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## Macro-order OBSERVATION

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### 1 Goal

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Lmacro-order has OBSERVATION use the operators PROJ\_CHAMP, CREA\_CHAMP, CREA\_RESU, MODI\_REPERE and POST\_RELEVE\_T for:

- to project a field of a digital model towards an experimental model,
- to modify the local reference marks,
- to select the degrees of freedom “of measurement”,
- to calculate the median value of a field of deformation in order to obtain the equivalent of the information delivered by a gauge of deformation

This macro-order accepts as starter a concept `evol_elas`, `dyna_trans`, `dyna_harmo` or one `mode_meca`. The produced concept is of the same type as the concept as starter. Caution: *Code\_Aster* do not memorize the reference marks in which the fields are written. The result of this macro-order should not thus be used in calculations of *Code-aster* later. One can use it for postprocessings in python, or visualizations.

## Contents

1 Goal.....	1
2 Syntax.....	3
3 Operands.....	5
3.1 Keyword RESULT.....	5
3.2 Keyword MODELE_1.....	5
3.3 Keyword MODELE_2.....	5
3.4 Keyword PROJECTION.....	5
3.5 Operand CAS_FIGURE.....	5
3.6 Keyword VIS_A_VIS.....	6
3.7 Operand TYPE_CHAM = 'NOEU'.....	6
3.8 Selection of the names of the fields.....	6
3.9 Operands MATR_RIGI, MATR_MASS.....	6
3.10 Selection of the sequence numbers.....	6
3.11 Operand MODI_REPERE.....	6
3.11.1 Keywords TYPE_CHAM/NOM_CMP.....	6
3.11.2 Keywords REPERE/VECT_X/VECT_Y/ANGL_NAUT/ORIGINE/AXE_Z.....	6
3.12 Operand FILTER.....	7
3.12.1 Keyword DDL_ACTIF.....	7
3.12.2 Keywords GROUP_NO/GROUP_MA.....	7
3.12.3 Keyword NOM_CHAM.....	7
3.13 Operand EPSI_MOYENNE.....	7
3.13.1 Keywords GROUP_NO/GROUP_MA.....	8
3.13.2 Keyword MASK.....	8
3.13.3 Keyword SEUIL_VARI.....	8
3.14 Operand TITLE.....	8

## 2 Syntax

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resu_out = OBSERVATION (
    ♦ RESULT = resu_in, / [evol_elas]
                        / [dyna_trans]
                        / [dyna_harmo]
                        / [mode_meca]

    ♦ MODELE_1 = mo1, [model]
    ♦ MODELE_2 = mo2, [model]
    ◇ CAS_FIGURE = / '3D',
                  / '2D',
                  / '2.5D',
                  / '1.5D',

    ◇ VIS_A_VIS = _F (
        ♦ | TOUT_1 = 'YES',
          | GROUP_MA_1 = lgma1, [l_gr_maille]
          | GROUP_NO_1 = lgno1, [l_gr_noeud]
        ♦ | TOUT_2 = 'YES',
          | GROUP_MA_2 = lgma2, [l_gr_maille]
          | GROUP_NO_2 = lgno2, [l_gr_noeud]
        ),

    # Selection of the names of the fields to treat
    ♦ NOM_CHAM = l_noch, [l_Kn]

    # Selection of the sequence numbers
    ◇ / TOUT_ORDRE = 'YES', [DEFECT]
      / NUME_ORDRE = l_nuor, [l_I]
      / INST = l_inst, [l_R]
      / FREQ = l_freq, [l_R]
      / LIST_INST = l_inst, [listr8]
      / LIST_FREQ = l_freq, [listr8]
      / LIST_ORDRE = l_ordr, [ listr8 ]
      / NUME_MODE = n_mod, [ I ]
      / NOEUD_CMP = l_nocmp, [l_K16]

    ◇ | PRECISION = /prec, [DEFECT]
      /1.0E-3, [DEFECT]
      | CRITERION = / 'RELATIVE', [DEFECT]
                  / 'ABSOLUTE',

    ◇ DISTANCE_MAX = d_max, [R]
    ◇ DISTANCE_ALARME = d_ala, [R]
    ◇ ALARM = / 'YES', [DEFECT]
              / 'NOT',

    ◇ TYPE_CHAM = NOEU',

    ◇ PROJECTION = / 'YES', [DEFECT]
                  / 'NOT',

    # if the projected SD is of standard "mode":
    ◇ MATR_RIGI = k_ass [matr_asse_depl_r]
    ◇ MATR_MASS = m_ass [matr_asse_depl_r]

    # Definition of the local reference marks for the sensors
    ◇ MODI_REPERE = _F (

```

```

    ◆ REFERENCE MARK = / 'USER',
                        / 'CYLINDRICAL',
                        / 'NORMAL',
                        / 'DIR_JAUGE',

    ◇ TYPE_CHAM = / 'VECT_2D',
                  / 'VECT_3D', [DEFECT]
                  / 'TENS_2D',
                  / 'TENS_3D',

    ◇ / ALL = 'YES', [DEFECT]
      / GROUP_NO = L_GRNO, [l_gr_noeud]
      / GROUP_MA = L_GRMA, [l_gr_maille]

    ◇ NOM_CMP = / cmp [l_Kn]
                / ('DX', 'DY', 'DZ') [DEFECT]

case: REFERENCE MARK = 'USER':
    ◆ ANGL_NAUT = (  $\alpha$ ,  $\beta$ ,  $\gamma$  ) [R*3]

case: REFERENCE MARK = 'CYLINDRICAL':
    ◆ ORIGIN = (X, there, Z) [R*3]
    ◆ AXE_Z = (X, there, Z) [R*3]

case: REFERENCE MARK = 'NORMAL':
    ◆ / VECT_X = (X, there, Z) [R*3]
      / VECT_Y = (X, there, Z) [R*3]

case: REFERENCE MARK = 'DIR_JAUGE':
    ◆ | VECT_X = (X, there, Z) [R*3]
      | VECT_Y = (X, there, Z) [R*3]
      ),

# Filtering of the not measured degrees of freedom
  ◇ FILTER = _F (
    ◇ DDL_ACTIF = liste_ddl [l_Kn]
    ◆ / ALL = 'YES',
      / GROUP_NO = L_GRNO, [l_gr_noeud]
      / GROUP_MA = L_GRMA, [l_gr_maille]
    ◆ NOM_CHAM = noch, [KN]
      ),

# Median value of the field of deformation
  ◇ EPSI_MOYENNE = _F (
    ◇ SEUIL_VARI = /seuil, [R]
                  /0.1, [DEFECT]
    ◇ MASK = lcmp, [l_cmp]
    ◆ / GROUP_NO = L_GRNO, [l_gr_noeud]
      / GROUP_MA = L_GRMA, [l_gr_maille]
      ),

  ◇ TITLE = title [KN]
  );

```

## 3 Operands

The first simple keywords are those used in the operator `PROJ_CHAMP`. Some of these concepts are however re-used in the following phases of the macro-order (modification of the reference marks and filter of the degrees of freedom). In the macro-order, the operator `PROJ_CHAMP` by default with the method is used `'COLLOCATION'` (cf [U4.72.04]). But one can explicitly use the method by group of dots by adding the keywords necessary detailed in documentation of this operator.

The produced concept is of the same type as the concept as starter, defined by the keyword `RESULT`.

### 3.1 Keyword `RESULT`

◆ `RESULT`

Structure of data which one wishes to handle. Currently, only structures of the type `evol_elas`, `dyna_trans`, `dyna_harmo` and `mode_meca` can be given as starter.

### 3.2 Keyword `MODELE_1`

◆ `MODELE_1`

Structure of the type `modele_sdaster` associated with the concept `result`. It is in general the digital model support.

### 3.3 Keyword `MODELE_2`

◆ `MODELE_2`

Structure of the type `modele_sdaster`. It is in general the model associated with the experiment. Caution: `PROJ_CHAMP` function only if the degrees of freedom of the nodes of model 1 are the same ones as those of model 2. For example, if model 1 is 3D, and thus has only degrees of freedom of translation, one cannot take a modeling `POU_D_T` (beam of Timoshenko, with degrees of freedom of translation and rotation) for model 2. One will choose in this case a modeling of the type `BAR`.

### 3.4 Keyword `PROJECTION`

◇ `PROJECTION` = / `'YES'` [DEFECT]  
/ `'NOT'`

This keyword makes it possible to carry out or not the projection of the results of the treatment towards model 2.

If one does not make projection, the results of the treatment overloads the results already present on model 1.

### 3.5 Operand `CAS_FIGURE`

This keyword (optional) is used to direct the program towards one of the 4 following cases:

- “3D”The only elements of the grid “1” which will be used for projection are the voluminal elements: hexahedrons, pentahedrons, tetrahedrons and pyramids. The nodes have 3 cordonnées  $(X, Y, Z)$ .
- “2D”The only elements of the grid “1” which will be used for projection are the surface elements: quadrangles and triangles. The grid is supposed plan. The nodes have 2 cordonnées  $(X, Y)$ .
- “2.5D”The only elements of the grid “1” which will be used for projection are the surface elements: quadrangles and triangles. The grid is 3D. The nodes have 3 cordonnées  $(X, Y, Z)$ . It is the case of the “hulls” plunged in 3D.

- “1.5D”The only elements of the grid “1” which will be used for projection are the linear elements: segments. The grid can be 2D or 3D. The nodes have 2 or 3 cordonnées ( $X, Y, Z$ ).

## 3.6 Keyword `VIS_A_VIS`

One will be able to refer to [U4.72.04] (documentation of the operator `PROJ_CHAMP`), for the use of this optional keyword, which makes it possible to explicitly declare the links between entities of model 1 and model 2 for projection.

## 3.7 Operand `TYPE_CHAM = 'NOEU'`

This keyword is used to force the fields projected to be fields “with the nodes”. This keyword is used systematically (for example) by the order `MACR_LIGN_COUPE` because one cannot create fields by elements on the “fictitious” model of beam created by this macro-order of visualization.

## 3.8 Selection of the names of the fields

The keyword `NOM_CHAM = l_noch` allows to choose which are the fields of `SD RESULT` that one wants to project. This keyword is obligatory. One can also project the fields by elements “ELNO”and”ELEM“(but not”ELGA“).

## 3.9 Operands `MATR_RIGI`, `MATR_MASS`

These 2 keywords make it possible to associate (for a structure of data of type “mode”) theirs `matr_asse` with the structure of data produced. They also make it possible to go back to the classification of the degrees of freedom. They are necessary if one wishes to use the result of the order in later calculations (orders `REST_GENE_PHYS`, `PROJ_BASE`, `MAC_MODES`,...).

## 3.10 Selection of the sequence numbers

Confer [U4.71.00].

## 3.11 Operand `MODI_REPERE`

◇ `MODI_REPERE = _F (`

Keyword factor allowing to define a local reference mark for the entities (nodes or meshes) of model 2 selected.

### 3.11.1 Keywords `TYPE_CHAM/NOM_CMP`

The operator `MODI_REPERE` must know the components to be transformed. One in general uses as starter a field of displacement, this is why the entries `'VECT_3D'` and (`'DX'`, `'DY'`, `'DZ'`) by defaults are proposed. But if one wishes, for example, to treat the case of a field of deformations (measured using the gauges), one will write `TYP_CHAM = 'TENS_3D'` and `NOM_CMP= ('EXX'`, `'EYY' ...)`

### 3.11.2 Keywords `REPERE/VECT_X/VECT_Y/ANGL_NAUT/ORIGINE/AXE_Z`

- `REFERENCE MARK = 'USER'`

The user can define itself the local reference mark associated with a node by the data with the three nautical angles. One will find a definition of the nautical angles in [U4.42.01-11], U4 documentation of `AFFE_CARA_ELEM`, paragraph 10.4.

- REFERENCE MARK = 'CYLINDRICAL'

To define a cylindrical reference mark, one must give the origin (keyword ORIGIN) and direction of the vertical axis (keyword AXE\_Z).

- REFERENCE MARK = 'NORMAL'

The axes of the local reference mark are noted  $(XI, YI, ZI)$ . In general, the sensors, for a measurement, have the axis  $ZI$  according to the normal with the wall of this structure. This option makes it possible to calculate a reference mark associated with this normal:

- calculation of the field of normal vectors to model 1 (most precise); these vectors will be the axes  $ZI$  local reference mark,
- projection of this field on the entities of model 2 selected,
- data clarifies second vector of the reference mark; if it be wished that the vector  $YI$  that is to say the same vector as  $Y$  in the total reference mark, one writes  $VECT\_Y = (0.0, 1.0, 0.0)$
- One thus needs two equations to calculate the local reference mark: one of them is given by the normal vector, the other is given by the keyword VECT\_X or VECT\_Y, according to whether the additional condition relates to the vector  $XI$  or  $YI$  local reference mark.

- REFERENCE MARK = 'DIR\_JAUGE'

The user can define the local reference mark associated with the gauge with deformation while informing VECT\_X ou/et VECT\_Y. These two vectors correspond to the first two basic vectors of the local reference mark.

## 3.12 Operand FILTER

◇ FILTER = \_F (

Describing keyword, for all the entities (nodes, meshes, groups of nodes,...) degrees of freedom to be preserved.

### 3.12.1 Keyword DDL\_ACTIF

◇ DDL\_ACTIF = liste\_ddl

List of the degrees of freedom to be preserved for the result.

### 3.12.2 Keywords GROUP\_NO/GROUP\_MA

Each filter of degree of freedom corresponds to a topological entity to choose (by default, all the structure is selected).

### 3.12.3 Keyword NOM\_CHAM

◆ NOM\_CHAM = noch

Reference symbol of the field to be filtered. This keyword is obligatory. It amongst other things makes it possible to differentiate the component  $DX$  field of displacement of the component  $DX$  field speed.

## 3.13 Operand EPSI\_MOYENNE

◇ EPSI\_MOYENNE = \_F (

Keyword factor allowing to calculate the median value of the field of deformation on a given topological entity. This median value of the field of deformation can be seen as being information that a gauge of deformation stuck on surface considered would have delivered. This is valid if the field is not too variable on the surface on which the gauge is stuck. The user is informed if the fluctuation of the field of deformation is too important.

With each occurrence of this keyword a calculation of average corresponds on the indicated entities. The computed values are then projected on model 2, except if the user specifies explicitly `PROJECTION = 'NOT'`. In this case, the entering concept is overloaded `resu_in` and one pours the computation results in `resu_out`.

### 3.13.1 Keywords `GROUP_NO`/`GROUP_MA`

This keyword indicates the topological entity on which one wants to calculate the average.

### 3.13.2 Keyword `MASK`

◇ `MASK = lcmp`

This keyword makes it possible to list not measured components of the field of deformation.

### 3.13.3 Keyword `SEUIL_VARI`

◇ `SEUIL_VARI = threshold`

One gives here a relative value of threshold from which the user is informed if the fluctuation of one of the components of the field, not masked, is too isolated calculated median value. The value taken by default is equal to `0.1`.

### 3.14 Operand `TITLE`

◇ `TITLE = titr,`

Title which one wants to give to the concept result.