Macro-order MACR_INFO_MAIL

1 Goal

To give information about the quality of a grid.

This macro-order makes it possible to obtain information on a grid, of degree 1 or 2, containing mesh-points, segments, triangles, quadrangles, tetrahedrons, hexahedrons or pentahedrons. The impression is directed on the file of messages.

One finds initially an assessment total of the grid: dimension, degree, number of nodes, number of meshs, dimensions extreme.

Then six information is accessible:

- a summary on the quality of the meshs,
- a summary on the diameter of the meshs,
- a control of nonthe interpenetration of the meshs,
- an assessment on the connexity of the grid
- a summary of the size of the various under-fields
- the number of overstrained elements

This analysis is made by the software of adaptation of grid LOBSTER. For more details, to see: http://www.code-aster.org/outils/homard or to refer to the documents quoted in bibliography.

Contents

2 Syntax

```
MACR_INFO_MAIL   (

♦  GRID = my                                                    [grid]

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

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

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

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

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

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

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

◊  MAILLAGE_FRONTIERE =   maf                                   [grid]
   ◊  GROUP_MA_FRONT = l_grma                                   [l_gr_maille]

◊  ELEMENTS_ACCEPTES = / 'LOBSTER'                              [DEFECT]
                       / 'IGNORE_PYRA'

◊  LANGUAGE =       / 'French'                                  [DEFECT]
                / 'FRENCH'
                / 'ENGLISH'
                / 'ENGLISH'

◊  VERSION_HOMARD = / 'V11_2'                                   [DEFECT]
                    / 'V11_N'
                    / 'V11_N_PERSONNELLEMENT'

◊  SOFTWARE =   software     [K]

#  If the version is the version of development, (V11_N, V11_N_PERSO):
   ◊ UNIT =     unit                                            [I]
#  Finsi

◊  INFORMATION =    / 1
   [DEFECT]
             / 2
             / 3
             / 4

)
```

3 Operands

3.1 Operand GRID

♦ GRID = my

Grid of the type [grid] to analyze. Attention, the analysis will relate only to the nodes, the mesh-points, the segments, the triangles, the quadrangles, the tetrahedrons, the hexahedrons or the pentahedrons. If one provides a comprising grid of other meshs, for example pyramids, two cases are possible: either a stop in error, or information on the authorized zone, the rest of the grid being ignored. The choice between these two operating processes is made by the keyword ELEMENTS_NON_HOMARD.

The grid is in degree 1 or 2, but it is not possible to mix both.

In all the cases, the presence of the enriched meshs HEXA27 is prohibited.

3.2 Operand NUMBER

◊ NUMBER = / 'YES' [DEFECT]
/ 'NOT'

If the choice is 'YES', an assessment of the numbers of nodes and meshs are printed on the file of messages.

3.3 Operand QUALITY

◊ QUALITY = / 'YES' [DEFECT]
/ 'NOT'

If the choice is 'YES', an assessment of the quality of the meshs is printed on the file of message.

The quality of a triangle is defined as being the relationship between the length on the largest side and the radius of the inscribed circle.

The quality of a quadrangle is defined like the quotient of the product biggest length and averages on the sides and the diagonals by smallest of surfaces of the internal triangles to the quadrangles.

In the same way, the quality of a tetrahedron is defined as being the relationship between the length on the largest side and the ray of the registered sphere.

The quality of a hexahedron is defined like worst of qualities of the registered tetrahedrons.

All these measurements of quality are standardized to be worth 1 in the case of an equilateral triangle, of a square, an equilateral tetrahedron or a cube. For any nonequilateral mesh, quality is higher than 1. See the reference [bib1] for detailed explanations.

The result is presented in the form of tables, with the extreme values.

The interpretation of the produced values depends on the digital method employed for calculation. According to whether the problem is isotropic or not, according to the speed of space variation of the data, according to the technique of calculation, the same mesh can lead to a good jacobien or not. Essence initially is to locate the frankly bad meshs. If it is observed that the maximum of quality exceeds 100, even 1,000 or 100,000, one must worry: one or more meshs are very deformed and the grid is certainly to begin again. In the second time, this information of quality must make it possible to compare two grids a priori correct, without much value. IF the problem is isotropic, one will may find it beneficial to use the grid with the distribution of quality nearest to 1.

One will find illustrations of values of quality of various meshs in [ref. 5].

3.4 Operand DIAMETER

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

If the choice is 'YES', an assessment of the diameters of the meshs is printed on the file of message.

The diameter of a mesh is defined as the length of the greatest segment than it is possible to insert in the mesh.

For a triangle or a tetrahedron, the diameter corresponds to the length on the largest side.

For a quadrangle, a hexahedron, a pentahedron or a pyramid, the diameter are the maximum between the length on the largest side and the length of the largest diagonal.

The result is presented in the form of tables, with the extreme values.

3.5 Operand CONNEXITY

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

If the choice is 'YES', an assessment of the connexities is printed on the file of messages. It will be known then if the segments, the meshs 2D (triangles and quadrangles joined together) or the meshs 3D (tetrahedrons, hexahedrons, pentaèDRES and pyramidES joined together) of only one holding or are divided into several blocks. One will also know the number of holes of the structure: crossing holes or internal holes.

3.6 Operand SIZE

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

If the choice is 'YES', an assessment of the sizes of the under-fields is printed on the file of messages. A under-field is defined like a set of the same meshs dimension and pertaining to the same groups.

3.7 Operand PROP_CALCUL

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

If the choice is 'YES', a diagnosis on the properties of the meshs as elements for calculation is printed on the file of messages. One counts the number of overstrained elements: the elements of which all the tops are located on the edge. One counts the voluminal meshs (resp. surface) which touches the edge of the field but which is not bordered by surface meshs (resp. linear).

3.8 Operand INTERPENETRATION

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

If the choice is 'YES', it is checked that the grid is correct from the point of view of covering: no mesh has one of its tops inside another mesh.

Caution: this operation can prove to be expensive for large grids, from where the choice 'NOT' by default.

3.9 Operand MAILLAGE_FRONTIERE

◊ MAILLAGE_FRONTIERE = maf

The choice of this option means that the segments forming the edge of the grid of calculation or a limit interns are attached to a fine description of this edge. This fine grid is transmitted here. The link is done by membership of the segments to the same groups.

3.10 Operand GROUP_MA_FRONT

◊ GROUP_MA_FRONT = l_grma

If this option is absent, the link between the segments is established for all the groups present in the grid of the border. If the link is established only for some groups, they are indicated here.

3.11 Operand ELEMENTS_ACCEPTES

◊ ELEMENTS_ACCEPTES = / 'LOBSTER' [DEFECT]
/'IGNORE_PYRA'

In its current version, LOBSTER makes carry information only on certain meshs: mesh-points, segments, triangles, quadrangles, tetrahedrons, hexahedrons, pentahedrons in degree 1 or 2.

By retaining the option 'LOBSTER', transmission of a grid containing another thing that these types of meshs will cause a stop in error. It is the option by default.

By choosing the option 'IGNORE_PYRA', one will be able to analyze a comprising grid of the pyramids. Information will relate only to the zones authorized by LOBSTER, the rest of the grid will be ignored.

In all the cases, the presence of the enriched meshs HEXA27 is prohibited.

3.12 Operand LANGUAGE

◊ LANGUAGE = /'French' [DEFECT]
/'FRENCH'
/'ENGLISH'
/'ENGLISH'

This operand specifies the language in which the messages resulting from LOBSTER are printed.

3.13 Operand VERSION_HOMARD

◊ VERSION_HOMARD = /'V11_2' [DEFECT]
/'V11_N'
/'V11_N_PERSONNELLEMENT'

This operand makes it possible to select the LOBSTER version which is used for the adaptation. By default, LOBSTER 11.2 is launched. It is the version of reference. The choice 'V11_N' activate the version 11.n LOBSTER which is the version of development. The choice 'V11_N_PERSONNELLEMENT' activate a version of development specific to the user. This option makes it possible to the development team of LOBSTER to develop new features. She also makes it possible to make profit the user from an innovation in LOBSTER before the commissioning in *Code_Aster*.

3.14 Operand SOFTWARE

◊ SOFTWARE = software [K]

Candyou option propose to use one other interface of coupling enters *Code_Aster* and LOBSTER that provided by default in the associated repertoire of the toolsS with *Code_Aster*. This option in fact is reserved to the development team of LOBSTER to develop new features. She makes it possible to test innovations before to have modified the macro-order of piloting.

3.15 Operand UNIT

◊ UNIT = unit [I]

Candyou option is not possible that if one has activated the version of development of LOBSTER, 11.n. The data file transmitted by the user under this number of logical unit will be directly transmitted like complement to the file of LOBSTER configuration. This option in fact is reserved to the development team of LOBSTER to develop new features. She makes it possible to test innovations before to have modified the macro-order of piloting.

3.16 Operand INFORMATION

◊ INFORMATION = /1
/2
/3
/4

If INFORMATION 1 is worth, the impressions are minimal; one obtains only those which were explicitly required, the quality of the meshs for example, and the possible error messages.

If INFORMATION is worth 2, one will obtain the messages transmitted by the orders subjacent with the macro-order: IMPR_RESU, LIRE_MAILLAGE, LIRE_RESU.

If INFORMATION is worth 3, one will have the standard LOBSTER messages, recapitulating the execution.

If INFORMATION is worth 4, one will have all the messages transmitted by LOBSTER, for déboggage.

4 Example

```
MACR_INFO_MAIL (GRID = HAMMER,
                SIZE = 'YES',
                CONNEXITY = 'YES',
                INTERPENETRATION = 'YES',
                DIAMETER = 'YES',
                QUALITY = 'YES')
```

This sequence will write general information (dimension, degree, many nodes and of meshs,…) then a diagnosis on quality, the diameters and the interpenetration of the meshs used in the grid HAMMER as well as the size and the connexity of the various under-fields. The LOBSTER by default version is used.

```
Grid has to analyze
HAMMER
Creation date: Monday, February 15, 2010 has 15:59 mn 22 S
Dimension: 2
Degree: 1
It is a starting grid.

    Direction    |       Unit       |  Minimum   |  Maximum
-------------------------------------------------------------
X                | cm               |  0.0000    |  20,000
there               | cm                | -2.0000    |  11,000
```

Information on the number of entities of calculation is classified by type: nodes, mesh-points, edges, etc. One makes the sorting between the meshs of edges and the others.

```
 MANY ENTITIES OF CALCULATION
 ============================


   ************************************************************
   *                        Nodes                             *
   ************************************************************
   * Full number                                 *         76 *
   ************************************************************

   ************************************************************
   *                        Segments                          *
   ************************************************************
   * Full number                                 *         32 *
   *. of which edges isolees                       *          0 *
   *. of which edges of edge of areas 2D          *         32 *
   *. of which internal edges with the faces/volumes    *          0 *
   ************************************************************

   ************************************************************
   *                        Triangles                         *
   ************************************************************
   * Full number                                 *        118 *
   ************************************************************
```

The diagnosis on the interpenetrations of the meshs is made by type of entities.

```
 INTERPENETRATION OF THE MESHS
 =============================


   ************************************************************
   *                                                          *
   *         Summary on the nodes                    *
   *                                                          *
   *         No problem was meeting.                *
   *                                                          *
   ************************************************************


   ************************************************************
   *                                                          *
   *         Summary on the triangles                 *
   *                                                          *
   *         No problem was meeting.                *
   *                                                          *
   ************************************************************
```

In the diagnosis on the quality of the meshs, one raises initially the extreme values recorded in the analyzed grid. Here the minimum is of 1.0044, very near to the theoretical absolute minimum which is of 1, and the maximum met is of 1.5788. Then one presents the distribution by equidistant slice starting from the optimum value, 1. It is seen that 3 triangles have a quality ranging between 1 and 1.025, that is to say 2,54% of the full number of triangles. In the same way, 16 triangles have a quality ranging between 1.025 and 1.050, either 11,02% of the full number of triangles and 10 triangles have a quality ranging between 1.050 and 1.075, or 8,47% of the full number of triangles. In cumulated, one thus notes whom 26 (=3+13+10) triangles have a quality better than 1.075, that is to say 22,03% of the total. And so on. For example, 98,31% of the meshs have a quality better than 1.425.

DIAMETERS OF THE TRIANGLES

Recall: the diameter is equal has the length of more great segment which one can trace in the mesh. For a triangle, it is the length of more backbone.

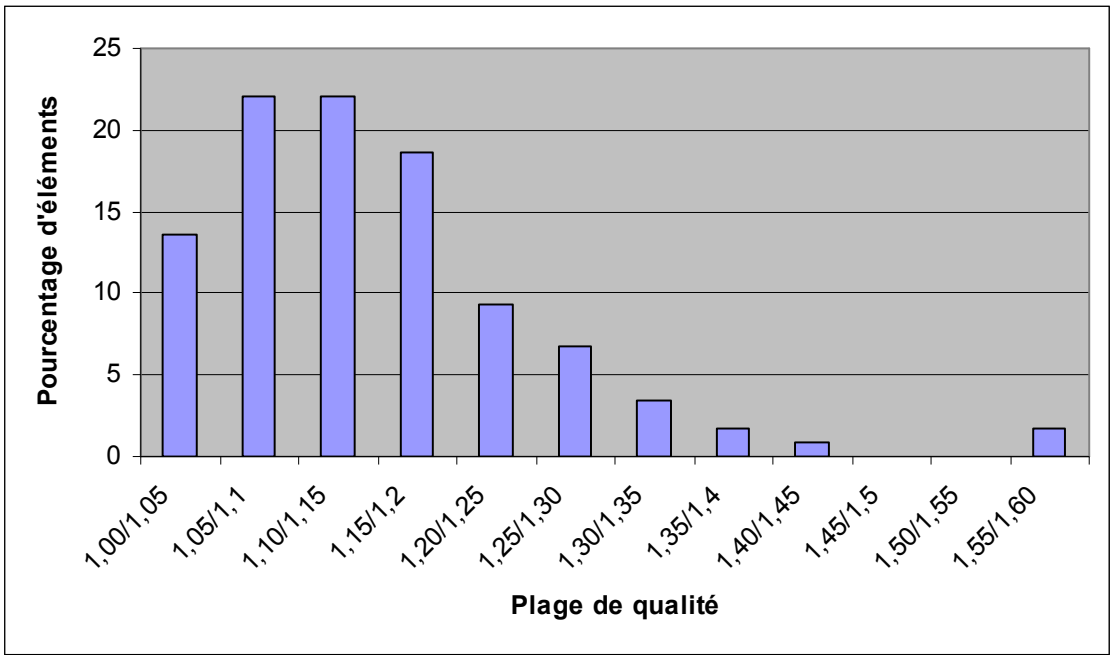
Minimum: 1.1777 Maximum: 2.7500

Function of distribution					
Values		Many meshs			
Minis <	< Maximum	by class		office plurality	
		in %	. number	in %	. number
1,100 <	1,150	0.00.	0	0.00.	0
1,150 <	1,200	0.85.	1	0.85.	1
1,200 <	1,250	0.00.	0	0.85.	1
1,250 <	1,300	0.85.	1	1.69.	2
1,300 <	1,350	0.85.	1	2.54.	3
1,350 <	1,400	1.69.	2	4.24.	5
1,400 <	1,450	1.69.	2	5.93.	7
1,450 <	1,500	1.69.	2	7.63.	9
1,500 <	1,550	2.54.	3	10.17.	12
1,550 <	1,600	6.78.	8	16.95.	20
1,600 <	1,650	4.24.	5	21.19.	25
1,650 <	1,700	11.02.	13	32.20.	38
1,700 <	1,750	5.08.	6	37.29.	44
1,750 <	1,800	6.78.	8	44.07.	52
1,800 <	1,850	6.78.	8	50.85.	60
1,850 <	1,900	2.54.	3	53.39.	63
1,900 <	1,950	3.39.	4	56.78.	67
1,950 <	2,000	11.86.	14	68.64.	81
2,000 <	2,050	2.54.	3	71.19.	84
2,050 <	2,100	5.08.	6	76.27.	90
2,100 <	2,150	2.54.	3	78.81.	93
2,150 <	2,200	3.39.	4	82.20.	97
2,200 <	2,250	0.85.	1	83.05.	98
2,250 <	2,300	3.39.	4	86.44.	102
2,300 <	2,350	2.54.	3	88.98.	105
2,350 <	2,400	2.54.	3	91.53.	108
2,400 <	2,450	2.54.	3	94.07.	111
2,450 <	2,500	0.00.	0	94.07.	111
2,500 <	2,550	0.00.	0	94.07.	111
2,550 <	2,600	0.00.	0	94.07.	111
2,600 <	2,650	2.54.	3	96.61.	114
2,650 <	2,700	0.00.	0	96.61.	114
2,700 <	2,750	0.00.	0	96.61.	114
2,750 <	2,800	3.39.	4	100.00.	118
2,800 <	2,850	0.00.	0	100.00.	118
2,850 <	2,900	0.00.	0	100.00.	118
2,900 <	2,950	0.00.	0	100.00.	118
2,950 <	3,000	0.00.	0	100.00.	118
3,000 <	3,050	0.00.	0	100.00.	118
3,050 <	3,100	0.00.	0	100.00.	118

QUALITIES OF THE TRIANGLES

```
 ************************************************************
 *  Recall: quality is equal to the report of the diameter    *
 *  triangle on the radius of the inscribed circle,             *
 *  standardize has 1 for a equilateral triangle.             *
 ************************************************************
 *   Minimum:   1.0044           Maximum:   1.5788       *
 ************************************************************
 *                  Function of distribution                 *
 *      Values       *         Many meshs          *
 *    Minis <  < Maximum  *    by class    *      office plurality       *
 *                    *  in %  . number  *  in %  . number  *
 ************************************************************
 *    1,000 <   1,025 *   2.54.       3 *   2.54.       3 *
 *    1,025 <   1,050 *  11.02.      13 *  13.56.      16 *
 *    1,050 <   1,075 *   8.47.      10 *  22.03.      26 *
 *    1,075 <   1,100 *  13.56.      16 *  35.59.      42 *
 *    1,100 <   1,125 *   7.63.       9 *  43.22.      51 *
 *    1,125 <   1,150 *  14.41.      17 *  57.63.      68 *
 *    1,150 <   1,175 *  11.86.      14 *  69.49.      82 *
 *    1,175 <   1,200 *   6.78.       8 *  76.27.      90 *
 *    1,200 <   1,225 *   5.08.       6 *  81.36.      96 *
 *    1,225 <   1,250 *   4.24.       5 *  85.59.     101 *
 *    1,250 <   1,275 *   2.54.       3 *  88.14.     104 *
 *    1,275 <   1,300 *   4.24.       5 *  92.37.     109 *
 *    1,300 <   1,325 *   1.69.       2 *  94.07.     111 *
 *    1,325 <   1,350 *   1.69.       2 *  95.76.     113 *
 *    1,350 <   1,375 *   1.69.       2 *  97.46.     115 *
 *    1,375 <   1,400 *   0.00.       0 *  97.46.     115 *
 *    1,400 <   1,425 *   0.85.       1 *  98.31.     116 *
 *    1,425 <   1,450 *   0.00.       0 *  98.31.     116 *
 *    1,450 <   1,475 *   0.00.       0 *  98.31.     116 *
 *    1,475 <   1,500 *   0.00.       0 *  98.31.     116 *
 *    1,500 <   1,525 *   0.00.       0 *  98.31.     116 *
 *    1,525 <   1,550 *   0.00.       0 *  98.31.     116 *
 *    1,550 <   1,575 *   0.85.       1 *  99.15.     117 *
 *    1,575 <   1,600 *   0.85.       1 * 100.00.     118 *
 *    1,600 <   1,625 *   0.00.       0 * 100.00.     118 *
 *    1,625 <   1,650 *   0.00.       0 * 100.00.     118 *
 *    1,650 <   1,675 *   0.00.       0 * 100.00.     118 *
 *    1,675 <   1,700 *   0.00.       0 * 100.00.     118 *
 *    1,700 <   1,725 *   0.00.       0 * 100.00.     118 *
 *    1,725 <   1,750 *   0.00.       0 * 100.00.     118 *
 ************************************************************
```

On the following figure, one can see the representation in the form of histogram of the percentages of meshs in each beach of quality concerned.



The control of the connexity makes it possible to make sure that the field of calculation is of only one piece. It can happen that this field is in several disjoined parts, for example for problems of contact. But the diagnosis of several pieces often reveals a problem during the creation of the grid: under-parts were badly restuck. And as the visual monitoring always does not make it possible to realize it, calculation is false… while looking to be right. The worst situation which can arrive. It is thus strongly recommended to use this option.

```
CONNEXITY OF THE ENTITIES OF CALCULATION
================================


  ************************************************************
  * triangles      are in only one block.                    *
  ************************************************************

  ************************************************************
  * segments       are in only one block.                    *
  *    This line is fermee.                                  *
  ************************************************************
```

The posting of the sizes of the under-parts of the grid is done by dimensions. The tri one roughly speaking takes place according to the declared groups of meshs; there can be a finer subdivision when the groups are recut. This presentation makes it possible to control that one has quite with a grid what one wanted. In particular, that makes it possible to flush out errors of sticking together or creation of groups during the creation of the grid. Here still, it is strongly recommended to use this option.

```
SIZES OF THE SOUS-DOMAINES OF CALCULATION
=================================


      Direction      |       Unit
  ---------------------------------------
     X               |  cm
     there            |  cm

  ************************************************************
  *                     2D Under-fields                      *
  ************************************************************
  * Number * Name                          *  Surface     *
  ************************************************************
  *    -12 * Sous-domaine_12                *  20.0000     *
  *    -11 * Sous-domaine_11                *  128,000     *
  ************************************************************
  * Total:                                  *  148,000     *
  ************************************************************

  ************************************************************
  *                     1D Under-fields                      *
  ************************************************************
  * Number * Name                          *  Length    *
  ************************************************************
  *     -2 * Sous-domaine_2                 *  10.0000     *
  *     -1 * Sous-domaine_1                 *  4.00000     *
  *     -3 * Sous-domaine_3                 *  16.0000     *
  *     -5 * Sous-domaine_5                 *  8.00000     *
  *     -4 * Sous-domaine_4                 *  26.2462     *
  ************************************************************
  * Total:                                 *  64.2462     *
  ************************************************************
  * Minimum:                               *  4.00000     *
  * Maximum:                               *  26.2462     *
  ************************************************************
```

The analysis of the properties of the elements of calculation displays a diagnosis on the overstrained elements and the elements of edge.

```
DIAGNOSES ON THE ELEMENTS OF CALCULATION
=======================================


  ************************************************************
  *                      Triangles                           *
  ************************************************************
  * Many overstrained elements             *          0 *
  * Many elements without meshs of edge      *          0 *
  ************************************************************
```

5 Bibliography

1) G. Nicolas; T. Fouquet: “Software LOBSTER - Volume 1 - general Presentation”, report EDF H-I23-2008-04107-FR, October 2014.
2) G. Nicolas; T. Fouquet: “Software LOBSTER - Volume 2 – Algorithms of refinement and déraffinement of grids”, report EDF H-I23-2008-04108-FR, October 2014.
3) G. Nicolas; T. Fouquet: “Software LOBSTER - Volume 3 – Interfaces with, computer codes” EDF the report H-I23-2008-04118-FR, October 2014.