD_J, NOM_CMP_I and NOM_CMP_J

These key words and the bind the terms of () the interspectrum (S) of excitation points of excitation when the parameters of the array were subscripted by physical data made up by the couple (Node - Component).

```
♦ /♦      NOEUD_I=ndi1      , ndi2,...
♦ NOM_CMP_I=cmpi1      , cmpi2,...
♦ NOEUD_J=ndj1        , ndj2,...
♦ NOM_CMP_J=cmpj1      , cmpj2,...
```

These lists of sequence number are paired two by two in order to determine the term of the interspectral matrix given. The length of the preceding lists must correspond to the number of excitations imposed on structure.

```
♦NOEUD=      list_noe      [l_noeud]
♦NOM_CMP=    list_comp     [l_cmp]
```

These two key words have the same meaning as in [§4.3.4].

```
◇ . MODAL=    "NON"      [DEFAULT]
```

the excitation is not modal in this case.

4.4 Key word response

```
♦RESPONSE = _F (
```

Factor key word for the definition of all the parameters concerning the response.

The three following key words describe the type of the response.

4.4.1 Operand derivative

```
◇DERIVATION =
```

This key word has the same meaning as for factor key word `the` `EXCIT` [§4.3.1].

4.4.2 Operand `OPTION`

`◇OPTION =`

If this key word is specified with "DIAG", then all the nondiagonal functions of the interspectrum response are initialized to zero without being calculated. Only the autospectrums are calculated. In the contrary case ("TOUT"), all the functions of the interspectrum response are calculated.

4.4.3 Operands `FREQ_MIN` / `FREQ_MAX` / `NOT` / `FREQ_EXCIT` / `NB_POIN_MODE`

These key words are used to describe the frequential discretization in which the response will be given.

`◇◇FREQ_MIN = fmin`
`◇◇FREQ_MAX = fmax`

`fmin` and `fmax` are the two limits of the interval of frequency. `not` is the minimum step of discretization.

`◇PAS = not`

If the values of `fmin` and `fmax` are given, `not` is worth then by default $\frac{f_{max} - f_{min}}{100}$.

If `not` one takes `fmax` the greatest eigenfrequency of the dynamic modes retained for computation.

Then the discretization covers the field $[0; 2.f_{max}]$ $pas = \frac{2.f_{max}}{100}$.

On the other hand, if `not` is present, one makes sure that the step of discretization of the response is lower than `step` everywhere.

`◇FREQ_EXCIT = / "AVEC"`
`/ "SANS"`

If the user gives the argument "AVEC" under key word `FREQ_EXCIT`, then the frequencies of the excitation are integrated into the discretization of the response (default option). If it gives argument "SANS", they will be ignored. This key word is put at "SANS" in the event of presence of key word `FREQ_MIN`.

`◇NB_POIN_MODE = N [default = 50]`

the response is refined towards eigenfrequencies in order to ensure a good description of the response towards peaks.

Key word `NB_POIN_MODE` makes it possible to define the number of steps of frequency per eigenfrequency taken into account. By default, there are 50 steps per eigenfrequency. This key word is not taken into account if `FREQ_MIN` is given.

Each function of the interspectrum will have by default a mode of "linear" interpolation `OF THE TYPE` and a mode of prolongation out of field of discretization of the "EXCLUDED" type.

4.5 Operand `TITER`

`◇TITER = title`

`title` is the title of computation. It will be printed at the top of the results. See [U4.03.01].

4.6 Operand INFO

◇INFO =

Specifies the options of printing on the message file .

- 1 step of printing
- 2 points out the selected computation options.

5 Count produced

the parameters of the produced array are described in the array below:

	PARAMETR ETYP EDES CRIP TION NOM_ CHAM K16n om	of the field (= 'DEPL_GENE')
OPTIONK16nom		of the option ("TOUT" or "DIAG")
DIMENSIONIdimensionNUME_VITE_FLUIInuméro		of order of the interspectral matrix of fluid correspondanteNUME_ORDRE_INUME_ORDRE_JK8Indices response modaleVITE_FLUIDERvitess
		of the sequence numbers i and j allowing to define a term of the matrix interspectraleFONCTIONK24nom
		of the function of modal response corresponding at the end of the matrix defined by NUME_ORDRE_x

6 useful Remarks for the use

- **Required of a static and standard mode of dynamic modes:**

In the case of excitation in imposed displacement, the dynamic modes are calculated out of blocked bearings and the presence of the static mode is compulsory.

In the other cases, the dynamic modes are calculated out of free bearings, and the presence of a static mode is not justified any more.

The dimension of the interspectral matrix is given by the sum of the static modes and the dynamic modes (if it there of a) taken into account.

Thus, for a structure with five dynamic modes, excited in displacement by two bearings, the dimension of the interspectral matrix of modal response is 7.

If the excitation is given in imposed force, there are no static modes and the dimension of the interspectral matrix is 5.

- **Use of key word MODAL under factor key word the EXCIT :**

In the case of use of key word MODAL under factor key word the EXCIT to directly introduce the matrix of modal spectral concentration like excitation, it is necessary to give again under the keys

- key EXCIT BASE_MODAL and MODE_STAT all the arguments which had been used to create this modal interspectral matrix (nodes and bearings degrees of freedom).

7 Phase of checking

One checks the coherence of the data:

- many modal dampings = many modes selected.
- number of nodes of bearings equal to the number of components (for the excitation).
- many couples of indices retained in the interspectrum excitation = number of bearings or many points of excitation.
- in the case of sources of pressure: number of nodes bearings equal to twice the number of couples of indices retained in the interspectrum of excitation.
- the presence of a mode_meca is checked in the cases of excitation by a quantity of the type DEPL_R.
- $f_{max} \geq f_{min}$

8 Example

```
DYNALEA1=DYNA_ALEA_MODAL (  
  BASE_MODAL=_F (  
    MODE_MECA = FREQ1,  
    NUME_ORDRE = 1,  
    AMOR_REDUIT = 0.05),  
  MODE_STAT=MODESTA1,  
  EXCIT=_F (derivative = 2,  
    INTE_SPEC = INTEREXC,  
    NUME_ORDRE_I = 1,  
    NUME_ORDRE_J = 1,  
    NOEUD = "P1",  
    NOM_CMP = "DX"),  
  REponse=_F (derivative = 2),  
)
```