ZZZZ319 – Data-processing validation of MACR_ADAP_MAIL

Summary:

The case test aims to validate certain options of the order by means of computer MACR_ADAP_MAIL.
1 Modeling A

1.1 Geometry

The geometry, presented by the following figure, is made up of two squares of with dimensions $1\text{ m}$.

![Geometry Diagram]

1.2 Characteristics of the grid

The grid is 2D, quadratic, and is presented by the following figure:

![Grid Diagram]

It is composed of 14 nodes for a mesh QUAD8 composing the group FACE_1 and two meshS TRIA6 composing the group FACE_2. The segments of edge are present in the form of meshes SEG3 and are arranged in the groups LOW, HIGH, RIGHT-HAND SIDE, LEFT.

1.3 Adaptations carried out and resulting grids

1.3.1 First series of adaptations
Two refinements are carried out starting from the initial grid and of a field of internal variables, with a proportion of meshes to be refined of 50%. For the first component of the field, $V_1$, the value $-1$ is assigned to the nodes of the face n°1 and the value $-2$ is assigned to the nodes of the face n°2. The keyword `USAGE_CMP` is equal to `RELATIVE` for the first adaptation and `ABSOLUTE` for the second. The goal is to compare the results of the two options. One thus expects to refine the face n°1 with the first adaptation and the face n°2 to the second. To test it, one will use the field created by `MACR_ADAP_MAIL` with the option `ADD_CHAM= (_F (CHAM_CAT=' DIAMETRE'),)`.

This field contains the value of the diameter of each mesh after refinement. For the triangles resulting from refinement by conformity, it is the length on the largest side whose value is of $\sqrt{1 + \frac{1}{2^2}} = 1.118033989$. For the quadrangles resulting from refinement, it is the diagonal whose value is of $\sqrt{\frac{1}{2^2} + \frac{1}{2^2}} = 0.70710681$. For the triangles resulting from standard refinement, the diameter is their larger side, 0.70710681.

The following figure presents the grid adapted with `USAGE_CMP = RELATIVE`:

![Grid adapted with USAGE_CMP = RELATIVE](image)

In accordance with our waitings, the face n°1 undergoes refinement.

**Note:**
The validation, starting from the value of the diameter, will be carried out on the meshes 15 and 23.

The following figure presents the grid adapted with `USAGE_CMP = ABSOLUTE`:

![Grid adapted with USAGE_CMP = ABSOLUTE](image)
In accordance with our waitings, the face n°2 undergoes refinement.

Note:
The validation, starting from the value of the diameter, will be carried out on meshes 12 and 20

1.3.2 Second series of adaptations

Two cycles of uniform refinement - déraffinement are carried out starting from the initial grid. This time, grid of exit of the adaptation $n$ is used as grid of entry of the adaptation $n + 1$. For refinements, a resulting field corresponding to the number of refinement per mesh is created via the keywords $\text{ADD\_CHAM= (_F (CHAM\_CAT=' NIVEAU',),)}$. For the déraffinements, this field is used as criterion with the option $\text{NIVE\_MIN=1}$. One seeks to check that one does not go déraffiner at the end of the first cycle and that one goes déraffiner at the end of the second.

The adapted grid, after the first cycle, is presented by the following figure:

Refinement operated whereas déraffinement was not carried out.
Note:
Validation, starting from the field ‘LEVEL’, will be realized on mesh 17. At the end of the first cycle as déraffinement was not carried out, the value of this field must be equal to 1.

The adapted grid, after the second refinement, is presented by the following figure:

New refinement indeed was carried out.

Note:
Validation, starting from the field ‘LEVEL’, will be realized on mesh 44. At the end of the refinement of the second the value of this field cycles must be equal to 2.

The grid adapté, after the second cycle, is presented by the following figure:

Déraffinement of dryness second cycle indeed was thus carried out.

Note:
Validation, starting from the field ‘LEVEL’, will be realized on mesh 17. At the end of the second cycle as déraffinement functioned, the value of this field must be again equal to 1.
1.3.3 Third series of adaptations

The grid is enriched to contain meshes TRIA7 and QUAD9. It is presented by the following figure:

The grid n°1 is obtained by requiring the refinement of the meshes of the group FACE_1.

The grid n°2 is obtained by refining the meshes whose edge is included in the bored disc of center (0,75/0,75), of interior ray 0,1, of external ray 0,4.
The grid n°3 is obtained by déraffinant the meshes contained in the rectangle of corners \((0.5/0.5)\) and \((1/1)\) and by refining the meshes whose edge is included in the rectangle of corners \((1.5/0)\) and \((2/0.5)\).

The tests are made on the centres of inertia of each half \textit{FACE}_1 and \textit{FACE}_2 structure.

### 1.4 Sizes tested

The following sizes of the first two refinements are tested:

<table>
<thead>
<tr>
<th></th>
<th>Analytical values</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(RELATIVE) Diameter of the mesh 23</td>
<td>0.707106781</td>
<td>1.E-6</td>
</tr>
<tr>
<td>(RELATIVE) Diameter of mesh 15</td>
<td>0.707106781</td>
<td>1.E-6</td>
</tr>
<tr>
<td>(ABSOLUTE) Diameter of mesh 12</td>
<td>0.707106781</td>
<td>1.E-6</td>
</tr>
<tr>
<td>(ABSOLUTE) Diameter of mesh 20</td>
<td>1.118033989</td>
<td>1.E-6</td>
</tr>
</tbody>
</table>

Following sizes of both cycles of uniform refinement - déraffinement are tested:
### Analytical values

<table>
<thead>
<tr>
<th></th>
<th>Analytical values</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(End of cycle 1) Level of mesh 17</td>
<td>1.</td>
<td>1.E-6</td>
</tr>
<tr>
<td>(Refinement of cycle 2) Level of mesh 44</td>
<td>2.</td>
<td>1.E-6</td>
</tr>
<tr>
<td>(End of cycle 2) Level of mesh 17</td>
<td>1.</td>
<td>1.E-6</td>
</tr>
</tbody>
</table>

### Values of nonregression

<table>
<thead>
<tr>
<th></th>
<th>Values of nonregression</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face n°1</td>
<td>1.283333333</td>
<td>1.E-6</td>
</tr>
<tr>
<td>Face n°2</td>
<td>1.383333333</td>
<td>1.E-6</td>
</tr>
</tbody>
</table>
2 Modeling B

2.1 Geometry

The geometry, presented by the following figure, is made up of a basic triangle 1m and height 1m.

2.2 Characteristics of the grid

The grid is 2D, quadratic and presented by the following figure:

It is composed of 6 nodes for a mesh TRIA6.

2.3 Adaptations carried out and resulting grids

A field of displacement to the nodes is created and the component $D_X$ is initialized to zero for all the nodes, except the node $A$ (located in the preceding figure) for which $D_X = 1$. 

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Two uniform refinements are carried out with update of the field of displacement. The first update is carried out with the option \texttt{CH.AUTO} and the second with the option \texttt{CH.ISOP2}. The expected updated field should not thus be the same one at the end of the two adaptations.

The following figure presents the initial field:

![Initial Field Diagram](image1)

Note:
The validation, starting from the updated field, will be carried out on nodes 2 and 4. The value of $DX$ in \textit{N2} must be equal to 1 whereas in \textit{N4}, it is worthless.

The following figure presents the field resulting from the adaptation with the option \texttt{CH.AUTO}:

![Field Resulting from Adaptation](image2)

It appears, as expected, that the interpolated field does not respect the extreme values of the initial field (confer U7.03.01, §4.15.5).

Note:
The validation, starting from the updated field, will be carried out on nodes 2.4 and 8. The values with nodes 2 and 4 must be identical to those of the initial field. For node 8, with the option CH_AUTO, functions of forms $P2$, $N_{N_{i}}(i \in [1,6])$ (confer R3.01.01 §3.1) of the initial grid are used for the interpolation. One thus expects to find: 

$$DX_{N_{8}} = \sum_{i=1}^{6} DX_{N_{i}} \cdot N_{N_{i}}(\xi_{N_{8}}, \eta_{N_{8}})$$

for $\xi_{N_{8}} = 1/4$, $\eta_{N_{8}} = 0$, $DX_{N_{2}} = 1$, and $DX_{N_{i}} = 0$ ($i \neq 2$) that is to say: 

$$DX_{N_{8}} = 1.(-1.0.25).(-2.(-1.0.25))$$

is 0.375.

The following figure presents the field resulting from the adaptation with the option CH_ISOP2:

It appears, as expected, that with the option CH ISOP2, the interpolated field respects the extreme values of the initial field (confer U7.03.01, §4.15.5).

**Note:**

Nodes 2.4 and 8 are located because they are used for the validation. The values with nodes 2 and 4 must be identical to those of the initial field. For node 8, with the option CH ISOP2, functions of forms $P1$, $N_{N_{i}}(i \in [1,3])$ (confer R3.01.01 §3.1) expressed on the under-meshs of the element of the initial grid are used for the interpolation. One thus expects to find:

$$DX_{N_{8}} = \sum_{i=1}^{3} DX_{N_{i}} \cdot N_{N_{i}}(\xi_{N_{8}}, \eta_{N_{8}})$$

for $\xi_{N_{8}} = 1/2$, $\eta_{N_{8}} = 0$, $DX_{N_{2}} = 1$, and $DX_{N_{i}} = 0$ ($i \neq 2$) that is to say: 

$$DX_{N_{8}} = 1.(-1.0.5) = 0.5$$

### 2.4 Sizes tested

The following sizes are tested:

<table>
<thead>
<tr>
<th>Initial field</th>
<th>Analytical values</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2</td>
<td>1.</td>
<td>1.E-6</td>
</tr>
<tr>
<td>N4</td>
<td>0.</td>
<td>1.E-6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field CH_AUTO</th>
<th>Analytical values</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2</td>
<td>1.</td>
<td>1.E-6</td>
</tr>
<tr>
<td>Field</td>
<td>Analytical values</td>
<td>Tolerance</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>N4</td>
<td>0.</td>
<td>1.E-6</td>
</tr>
<tr>
<td>N8</td>
<td>0.375</td>
<td>1.E-6</td>
</tr>
</tbody>
</table>