Code_Aster

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Responsable : PELLET Jacques

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Révision :
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Operator MODI_MAILLAGE

1 Goal

To carry out modifications on an existing grid. The possibilities of modifications are:

- to reorientate meshs of edge being used to apply a pressure,
- to reorientate the meshs HEXA8 modeling SHB,
- to check the orientation of the normals on the elements of hull,
- to reorientate the meshs of full-course of elements of joint,
- to reactualize the grid starting from a deformation calculated previously,
- in a grid with bottom of crack, to move the nodes mediums of the edges touching the bottom of crack to the quarter of these edges,
- to relocate a grid,
- to impose one or more rotations of unspecified axes on a grid,
- to generate a symmetrical grid compared to a plan in 3D or a line in 2D.
- to calculate the curvilinear X-coordinate along a formed line by linear elements (SEG)
- to modify the coordinates of the nodes by chance

Product a structure of data of the type grid or the structure of data (operator entering D) modifies.

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2   Syntax

```
netted [grid] = MODI_MAILLAGE

    (   ♦   reuse      = netted,
        ♦   GRID   = my,                          [grid]

        ◊   ORIE_FISSURE = _F   ( ♦   GROUP_MA =   l_gm      [l_gr_ma]
                        ),

        ◊   ORIE_SHB  = _F (  ♦   GROUP_MA =   l_gm        [l_gr_ma]
                    ),
        ◊   DEFORM =  _F  (  ♦   OPTION      = 'TRAN',
                        ♦  /  DEPL          =  depl, [cham_no]
                           /  RISK          =  epsi,  [R]
                    ),

        ◊   ORIE_PEAU_2D = _F(  ♦   GROUP_MA      =  lgrma,    [l_gr_ma]
                                ◊   GROUP_MA_SURF=  l_gms),   [l_gr_ma]
                        ),

        ◊   ORIE_PEAU_3D = _F(  ♦   GROUP_MA      =  lgrma,    [l_gr_ma]
                                ◊   GROUP_MA_VOLU=  l_gmv),   [l_gr_ma]
                        ),


        ◊   ORIE_NORM_COQUE=_F (  ♦   GROUP_MA =  lgrma,       [l_gr_ma]
                                ◊   VECT_NORM =  (n1, N2, [n3]), [l_R]
                                 ◊   GROUP_NO=   grno,        [gr_no]
                        ),

        ◊   ORIE_LIGNE=_F (   ♦   GROUP_MA  =  lgrma,       [l_gr_ma]
                                ◊   VECT_TANG =  (n1, N2, [n3]),  [l_R]
                                 ◊   GROUP_NO=  grno,         [gr_no]
                        ),

        ◊   MODI_MAILLE  = _F ( ♦   OPTION = 'NOEUD_QUART',
                                ♦  /  GROUP_MA_FOND= lgma_fo,[l_gr_ma]

                                   /  GROUP_NO_FOND= lgno_fo,[l_gr_no]
                        ),


        ◊   TRANSLATION  =  (n1, N2, [n3]),                      [l_R]

        ◊   ROTATION  =_F(  ♦     POIN_1 = (n1, N2, [n3]),      [l_R]
                            ♦  /  POIN_2 = (n1, N2, [n3]),      [l_R]
                            /  DIR   = (n1, N2, [n3]),          [l_R]
                            ♦     ANGLE = /  has,               [R]
                                         /  0. ,               [DEFECT]
                ),

        ◊   SCALE     = n1,                          [R]

        ◊   MODI_BASE =_F (  ♦     VECT_X = (n1, N2, [n3]),     [l_R]
                            ◊     VECT_Y = (n1, N2, [n3]),      [l_R]
                    ),

        ◊   SYMMETRY =_F (  ♦     NOT=  (n1, N2, [n3]),        [l_R]
                            ♦     AXE_1 =  (n1, N2, [n3]),      [l_R]
                            ◊     AXE_2 =  (n1, N2, n3),        [l_R]
```

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```
                    ),

    ◊  ABSC_CURV = _F ( ♦  /  ALL =      'YES' ,
                          /  GROUP_MA = (gm1, gm2,…),   [l_gr_ma]
                        ♦  GROUP_NO_ORIG =    gnorig ,  [gr_no]
                    ),

    ◊  INFORMATION =   /  1,
[DEFECT]
                 /   2,
    )
```

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3   Operands

3.1   Operand GRID

♦   GRID = my,

Grid of the type [grid] on which will amend and/or checks.

3.2   Operand INFORMATION

◊   INFORMATION =

Indicate the level of impression of the results of the operator,

1 =   no impression,
2 =   impression of the meshs whose connectivity was modified, including the impression of old and new connectivities.

The impressions are done in the file 'MESSAGE'.

3.3   Keyword ORIE_FISSURE

◊   ORIE_FISSURE =

This keyword is used to reorientate (if necessary) the meshs of a group forming "mono lay down" elements. It functions in 2D or 3D, with a linear or quadratic grid [Figure 3.4-a].
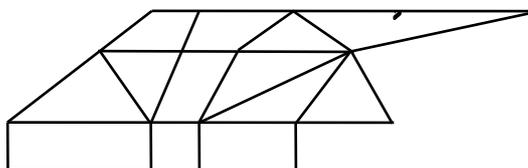
Figure 3.4-a

Currently, this keyword is used to reorientate the elements of joint and the elements of interface (modelings AXIS_xxx, PLAN_xxx and 3D_xxx with xxx=JOINT or INTERFACE).

The user specifies (with the keyword GROUP_MA) which are the meshs candidates with the reorientation (the "mono one sleeps").
These meshs must be "prisms" (QUAD in 2D, HEXA and PENTA in 3D).

The "transverse" direction with the layer is given in a topological way (and not according to a criterion of flatness). To be able to be reorientated, the elements of the layer must be pressed (via the bases of the prisms) on other of the same meshs dimension (2D or 3D) which do not belong to the group of the meshs to be reorientated.

That is to say the grid (2D) opposite.

One wishes to reorientate the group of the 3 meshs WITH, B and C.
For the meshs With and B, the meshs of support (with the top and the lower part) determine a nonambiguous transverse orientation (vertical).
On the other hand, the mesh C has 3 meshs of support high (, low, right-hand side) and one cannot determine the transverse direction.
The algorithm of reorientation will fail.

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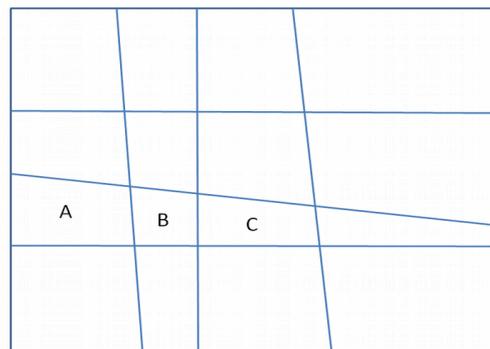
Note:

The "reorientation" which one speaks here actually consists in modifying the definition of the connectivity of the meshs. For example, in 2D, convention is that sides 2 and 4 of the quadrangles are transverse with the layer.

♦ GROUP_MA= l_gm,

List of the groups of meshs which one wishes the checking (and possibly modification) of the orientation.

3.4 Keyword ORIE_SHB

◊ ORIE_SHB =

The purpose of this keyword factor is to correctly reorientate the voluminal meshs of finite elements SHB. It is necessary to modify the local classification of the nodes of the meshs to be able to recognize the direction of the normal to the hull.

The connectivity of the meshs thus is possibly modified by this operator.

♦ GROUP_MA= l_gm,

List of the groups of meshs which one wishes the modification of the orientation.

3.5 Keyword DEFORMATION

♦ DEFORM / OPTION = ' TRAN'

Option allowing to add to the initial geometry of the grid my:
- values of TRANslation (dx, Dy (+ dz in 3D)) field of displacement depl given by the keyword DEPL ;
- Or a random quantity.

/ DEPL = depl,

Field of displacement being used to reactualize the geometry

/ RISK = epsi,

One adds to each coordinate of each node of the grid a quantity (delta) random.

This quantity is obtained by the formula: delta=epsi*dim*alea ()
Where:
- epsi is a number provided by the user (1.e-8 for example)
- dim is the dimension of the grid in the direction concerned with the component (X, Y or Z)
- risk () is a function turning over a pseudo-random number in the interval
- [- 1.1].

Note:

The possibility of modifying by chance the coordinates of a grid is, a priori, a functionality of "developer". It is dangerous in certain situations: very flattened meshs (joined,…)

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3.6 Keywords ORIE_PEAU_2D / ORIE_PEAU_3D

◊ ORIE_PEAU_2D =
◊ ORIE_PEAU_3D =

These keywords are used to reorientate meshs of edge so that their normals are coherent (towards the outside of the matter). It is an essential precondition if, for example, one wants to apply a loading of pressure to this "skin".

♦ GROUP_MA =   lgrma,   [l_gr_ma]

Groups of meshs to be reorientated.

The meshs are directed in such way that the normal is outgoing. For each mesh of edge (edge or face), one seeks the "voluminal" mesh which it "borders". One directs it in such way that its normal is direction opposed to the vector connecting its first node to the barycentre of the voluminal mesh.

It happens sometimes that the "skin" which one wishes to direct is inserted in the matter (for example, when one does a calculation for which, of the meshs is gradually added or withdrawn from the model: modeling of an excavation, or a construction by layers). The algorithm of orientation describes above fails then because one in general finds 2 meshs voluminal on both sides of the mesh of skin. One does not know then which to use to direct the mesh of skin.

For that, one introduced the keywords optional GROUP_MA_VOLU (or GROUP_MA_SURF in the case 2D). These keywords make it possible to the user to specify which are the "voluminal" meshs to use to direct the meshs of skin.

Example:

That is to say 1 group of mesh of skin (GPEAU) that one wants to direct with a directed normal towards outside. It should be indicated that it is the skin of the group of "voluminal" meshs GV2. One will write:

ORIE_PEAU_2D=_F (GROUP_MA=' GPEAU', GROUP_MA_SURF=' GV2'),

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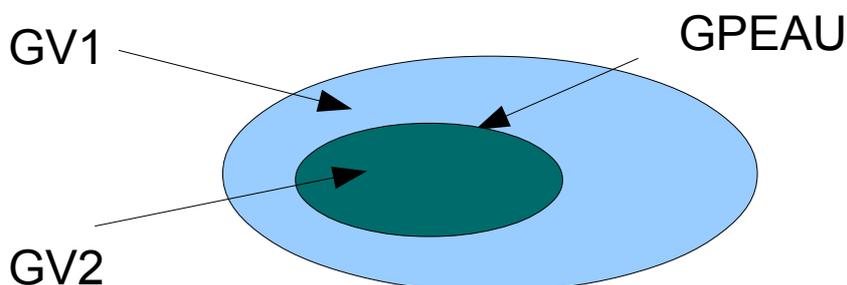
3.7 Keyword `ORIE_NORM_COQUE`

◊   ORIE_NORM_COQUE = _F (

This keyword is used to check that in a list of surface meshs (hulls), the normals are coherent between them. In the contrary case, certain meshs are reorientated.

♦   GROUP_MA =   lgrma,   [l_gr_ma]

Surface groups of meshs to reorientate. Meshs of `lgrma` must form a "related" group so that one can reorientate them by continuity.

One can impose the sense of direction using the keywords `GROUP_NO/VECT_NORM`. If it is not done, the followed orientation will be that of the 1st mesh of `lgrma`, but it is not inevitably the 1st mesh of 1st `GROUP_MA` ! It is thus advised always to use the keyword `VECT_NORM`.

◊   VECT_NORM = (n1, N2, [n3]),   [l_R]

`nor` : 2 or 3 components (according to dimension) of the normal vector. It is also necessary to specify the node support of this normal:

◊   GROUP_NO = grno,   [gr_no]

`grno` must be one `GROUP_NO` containing one node.
The selected normal will be that which forms an acute angle with the vector given by `VECT_NORM`.

3.8 Keyword `ORIE_LIGNE`

◊   ORIE_LIGNE = _F (

This keyword is used to check that in a list of linear meshs (beams), the tangents are coherent between them. In the contrary case, certain meshs are reorientated.

♦   GROUP_MA =   lgrma,   [l_gr_ma]

Linear groups of meshs to reorientate. Meshs of `lgrma` must form a "related" group so that one can reorientate them by continuity.

One can impose the sense of direction using the keywords `GROUP_NO/VECT_TANG`. If it is not done, the followed orientation will be that of the 1st mesh of `lgrma`, but it is not inevitably the first mesh of the first `GROUP_MA` ! It is thus advised always to use the keyword `VECT_TANG`.

◊   VECT_TANG = (n1, N2, [n3]),   [l_R]

`nor` : 2 or 3 components (according to dimension) of the tangent vector. It is also necessary to specify the node support of this normal:

◊   GROUP_NO = grno,   [gr_no]

`grno` must be one `GROUP_NO` containing one Nœud.
The selected tangent will be that which forms an acute angle with the vector given by `VECT_TANG`.

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3.9   Keyword MODI_MAILLE

♦   OPTION = 'NOEUD_QUART',

Activate the displacement of the nodes mediums of the edges touching the bottom of crack to the quarter of these edges (towards the bottom of crack).

♦   /   GROUP_MA_FOND = lgma_fo,   [l_gr_ma]

/   GROUP_NO_FOND = lgno_fo,   [l_gr_no]

In 2D, one returns the node of the bottom of crack (by GROUP_NO_FOND).

In 3D, one returns either the nodes of the bottom of crack, or meshs SEG3 of the bottom of crack (and not meshs of the lips of the crack or the matter meshs leaned with the bottom).

3.10   Keyword TRANSLATION

Caution

> *One can combine this functionality with ROTATION , but these operations are not commutative. The translation is always carried out before rotation.*
> *One cannot combine this functionality with SYMMETRY .*

◊   TRANSLATION = (n1, N2, [n3]),   [l_R]

Simple keyword for the translation of a grid following a vector.

3.11   Keyword ROTATION

Caution

> *One can combine this functionality with TRANSLATION , but these operations are not commutative. On the other hand, it is not authorized to use ROTATION , MODI_BASE and SYMMETRY at the same time. The translation is always carried out before rotation.*

◊   ROTATION =

Keyword factor for the unspecified rotation of axis of a grid.

♦   POIN_1   = (nor, N2, [n3]),   [l_R]

Coordinates of the first point to define the axis of rotation.

♦   /   POIN_2 = (nor, N2, [n3]),   [l_R]
/   DIR   = (nor, N2, [n3]),   [l_R]

Coordinates of the second point or direction to define the axis of rotation completely.

♦   ANGLE   = has,   [R]

Swing angle expressed in degrees.

Rotation is done in the direct direction, compared to its directed axis. This axis passes by the point POIN_1 and its orientation is given, that is to say by the vector DIR, that is to say by the vector of origin POIN_1 and of end POIN_2.

Rotation is defined by:

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That is to say $\mathbf{M}(x,y,z)$ a point of space, one imposes a rotation of angle to him α (in radians) whose axis passes by $\mathbf{P}(px,py,pz)$ and has as a direction $\mathbf{D}(dx,dy,dz)$. Then $\mathbf{M}$ becomes $\mathbf{M}$' after rotation:

$$\mathbf{M'}=\mathbf{P}+\cos\alpha.\,\mathbf{PM}+(1-\cos\alpha).(\mathbf{PM}.\mathbf{D}).\mathbf{D}+\sin\alpha(\mathbf{D}\wedge\mathbf{PM})$$

3.12   Keyword SCALE

Caution

This functionality is usable with TRANSLATION and ROTATION. The scaling, when she is asked, is always made afterwards TRANSLATION and ROTATION.
One cannot combine this functionality with SYMMETRY.

◊   SCALE = n1,   [R]
Simple keyword for the setting at the level of a grid according to a reality.

That is to say $\mathbf{M}(x,y,z)$ a point of the grid,
it will become, by this transformation of report $n1$: $\mathbf{M}$'$(n1\cdot x, n1\cdot y, n1\cdot z)$.

3.13   Keyword MODI_BASE

Caution

This functionality is not authorized with ROTATION and SYMMETRY.

◊   MODI_BASE =

Keyword factor for the basic change in which one expresses the coordinates of a grid. The change of reference mark always takes place between 2 orthonormal bases.

♦   VECT_X   = (n1, N2, [n3]),   [l_R]
Coordinated first vector of the new base, unspecified standard.

◊   VECT_Y   = (n1, N2, [n3]),   [l_R]
Coordinated second vector of the new base (not used in 2D), also of unspecified standard.

In 2D, it is enough to give the axis VECT_X, and *Code_Aster* automatically built the second vector to define a direct orthogonal base. A test checks if VECT_X is of nonworthless standard.

In 3D, it is checked that VECT_X and VECT_Y are of nonworthless standard and it is checked that they are orthogonal. The third vector which supplements the base is built as being the vector product of VECT_X with VECT_Y. One thus makes sure construction of a direct orthogonal base.

Then, in all the cases (2D and 3D), the vectors of the base are normalized to 1, the user does not have thus to be concerned with it. There is thus finally a direct orthonormal base.

In 3D, one thus expects the data of **VECT_X** and **VECT_Y**, the first two vectors of the new base. Then the basic change is defined as:

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3.14 Keyword SYMMETRY

Caution

One cannot combine this functionality with TRANSLATION , ROTATION , SCALE and MODI_BASE .

♦ NOT = (n1, N2, [n3]) [l_R]
Punctual coordinates pertaining to the right-hand side in 2D or the plan in 3D.

♦ AXE_1 = (n1, N2, [n3]) [l_R]
Directing vector of the right-hand side in 2D or 1er vector allowing to describe the plan.

◊ AXE_2 = (n1, N2, n3) [l_R]
2Nd vector allowing to describe the plan.

In 2D, symmetry is done compared to a line, which is in the plan OXY. To define this line it is necessary to give the directing vector of the right-hand side (AXE_1) and a point (NOT) belonging on this line.
In 3D, symmetry is done compared to a plan. To define this plan, it is necessary to give 2 vectors of the plan (AXE_1, AXE_2) and a point (NOT) belonging to this plan.

In all the cases (2D or 3D), symmetry is carried out compared to a plan. In 2D, the second vector necessary to the definition of the plan is fixed at AXE_2 = (0.0, 0.0,-1.0).

The algebraic distance δ between a point $\mathbf{M}(x,y,z)$ and a plan passing by the point $\mathbf{Mo}(xo,yo,zo)$ with for perpendicular vector $\mathbf{V}=\text{AXE\_1}\wedge\text{AXE\_2}=(a,b,c)$ is:

$$\delta=\frac{a(x-x_0)+b(y-y_0)+c(z-z_0)}{\sqrt{a^2+b^2+c^2}}$$

Coordinates of the point $\mathbf{M}'$ symmetrical of the point $\mathbf{M}$ compared to the plan are given by:

$$OM'=-2\,\delta\cdot\frac{V}{\|V\|}+OM$$

3.15 Keyword ABS_CURV

◊ ABS_CURV = _F (...),

Calculate the curvilinear X-coordinate for the whole of the meshs SEG provided via the keywords GROUP_MA or TOUT=' OUI'.
For each node of the meshs concerned, one calculates his curvilinear X-coordinate by taking account of his possible curve.

The keyword GROUP_NO_ORIG allows the user to choose the origin of the curvilinear X-coordinates (the node where the X-coordinate is worthless). The origin must be one of the ends of the line on which one wants to calculate the curvilinear X-coordinate.

This option is necessary, for example, to carry out a modal calculation for a tube with external fluid and intern, when the density of the external fluid is defined according to the curvilinear X-coordinate.

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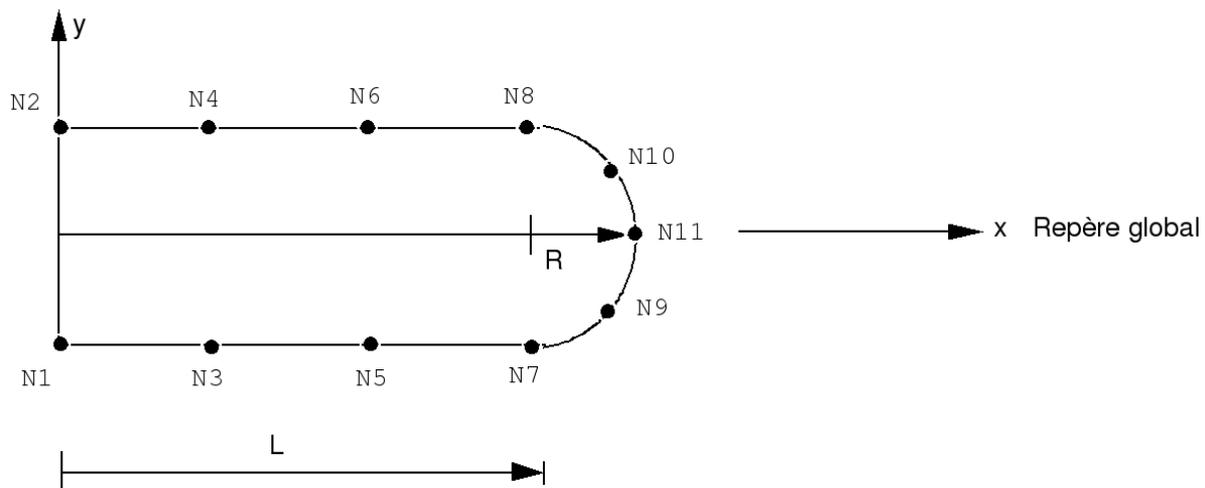
Note:
- All the meshs concerned must be of the type SEG2, SEG3 or SEG4.
- Meshs of the type SEG2 are regarded as right-hand sides and the meshs SEG3 and SEG4 are supposed in the shape of arc of a circle.