ZZZZ164 - Validation of key keys TRANSLATION, ROTATION, MODI_BASE and Summarized ECHELLE of the command

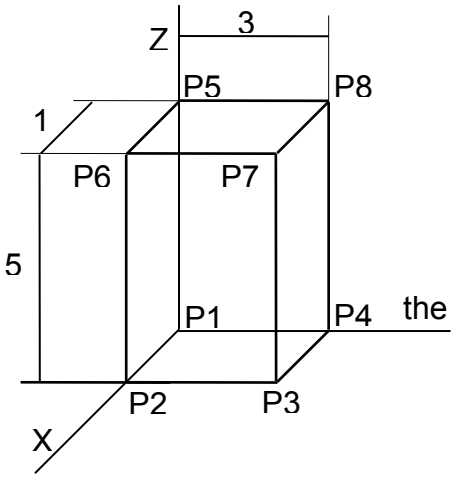
MODI_MAILLAGE:

This test validates key keys TRANSLATION, ROTATION, MODI_BASE and ECHELLE of MODI_MAILLAGE. With this aim, one will impose on two meshes, one 3D and the other 2D two combinations of these key keys. First is made up of a translation, two unspecified rotations and a scaling. One will thus test the two possibilities of definition of the rotational axis: either by two points, or by a point and the direction. The second will combine a basic change and a scaling. One will thus have tested thus all the cases authorized by these keywords.

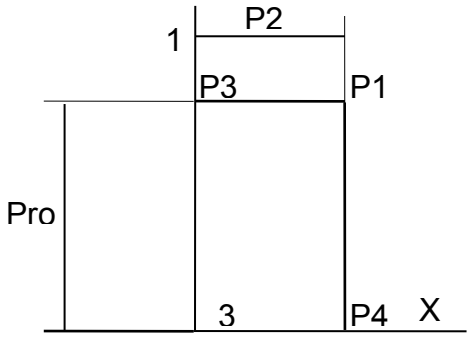
1 Problem of reference

1.1 Geometry

the problem is 3D, it acts of a right-angled parallelepiped:



One will net this volume with a solid element of type HEXA8.
A modelization 2D is deduced from it, with a grid with a solid element QUAD4:



1.2 of the material

does not take place there to be here.

1.3 Nondefinite boundary conditions

and loadings.

1.4 Non

definite initial conditions.

2 Reference solution

2.1 Method of calculating

the reference solution is analytical.
That is to say $M(x,y,z)$ a point of space, one imposes a translation of T vector, (tx,ty,tz) and a rotation of R angle to him α (in radians) whose axis passes by $P(px,py,pz)$ and has as a direction $D(dx,dy,dz)$.
Then M becomes M_T after the translation: $M_T(x+tx,y+ty,z+tz)$.
M_T becomes M_{TR} after rotation:

$$M_{TR}=P+\cos\alpha\cdot PM_T+(1-\cos\alpha)\cdot(PM_T\cdot D)\cdot D+\sin\alpha\cdot(D\wedge PM_T)$$
with $M_T=M+T$

the setting at the level of a factor ech, gives:

$$M_{TRE}=ech\cdot M_{TR}$$

The functionality of basic change expects in entry the data by the user of two orthogonal vectors in 3D (only one vector in 2D). One comes to supplement these data in order to generate a direct orthogonal base, in 3D or 2D. Tests are carried out in order to check if the data input will make it possible to define a direct orthogonal base. A standardization of the vectors of the base is then carried out.
In 3D, one thus expects the data of U and V, the first two vectors of the new base:

$$W(x,y,z)=U(x,y,z)\wedge V(x,y,z)$$
$\Rightarrow B=(U,V,W)$: stamp formed by the basic vectors
$$M(U,V,W)=B^T M(x,y,z)$$

In 2D, one generates the second vector of the base by rotation of 90° of the vector seized by the user.
This basic change can be combined with a scaling and a translation, for example.
The programming of these transformations is done differently in 3D and 2D, so as to optimize each one of these two cases.

2.2 Quantities and results of reference

One will control the new coordinates of the point $P1$, $P7$ and $P8$ in 3D ($P1$, $P3$ and $P4$ in 2D).

2.3 Uncertainties on the solution

uncertainties come from the numerical accuracy in *Code_Aster* (dependence of the platform) and in the computation of the analytical solution of reference. One can thus consider a relative criterion of accuracy about $1.E-13$ in the tests.

2.4 Bibliographical references

Without use.

3 Modelization A

3.1 Characteristic of the modelization

One is placed in a frame 3D massive. One will impose successively:

a translation of vector $(2.5;3.9;-12.3)$,
a rotation of angle 33 degrees and axis passing by the points $(10;0.5;3.8)$ and $(0;10;0)$,
the second rotation of angle -161 degrees and axis passing by $(-3.;0.5;3.8)$ and from direction $(0;1;0)$,
a setting at the level of a factor 5.

One thus tests all the cases authorized by the syntax of key keys TRANSLATION, ROTATION and ECHELLE.

Then, one sets out again of the initial mesh and one imposes to him successively:

a basic change of vectors $(1.23;0.23;0)$ and $(-2.3;12.3;0)$,
a setting at the level of a factor 5.

One tests together thus key keys MODI_BASE and ECHELLE.

3.2 Characteristics of the mesh

The mesh comprises only one element of type HEXA8.

3.3 Quantities tested and results

For the first part, with TRANSLATION, ROTATION and ECHELLE:

Points observed	Coordinated	Reference
P1	*X*	5.2501368890123E+00
	Y	– 2.1551486020681E+00
	Z	7.8600118786924E+01
P7	*X*	– 1.3714414455621E+01
	Y	1.9199906921638E+01
	Z	7.0898989267417E+01
P8	*X*	– 9.9168576521849E+00
	Y	2.0297577804345E+01
	Z	6.7837342495183E+01

For the second part, with MODI_BASE and ECHELLE :

Points observed	Coordinated	Reference
P1	X	4.9148126952461E+00
	Y	– 9.1903001618423E-01
	Z	0.0000000000000E+00
P7	X	7.6719027437988E+00
	Y	1.3825408069554E+01
	Z	2.5000000000000E+01
P8	X	2.7570900485527E+00
	Y	1.4744438085738E+01
	Z	2.5000000000000E+01

4 Modelization B

One is placed in a frame 2D. One will impose successively:

a translation of vector $(2.5;3.9)$,
a rotation of angle 33 degrees and axis passing by the point $(10.;0.5)$,
the second rotation of angle -161 degrees and axis passing by the point $(-3;0.5)$,
a setting at the level of a factor 5.

One thus tests all the cases authorized by the syntax of key keys TRANSLATION, ROTATION and ECHELLE.

Then, one sets out again of the initial mesh and one imposes to him successively:

a change of reference of vectors $(1.23;0.23)$,
a setting at the level of a factor 5.

One tests thus together key keys MODI_BASE and ECHELLE.

4.1 Characteristics of the mesh

The mesh comprises only one QUAD4 element of type.

4.2 Quantities tested and results

For the first part, with TRANSLATION, ROTATION and ECHELLE:

Points observed	Coordinated	Reference
P1	X	– 3.9975219277929E+01
	Y	4.2222814000070E-01
P3	X	– 3.1233365350457E+01
	Y	– 1.2752747757918E+01
P4	X	– 2.8155057973828E+01
	Y	– 8.8126939898842E+00

For the second part, with MODI_BASE and ECHELLE :

Points observed	Coordinated	Reference
P1	*X*	0.0000000000000E+00
	Y	0.0000000000000E+00
P3	*X*	7.6719027437988E+00
	Y	1.3825408069554E+01
P4	*X*	2.7570900485527E+00
	Y	1.4744438085738E+01

5 Summary of the results

the numerical results for the translation, rotation, the change of reference and the setting at the level of the mesh are identical to the analytical results of reference, in 3D or 2D, except for the numerical accuracy.