Operator DYNA_ISS_VARI

1 Goal

This operator allows to calculate the answer of a structure subjected to a variable seismic movement in space starting from a function of coherence, matrix of impedance and seismic force. These last can be calculated by software PROMISS3D. More precisely, one builds the spectral vectors of modal answer (exits of a spectral decomposition of the matrix of coherence) via a harmonic calculation in generalized components. At exit, one obtains the spectral concentration (DSP) of the modal answer (for a unit excitation) or the temporal answer in acceleration to deduce some from the spectra of answer if a accélérogramme is given.

Product a concept of the type `interspectre` or `tran_gene`.

2 Syntax

```
RES_VARI  =  DYNA_ISS_VARI    (

    ♦  |  FONC_SIGNAL   =  acce                   [fonction_sdaster]
               ◊  ♦  FREQ_PAS  =  not,            [R]
                  ♦  FREQ_FIN  =  end,            [R]

       |  NB_FREQ   =  fpas,                      [I]
               ♦  FREQ_INIT =  fmin,              [R]
               ♦  FREQ_PAS  =  not,               [R]
               ◊  OPTION    =  /  'ALL',        [DEFECT]
                               /  'DIAG',

    ♦  NOM_CMP         =  /  'DX',
                          /  'DY',
                          /  'DZ',

    ◊  PRECISION       =  /  prec,                [R8]
                          /  0,999,               [DEFECT]

    ♦  INTERF          =  _F  (
               ♦  GROUP_NO_INTERF  =  ma_interf,  [grma]
               ♦  MODE_INTERF      =  /  'ALL',
                                      /  'CORPS_RIGI'
                               ),

    ◊  ISSF            =  /'NOT'                  [DEFECT]
                          /'YES'

    ♦  MATR_COHE       =  _F  (

               ◊  TYPE       =     / 'MITA_LUCO'
                                   / 'ABRAHAMSON'
               ◊  VITE_ONDE   =  vite_onde,       [R8]
                                 /  600.0,        [DEFECT]
               ◊  PARA_ALPHA  =  /  alpha,        [R8]
                                 /  0.5,          [DEFECT]
                               ),

    ♦  MATR_GENE       =  _F  (
               ♦  MATR_MASS =  massgen,           [matr_asse_gene_R]
               ♦  MATR_RIGI =  rigigen,           [matr_asse_gene_R]
               ◊  MATR_AMOR =  amogen,            [matr_asse_gene_C]
                               ),

    ◊  UNITE_RESU_IMPE =  /  uresimp,             [I]
                          /  32,                  [DEFECT]

    ◊  UNITE_RESU_FORC =  /  uresfor,             [I]
                          /  33,                  [DEFECT]

    ◊  TYPE            =  /  'BINARY',
                          /  'ASCII'              [DEFECT]

    ◊  INFORMATION             =  /  1,                  [DEFECT]
```

```
                                              /   2,
                                                  );

       if FONC_SIGNAL present :   RES_VARI  =                       [tran_gene]
       if NB_FREQ present     :   RES_VARI  =                       [interspectre]
```

3 Operands

3.1 Operand UNITE_RESU_IMPE and UNITE_RESU_FORC

```
♦  UNITE_RESU_IMPE  =  /  uresimp,      [I]
                       /  32,           [DEFECT]
```

Logical unit of the file of the matrix of impedance of interface calculated by CALC_MISS option TYPE_RESU=' FICHIER'. This matrix can be either already calculated and given like entry in the profile of study, or result of CALC_MISS in the same command file.

```
♦  UNITE_RESU_FORC  =  /  uresfor,      [I]
                       /  33,           [DEFECT]
```

Logical unit of the file of the seismic forces of interface previously calculated by MISS3D with CALC_MISS in postprocessing and data like entry in the profile of study.

3.2 Operand TYPE

```
◊  TYPE= /  'BINARY'
         /  'ASCII'                     [DEFECT]
```

This operand makes it possible to read the impedances calculated by the order CALC_MISS [U7.03.12] in a file of binary format if necessary.

3.3 Operand FONC_SIGNAL

If one wishes to obtain one **temporal answer**, one must give a accélérogramme via the keyword FONC_SIGNAL.

```
◊  FONC_SIGNAL  =  acce,               [fonction_sdaster]
```

Note:

If FONC_SIGNAL is not informed, then DYNA_ISS_VARI give at exit the spectral concentrations of answer (for a unit excitation).

The frequential discretization is given starting from the temporal discretization of the accélérogramme:

$$FREQ\_INIT=0.0 , PAS=1./(NB*DT) ,$$

where NB indicates the number of steps of time of the accélérogramme and DT is the step of time.

Note:

It is necessary that the step of time of the accélérogramme is constant.

In order to reduce the time of computing time, it is possible to indicate the step of frequency and the maximum frequency for the calculation of the transfer transfer function (advised):

```
◊  FREQ_FIN  =  end

◊  FREQ_NOT  =  not
```

If FREQ_FIN and FREQ_NOT are informed, then one determines the transfer transfer function, taking account of space variability, only for one reduced number of frequency. For the calculation of the temporal answer to the excitation by a seismic signal (accélérogramme), one interpolates these values in order to lead to the necessary frequential discretization by the theorem of Shannon.

If FREQ_FIN is lower than the cut-off frequency $(NB-1)*PAS$ signal, then one supplements the answer by zeros until the cut-off frequency. The last frequency of calculation is consequently the cut-off frequency.
It is advisable to check that the step FREQ_NOT is not too small for modelling the transfer transfer function well with space variability.

3.4 Operands NB_FREQ

If ON wishes to calculate **spectral concentrations**, then it is necessary to indicate the parameters of Discretisation in the field as of frequencies (harmonic calculation) according to:

♦ NB_FREQ = NF

Many steps of frequency to be calculated.

♦ FREQ_INIT = finished

Frequency of beginning of harmonic calculation.

♦ FREQ_NOT = not

Step value of frequency for harmonic calculation.

```
◊ OPTION    =  /  'ALL',        [DEFECT]
               /  'DIAG',
```

By default, one obtains at exit the matrix of DSP of the transfer transfer function (or of the answer for a unit excitation). If one chooses OPTION = ' DIAG', then one recovers only the diagonal terms of this matrix.

Note:
It is the DSP in generalized coordinates. In most studies, it is initially necessary to make projection with the matrix of complete DSP to retain only the diagonal terms of the DSP of answer in physical coordinates.

3.5 Operand NOM_CMP

```
♦ NOM_CMP   =  /  'DX',
               /  'DY',
               /  'DZ',
```

Name of the component corresponding to a direction of incidental seismic field.

3.6 Operand ISSF

```
◊ ISSF  =  /  'YES'
           /  'NOT'            [DEFECT]
```

This operand indicates if one has or not a field of fluid and thus also of the interfaces fluid-structure and ground-fluid indicated by the operands GROUP_MA_FLU_STR and GROUP_MA_FLU_SOL in the order IMPR_MACR_ELEM [U7.04.33].

3.7 Keyword INTERF

3.7.1 Operand MODE_INTERF

```
♦ MODE_INTERF  =  /  'ALL',
                  /  'CORPS_RIGI'
                  /  'UNSPECIFIED'
```

This operand makes it possible to characterize the type of modes of interface of the model. Three types of modes of interface are possible: if one chooses a modeling being based on the six modes of rigid body, one must inform 'CORPS_RIGI', if one works with all the fashions of interface (unit modes finite elements), one informs 'ALL'. For all the other cases of foundation (inserted geometry, modes of unspecified representation for flexible foundation, case ISSF=' OUI'), one informs 'UNSPECIFIED'.

3.7.2 Operand GROUP_NO_INTERF

♦ GROUP_NO_INTERF = gr_inter

With this keyword, one defines the group of nodes being pressed on the surface meshs constitutive of the interface ground-structure.

3.8 Mot_clé MATR_COHE

3.8.1 Operands VITE_ONDE and PARA_ALPHA

♦ TYPE = model
One can choose between the function of coherence of Became moth-eaten & Luco (MITA_LUCO) and that of Abrahamson for hard ground (ABRAHAMSON). If one chooses MITA_LUCO, then one can inform:

◊ VITE_ONDE = c_{app}
◊ PARA_ALPHA = α

They are the parameters of the function of coherence of Luco and Wong (pure inconsistency without the effect of the passage of wave):

$$\gamma(d)=\exp[-(\alpha . f . \frac{d}{c_{\mathrm{app}}})^2]$$

where *D* indicate the distance between two items I and J on the foundation, f is the frequency and c_{app} speed connects propagation on the surface of wave HS (for example $200-600\mathrm{m}/s$). The parameter α is generally taken equal to 0.5 (defect). The value of defect for VITE_ONDE is worth 600.

Note:
For the two preceding functions of coherence, the program supposes that the various quantities are exprimées in units S.I In particular, the grid must be measured in meters.

3.9 Keyword MATR_GENE

3.9.1 Operands MATR_MASS, MATR_RIGI, MATR_AMOR

♦ MATR_MASS = m

Name of the concept stamps assembled corresponding to the matrix of mass generalized of the system.

♦ MATR_RIGI = rigigen

Name of the concept stamps assembled corresponding to the matrix of rigidity generalized of the system.
A hysterical damping is obtained with a complex matrix of rigidity.

◊ MATR_AMOR = amogen

Name of the concept stamps generalized assembled corresponding to the matrix of damping generalized of the system.

3.10 Operand `PRECISION`

◊ `PRECISION = prec`

This parameter is by default taken equal to 0.999.

For the calculation of the seismic forces with space variability of the incidental field, one carries out the spectral decomposition of the matrix of coherence $[\gamma_{ij}]$, $i=1...,M$. The parameter `prec` give the share of “the energy” of the matrix which one preserves by retaining only one reduced number of clean vectors. If one indicates by $K \ll M$ the number of eigenvalues selected (one retains them K greater eigenvalues), one has

$$\mathrm{prec}=\frac{\sum_{i=1}^{K}\lambda_i^2}{\sum_{i=1}^{M}\lambda_i^2}$$

3.11 Operand `INFORMATION`

◊ `INFORMATION =`

Indicate the level of impression of the results of the operator.

`1` = no particular impression,
`2` = impression of the eigenvalues of the spectral decomposition retained.

The impressions are done in the file `'MESSAGE'`.

4 Examples of use

One presents here two examples of use of DYNA_ISS_VARI. The first example presents a calculation of spectral concentration of answer. The second example presents a calculation of spectrum of answer of oscillator.
The user must have done a ProMISS3D calculation before (CALC_MISS [U7.03.12] with TYPE_RESU=' FICHIER').

4.1 Example 1

One presents here an example of command set for the calculation of the spectral concentration of answer which takes account of the space variability of the incidental seismic movement.

```
RESU = DYNA_ISS_VARI (
                       FREQ_INIT  =fmin,
                       NB_FREQ  = NF,
                       NOT = df,
                       NOM_CMP =  'DX',
                       PRECISION  =  0,999,
                       INTERF = _F (
                                GROUP_NO_INTERF=' RADIER',
                                MODE_INTERF = ' CORPS_RIGI',),
                       MATR_COHE = _F (
                                  VITE_ONDE = 600. ,
                                  PARA_ALPHA =0.5,),
                       UNITE_RESU_IMPE = 32,
                       UNITE_RESU_FORC = 33,
                       MATR_GENE = _F (
                                 MATR_MASS = MASSGEN,
                                 MATR_RIGI = RIGIGEN,


                                 MATR_AMOR = AMORT,
                           ),
                       INFORMATION   =2,);
```

One can also consult the CAS-test SDLS118A for an implementation of the method.
One can recover the spectral concentration of answer in physical coordinates using the operator REST_SPEC_PHYS.

```
SPVX=REST_SPEC_PHYS (MODE_MECA=BAMO,
                     TOUT_ORDRE = 'YES',
                     INTE_SPEC_GENE = RESU,
                     NOM_CHAM=' DEPL',
                     NOEUD= ('N77'  ),
                     NOM_CMP= ('DX',),
                     OPTION=' TOUT_TOUT'   );
```

The transfer transfer function is obtained for a unit seismic excitation and by tracing the root of the values of the auto--spectrum.

4.2 Example 2

One presents here an example of command set for the calculation of the spectral concentration of answer which takes account of the space variability of the incidental seismic movement.

```
RESU = DYNA_ISS_VARI (
                       FONC_SIGNAL  = ACCE_X,
                       FREQ_MAX  =50.0,  FREQ_PAS = 0.5,
                       NOM_CMP =  'DX',
                       PRECISION  =  0.99,
                       INTERF =_F (
                                GROUP_NO_INTERF=' RADIER',
                                MODE_INTERF = ' CORPS_RIGI',),
                       MATR_COHE = _F (
                                  VITE_ONDE = 600. ,
                                  PARA_ALPHA =0.5,),
                       UNITE_RESU_IMPE = 32,
                       UNITE_RESU_FORC = 33,
                       MATR_GENE = _F (
                                 MATR_MASS = MASSGEN,
                                 MATR_RIGI = RIGIGEN,


                                 MATR_AMOR = AMORT,
                           ),
                       INFORMATION   =2,);



    test_1=RECU_FONCTION (RESU_GENE=test_1_a,
                       NOM_CHAM=' ACCE',
                       NOM_CMP=' DX',
                       NOEUD= ('N11'  ),
                       INTERPOL=' LIN',
                       TITRE=' ACCELERATION IN THE LOW CENTER OF THE
RADIER',);

SROX1=CALC_FONCTION (SPEC_OSCI=_F (FONCTION=test_1,
                                  NORME=9.81, AMOR_REDUIT=0.05,  ),);
```

One can also consult the CAS-test `SDLS118B` for an implementation of the method.