ZZZZ285 - Validation of PROJ_CHAMP/Collocation

Summary:

This test is a data-processing test. It validates the order PROJ_CHAMP METHODE=' COLLOCATION' for all the types of meshs 2D and 3D, with flat rims or curved.

There exist 6 modelings (A , B , C , D , E , F).

1 Goal of the test

One wants to validate the implementation of the method 'COLLOCATION'of projection of the fields to the nodes for all the types of meshs 2D and 3D on right or curved board.

2 Principle of the test

One nets a square (in 2D) or a cube (in 3D) by using linear elements on right board (TRIA3, QUAD4, HEXA8, PENTA6, TETRA4, PYRAM5). The square (or the cube) is with a grid 2 times with different discretizations. Let us call these 2 grids MA1 and MA2.

The order is used CREA_MAILLAGE to transform these linear grids into quadratic grids ('LINE_QUAD'). The order is also used CREA_MAILLAGE to create meshs "QUAD+": QUAD9, HEXA27 and PENTA18.

One has then for all the types meshs: SORTED, QUAD,…, PYRAM linear grids (" FLAX "), quadratic (" QUAD ") or " QUAD+ "

With the order MODI_MAILLAGE / DEFORM, one can deform the grids MA1 and MA2 so that the edges of the elements become curved.

One creates a field with the nodes then (CH1) whose form is "analytical" (application of a formula to the coordinates of the nodes of the grid MA1). One can use 3 different formulas:

- a function refines coordinates (noted "degree 1")
- a quadratic function of the coordinates (noted "degree 2")
- an unspecified function of the coordinates (noted "degree 2+" although one uses actually fractional powers).

One carries out a projection then of CH1 of MA1 towards MA2. One obtains CH2. This field is again project of MA2 towards MA1. One obtains CH1B.
CH1 and CH1B having the same grid support, one can then calculate the relative error caused by double projection.

One calculates then (and one tests) the "maximum" of the relative error on the grid.

Note: Like the order PROJ_CHAMP is sometimes used between 2 grids whose nodes are geometrically confused (for example the studies THM), one also tests this configuration (MA2 = MA1) to check that in this case, the error of projection is worthless.

3 Reference solution

Lreference solution has is 0. Ideally, the error of projection must be worthless.

4 Results

In the 2 tables below, one raised the maximum relative error related to the double projection for the various cases: flat rims or curved, types of meshs, field linear, quadratic,…

When the error of projection is lower than 1.e-9, the box is coloured in yellow. It is considered whereas projection is “perfect”.

Note:

Combination “curved edges + degree of the meshs FLAX ” does not exist!
The degree QUAD+ do not exist for TETRA / PYRAM

4.1 Projection of a grid on another grid (different)

edges	degree of the meshs	degree of the field	/QUAD SORTED	HEXA/PENTA	TETRA/PYRAM
rights	FLAX	1	6.6E-12	4.9E-12	2.2E-16
		2	6.3E-03	4.2E-03	0,046
		2+	2.0E-03	1.3E-03	0,012
	QUAD	1	2.6E-11	2.0E-11	5.2E-16
		2	4.3E-04	2.8E-04	5.5E-16
		2+	1.1E-04	7.7E-05	1.5E-04
	QUAD+	1	3.0E-11	2.2E-11	
		2	1.1E-10	6.5E-11	
		2+	2.5E-06	4.9E-06	
curves	QUAD	1	2.3E-03	1.7E-03	0,023
		2	0,012	6.5E-03	0,048
		2+	2.9E-03	1.9E-03	0,033
	QUAD+	1	2.3E-03	1.7E-03	
		2	0,012	6.5E-03	
		2+	2.9E-03	1.9E-03	

4.2 Projection of a grid on itself

edges	degree of the meshs	degree of the field	/QUAD SORTED	HEXA/PENTA	TETRA/PYRAM
rights	FLAX	1	0.0E+00	4.6E-16	0.0E+00
		2	0.0E+00	3.3E-16	0.0E+00
		2+	0.0E+00	3.9E-16	0.0E+00
	QUAD	1	3.4E-16	9.2E-16	7.8E-16
		2	4.0E-16	1.0E-15	1.1E-15
		2+	3.8E-16	8.0E-16	7.8E-16
	QUAD+	1	8.1E-16	8.8E-16	
		2	8.8E-16	1.2E-15	
		2+	8.4E-16	8.9E-16	
curves	QUAD	1	1.2E-10	9.6E-11	1.1E-10
		2	7.1E-10	3.0E-10	2.7E-10
		2+	2.5E-10	1.8E-10	2.6E-10
	QUAD+	1	1.3E-10	9.6E-11	
		2	5.2E-10	3.0E-10	
		2+	2.5E-10	1.8E-10	

5 Summary of the results

When one projects a grid on itself, there is no error of projection (all boxes its yellows)
When the edges are right and that the fields are same degree that the elements, There is no error of projection.
In the case general (different grids and unspecified field), the error can vary 1.e-6 with 5.e-2 (5%) if the edges are right. When the edges are curved the error varies between 2.e-3 and 5.e-2. It is thus noted that for the curved edges, even if they disturb algorithm of pairing (in two stages whose first linearizes the meshs), the maximum error is not more important than for the flat rims (here 5%).