

## Operator DYNA\_ISS\_VARI

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### 1 Goal

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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 accélérogrammeS are givenS in one or more directions.

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

## 2 Syntax

```
RES_VARI = DYNA_ISS_VARI (
  ◆ | EXCIT_SOL = _F (
    ◇ ACCE_X = acceX [fonction_sdaster]
    ◇ ACCE_Y = accethere
  [fonction_sdaster]
    ◇ ACCE_Z = acceZ [fonction_sdaster]
    ),
  ◆ ◆ FREQ_MAX = Fmax, [R]
  ◆ ◆ FREQ_PAS = not, [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'
  / 'ABRA_ROCHER'
  / 'ABRA_SOLMOYEN'
  ◆ VITE_ONDE = vite_onde, [R8]
  ◇ PARA_ALPHA = / alpha, [R8]
  / 0.1, [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,
                      / 2,
                      );                  [DEFECT]

if EXCIT_SOL 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 Keyword factor EXCIT\_SOL

If one wishes to obtain one **temporal answer**, one must give one or several accélérogrammes viaS wordS- keyS ACCE\_X, ACCE\_Y and ACCE\_Z.

**Note:**

*If EXCIT\_SOL is not informed, then DYNA\_ISS\_VARI give at exit the spectral concentrations of answer (for a unit excitation).*

#### 3.3.1 Operands ACCE\_X, ACCE\_Y and ACCE\_Z

◇ ACCE\_X = acce X [fonction\_sdaster]  
◇ ACCE\_Y = accethere [fonction\_sdaster]  
◇ ACCE\_Z = accez [fonction\_sdaster]

Accélérogrammes , respectively in the directions X , Y and Z . If several operands are then indicated the signals must have the same X-coordinates.

The frequential discretization is givenE starting from the temporal discretization ofS accélérogrammes :

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

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.*

### 3.4 Operands FREQ\_MAX and FREQ\_PAS

If `EXCIT_SOL` is present, hasend to reduce the 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_MAX = Fmax`

◇ `FREQ_NOT = not`

If `FREQ_MAX` 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_MAX` is lower than the cut-off frequency  $(NB-1)*PAS$  signal, then one supplements the answer by zero 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.

## 3.5 Operand `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.*

## 3.6 Operand `NOM_CMP`

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

Name of the component corresponding to a direction of incidental seismic field. This keyword is to be informed only if `NB_FREQ` is present.

## 3.7 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].

## 3.8 Keyword INTERF

### 3.8.1 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'.

### 3.8.2 Operand GROUP\_NO\_INTERF

◆ `GROUP_NO_INTERF` = `gr_inter`

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

## 3.9 Mot-clé MATR\_COHE

### 3.9.1 Operands VITE\_ONDE and PARA\_ALPHA

◆ `TYPE` = `model`

One can choose between the function of coherence of Became moth-eaten & Luco (`MITA_LUCO`) and three empirical functions of coherence established by Abrahamson (`ABRAHAMSON`, `ABRA_ROCHER`, `ABRA_SOLMOYEN`).

If one chooses `MITA_LUCO`, then one can inform:

◆ `VITE_ONDE` =  $V_s$   
◇ `PARA_ALPHA` =  $\alpha$

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

$$\gamma(d) = \exp\left[-\left(\alpha \cdot 2\pi f \cdot \frac{d}{V_s}\right)^2\right]$$

where  $D$  indicate the distance between two items I and J on the foundation,  $f$  is the frequency and  $V_s$  the propagation velocity of the wave. The propagation velocity `VITE_ONDE` initially considered by Became moth-eaten & Luco is worth 600m/s. The parameter  $\alpha$  is without dimension, it is by default taken equal to 0.1.

The three models of Abrahamson are

- `ABRAHAMSON` : model of generic coherence of Abrahamson (EPRI 1014101.2006)
- `ABRA_ROCHER` : model for a site rock established by Abrahamson starting from earthquakes recorded in Pinyon Flat, the USA (EPRI 1015110.2007).

- ABRA\_SOLMOYEN : model for a site of average ground established by Abrahamson starting from various sites of average ground in the USA (EPRI 1015110.2007).

## 3.10 Keyword MATR\_GENE

### 3.10.1 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.

## 3.11 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  $[y_{ij}]$ ,  $i=1\dots,M$ . 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

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

## 3.12 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 (
    EXCIT_SOL = _F (ACCE_X=ACCE_X),
    FREQ_MAX =50.0, FREQ_PAS = 0.5,
    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.