

Operator DYNA_ALEA_MODAL

1 Goal

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

The operator then provides the modal answer in the form of his spectral concentration (the interspectre of the answer).

The produced concept is of type `interspectre`.

2 Syntax

```
dyalea [interspectre] = DYNA_ALEA_MODAL
(
  ♦ BASE_MODEALE =_F (
    ♦ MODE_MECA = modemec [mode_meca]
    ♦ / ♦ NUME_ORDRE = order [l_I]
      ♦ AMOR_REDUIT = lamor [l_R]
    / ♦ BAND = (f1, f2) [l_R]
      ♦ AMOR_UNIF = amor [R]
    )
  ♦ MODE_STAT = mosta [mode_meca]
  ♦ EXCIT =_F (
    # Order of derivation of the excitation
    ♦ DERIVATION = / 0 [DEFECT]
      / 1
      / 2
    ♦ SIZE = / 'DEPL_R' [DEFECT]
      / 'EFFO'
      / 'SOUR_DEBI_VOLU'
      / 'SOUR_DEBI_MASS'
      / 'SOUR_PRESS'
      / 'SOUR_FORCE'
    # interspectre excitation
    ♦ INTE_SPEC = interexc [interspectre]
    ♦ NUME_VITE_FLUI = list_ind [l_I]
    ♦ OPTION = / 'ALL' [DEFECT]
      / 'DIAG'
    # place of application of the excitation
    ♦ MODAL = 'OUI'
      = 'NOT'
    ♦ / ♦ NUME_ORDRE_I = noi [l_I]
      ♦ NUME_ORDRE_J = noj [l_I]
      ♦ / ♦ NODE = list_noe [l_noeud]
        ♦ NOM_CMP = list_comp [l_cmp]
        ♦ MODAL = 'NOT' [DEFECT]
      / ♦ CHAM_NO = list_vass [l_cham_no_*]
        ♦ MODAL = 'NOT' [DEFECT]
      / ♦ MODAL = 'YES'
    / ♦ NOEUD_I = noeudi [l_noeud]
      ♦ NOEUD_J = noeudj [l_noeud]
      ♦ NOM_CMP_I = cmpi [l_cmp]
      ♦ NAME_CMP_J = cmpj [l_cmp]
      ♦ NODE = list_noe [l_noeud]
      ♦ NOM_CMP = list_comp [l_cmp]
      ♦ MODAL = 'NOT' [DEFECT]
  )
)
```

```
♦ ANSWER = _F .
# order of derivation of the answer

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

# possible limitation of calculation to the diagonal

    ◇ OPTION = / 'ALL'          [DEFECT]
              / 'DIAG'

# frequential discretisation for the answer

    ◇ ♦  FREQ_MIN =  fmin          [R]
      ♦  FREQ_MAX =  fmax          [R]
    ◇ NOT =          not          [R]
    ◇ FREQ_EXCIT =   / 'WITH'     [DEFECT]
                        / 'WITHOUT'
    ◇ NB_POIN_MODE = / 50          [DEFECT]
                        / N        [I]

)

◇ TITLE      =      title          [l_Kn]

◇ INFORMATION = / 1                [DEFECT]
                / 2

);
```

3 Features

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

The size excitation can be of `ddl` type imposed or effort 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, speed or acceleration).

The operator `REST_SPEC_PHYS` [U4.63.22] allows to restore the response in displacement or effort the degrees of freedom "of observation" (couples node, component).

The matrix interspectrale of modal answer thus calculated can be reintroduced in a new calculation.

4 Operands

4.1 Keyword `BASE_MODAL`

- ◆ `BASE_MODAL = _F (`
Keyword factor for the definition of the parameters of selection of the modal base of calculation.

4.1.1 Operand `MODE_MECA`

- ◆ `MODE_MECA = modemec`
`modemec` is the concept of the type `mode_meca` 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 LE calculation. Example: (2,3,4).

`AMOR_REDUIT = lamor`

`lamor` is the list of reduced modal depreciation 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 keyword is usable only with `NUME_ORDRE`.

4.1.3 Operands `BAND` / `AMOR_UNIF`

`/ BAND = (f1 f2)`

The dynamic modes taken into account will be those of `modemec` whose frequency is in the band (f1 f2)

`AMOR_UNIF = amor`

For each mode selected, damping is equal to `amor`. This keyword is usable only with `BAND`.

4.2 Operand **MODE_STAT**

◇ `MODE_STAT = mosta`

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

This keyword is necessary only in the case of a seismic calculation multi-supports where the excitation is done on degrees of freedom (I. E. when the keyword `SIZE` under the keyword `factor` `EXCIT` is worth 'DEPL_R').

4.3 Keyword **EXCIT**

◆ `EXCIT = _F (`

Keyword factor defining all the parameters relating to the excitation.

Keywords `DERIVATION`, `SIZE` and `MODAL` define the type of excitation.

Keywords `INTE_SPEC`, `NUME_VITE_FLUI`, `NUME_ORDRE_I`, `NUME_ORDRE_J`, `NOEUD_I`, `NOEUD_J`, `NOM_CMP_I` and `NOM_CMP_J` define the interspectre of excitation.

4.3.1 Operand **DERIVATION**

◇ `DERIVATION =`

When the size of the excitation is of imposed ddl type ('DEPL_R'), this keyword makes it possible to describe if the interspectre of excitation must be regarded as a displacement, a speed or an acceleration imposed. The user specifies then 0, 1 or 2.

This keyword is optional. By default, it is equal to 0.

Note:

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

4.3.2 Operand **SIZE**

◇ `SIZE =`

This keyword makes it possible to say if the excitation is of imposed ddl type ('DEPL_R'), imposed effort ('EFFF'), 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 keyword is optional. By default, it is equal to 'DEPL_R' and the excitation is of ddl type of displacement imposed in all the cases except in the case of supports represented by assembled vectors (keyword `CHAM_NO`).

4.3.3 Operands **INTE_SPEC** and **NUME_VITE_FLUI**

These keywords define L (be) interspectre (S) of excitation.

◆ `INTE_SPEC = interexc`

`interexc` is the concept of the type `interspectre` containing the whole of the matrices interspectrales (matrices 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:

- that is to say to give the whole of the spectrum on the axis of realities,
- that is to say to apply a coefficient 2 to the value of the DSP, possible skirting, since the spectral concentrations are supposed to be symmetrical in the calculations carried out by the order DYNA_ALEA_MODAL.

The parameters necessary of the table are:

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

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

◇ NUME_VITE_FLUI = nk

nk is the sequence number the speed of the fluid associated with `interexc`.

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

These keywords bind the terms of () the interspectre (S) of excitation and the points of excitation for a modal excitation or when the parameters of the table were subscripted by sequence numbers.

◆ / ◆ . NUME_ORDRE_I = noi1, noi2.
◆ . NUME_ORDRE_J = noj1, noj2,...

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

◆ / ◆ NODE = list_noe

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

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

◆ . NOM_CMP = list_cmp

This keyword makes it possible to specify the components to which the spectral excitation multi - will be applied. Example ('CLOSE' 'DRZ' 'PHI').

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

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

For the fluid sources, it is the degree of freedom 'CLOSE' who is excited.

◇ MODAL = 'NOT' [DEFECT]

The excitation is not modal in this case.

/ ◆ CHAM_NO = list_vass

When this keyword is present, each support of excitation is a definite vector before assembled in the command file. `list_vass` the list of the assembled vectors contains holding place of supports. The associated exiting size is 'EFFO'. It is recommended that L' intensity associated with the effort which one imposes by this skew is given by the interspectre: the assembled vector is primarily used to define a function of form support of a spectrum of power in effort. It is thus standardized.

This option makes it possible to affect a spectrum of power of effort on a function of form.

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

/ ◆ MODAL = 'YES'

The presence of 'YES' under this keyword implies that the interspectre of excitation is regarded as a modal excitation.

4.3.5 Operands NOEUD_I, NOEUD_J, NOM_CMP_I and NOM_CMP_J

These keywords bind the terms of () the interspectre (S) of excitation and the points of excitation when the parameters of the table 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 matrix interspectrale given. The length of the preceding lists must correspond to the number of excitations imposed on the structure.

◆ NROEUD = list_noe [l_noeud]
◆ NOM_CMP = list_comp [l_comp]

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

◇ . MODAL = 'NOT' [DEFECT]

The excitation is not modal in this case.

4.4 Keyword ANSWER

◆ ANSWER = _F (

Keyword factor for the definition of all the parameters concerning the answer.

The three following keywords describe the type of the answer.

4.4.1 Operand DERIVATION

◇ DERIVATION =

This keyword has the same direction as for the keyword factor `EXCIT` [§4.3.1].

4.4.2 Operand OPTION

◇ OPTION =

If this keyword is specified with 'DIAG', then all the nondiagonal functions of the interspectre answer are initialized to zero without being calculated. Only the autospectres are calculated. In the contrary case ('ALL'), all the functions of the interspectre answer are calculated.

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

These keywords are used to describe the frequential discretization in which the answer will be given.

◇ ◆ FREQ_MIN = fmin
◆ FREQ_MAX = fmax

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

◇ NOT = not

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

If not one takes fmax the greatest Eigen frequency of the dynamic modes retained for calculation.

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 answer is lower everywhere than not.

◇ FREQ_EXCIT = / 'WITH'
/ 'WITHOUT'

If the user gives the argument 'WITH' under the keyword FREQ_EXCIT, then the frequencies of the excitation are integrated into the discretization of the answer (option by default). If it gives the argument 'WITHOUT', they will be ignored. This keyword is put at 'WITHOUT' in the event of presence of the keyword FREQ_MIN.

◇ NB_POIN_MODE = N [defect = 50]

The answer is refined towards Eigen frequencies in order to ensure a good description of the answer towards peaks.

The keyword NB_POIN_MODE the number of steps of frequency per Eigen frequency taking into account makes it possible to define. By default, there is 50 pas by Eigen frequency. This keyword is not taken into account if FREQ_MIN is given.

Each function of the interspectre will have by default a mode of interpolation of the type 'LINÉAIRE' and a mode of prolongation out of field of discretization of the type 'EXCLUDED'.

4.5 Operand **TITLE**

◇ TITLE = title

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

4.6 Operand **INFORMATION**

◇ INFORMATION =

Specify the options of impression on the file MESSAGE.

1 pas d' impression

- 2 point out the selected options of calculation.

5 Produced table

The parameters of the produced table are described in the table below:

PARAMETER	TYP E	DESCRIPTION
NOM_CHAM	K16	name of the field (= 'DEPL_GENE')
OPTION	K16	name of the option ('ALL' or 'DIAG')
DIMENSION	I	dimension
NUME_VITE_FLUI	I	sequence number of the matrix interspectrale of modal answer
VITE_FLUIDE	R	corresponding speed of fluid
NUME_ORDRE_I NUME_ORDRE_J	K8	Indices of the sequence numbers i and j allowing to define a term of the matrix interspectrale
FUNCTION	K24	name of the function of modal answer corresponding at the end of the matrix defined by NUME_ORDRE x

6 Useful remarks for the use

- **Need for a static and standard mode of dynamic modes:**

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

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

The dimension of the matrix interspectrale 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 supports, the dimension of the matrix interspectrale of modal answer is 7.

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

- **Use of the keyword MODAL under the keyword factor EXCIT :**

In the case of use of the keyword MODAL under the keyword factor EXCIT to directly introduce the matrix of modal spectral concentration like excitation, it is necessary to give again under the keywords EXCIT BASE_MODALE and MODE_STAT all the arguments which had been used to create this modal matrix interspectrale (nodes and degrees of freedom supports).

7 Phase of checking

The coherence of the data is checked:

- many modal depreciation = many modes selected.
- number of nodes of supports equal to the component count (for the excitation).
- many couples of indices retained in the interspectre excitation = number of supports or many points of excitation.
- in the case of sources of pressure: number of nodes supports equal to twice the number of couples of indices retained in the interspectre of excitation.
- the presence of one mode_meca is checked in the cases of excitation by a size 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 (DERIVATION = 2,
    INTE_SPEC = INTEREXC,
    NUME_ORDRE_I = 1,
    NUME_ORDRE_J = 1,
    NODE = 'P1',
    NOM_CMP = 'DX'),
  REponse=_F (DERIVATION = 2),
)
```