PYNL02 - STAT_NON_LINE in orders burst for an elastoplastic calculation

Summary:

The purpose of this document is to validate the methodology of resolution of a non-linear problem (here a problem of elastoplasticity) in burst orders, without using the order STAT_NON_LINE .

1 Problem of reference

1.1 Geometry

A unit cube is considered.

1.2 Properties of material

One considers a material with a law of behavior of Von Mises with mixed work hardening (VMIS_ECMI_TRAC).
The elastic properties are the following ones:
•Young modulus: $E=221300\,MPa$
•Poisson's ratio: $\nu=0,3$
The constant of Prager is worth: $C=2200\,MPa$.
The traction diagram considered is given on Figure 1.2-1 .

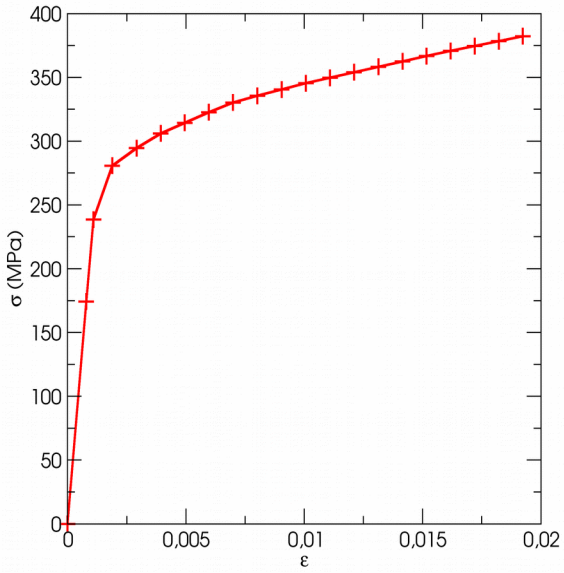

Figure 1.2-1 : Traction diagram

1.3 Boundary conditions and loadings

The lower face (in the plan $z=0$) is embedded.
The higher face (in the plan $z=1$) is subjected to a vertical displacement $dz=10^{-2}[\ m\ ]$.

2 Reference solution

The reference solution is obtained by a digital resolution of the problem using the order STAT_NON_LINE. One thus obtains the stress field and the field of internal variables.
The increment of load is discretized in 2 moments between 0 and 1.
An elastic prediction is carried out, and one reactualizes the tangent matrix with each iteration and each increment.

The table of convergence is represented below:

INSTANT DE CALCUL : 5.000000000E-01

ITERATIONS NEWTON		RESIDU RELATIF RESI_GLOB_RELA		RESIDU ABSOLU RESI_GLOB_MAXI	OPTION ASSEMBLAGE
0	X	3.98344E-01	X	1.21090E+02	ELASTIQUE
1	X	7.07348E-04	X	9.25744E-02	TANGENTE
2		8.74324E-10		1.14308E-07	TANGENTE

INSTANT DE CALCUL : 1.000000000E+00

ITERATIONS NEWTON		RESIDU RELATIF RESI_GLOB_RELA		RESIDU ABSOLU RESI_GLOB_MAXI	OPTION ASSEMBLAGE
0	X	3.84934E-01	X	1.67339E+02	ELASTIQUE
1	X	5.82064E-04	X	1.29881E-01	TANGENTE
2		6.38364E-10		1.42368E-07	TANGENTE

Figure 2-1 : Table of convergence of reference

3 Modeling A

3.1 Characteristics of modeling

In this modeling, the order is replaced STAT_NON_LINE by burst orders. The boundary conditions are applied by dualisation (Lagranges)

3.2 Characteristics of the grid

The grid is composed of only one nets HEXA8.

3.3 Sizes tested and results

One tests the difference between the stress field (respectively of internal variables) calculated by STAT_NON_LINE and by the order CALCULATION, with convergence at the last moment.

Identification	Reference	% difference
$min(\Delta\sigma)$	0	0
$max(\Delta\sigma)$	0	0
$min(\Delta vi)$	0	0
$max(\Delta vi)$	0	0

The table of convergence is also identical to that of reference:

```
instant  0.5
IterNewton | Resi_Glob_rela   | Resi_Glob_Maxi   | Convergence
     0     |   3.983444e-01   |   1.210901e+02   |    0
     1     |   7.073482e-04   |   9.257440e-02   |    0
     2     |   8.743236e-10   |   1.143078e-07   |    1

instant  1.0
IterNewton | Resi_Glob_rela   | Resi_Glob_Maxi   | Convergence
     0     |   3.849340e-01   |   1.673393e+02   |    0
     1     |   5.820635e-04   |   1.298814e-01   |    0
     2     |   6.383644e-10   |   1.423681e-07   |    1
```

Figure 3.3-1: Table of convergence obtained via the order CALCULATION

4 Summary of the results

This test made it possible to validate methodology of resolution of a non-linear problem (here a problem of elastoplasticity) in burst orders, without using the order STAT_NON_LINE.
In this test, the range of methodology is limited:
•pas de external forces (loading imposed via of Lagranges)
•pas de loading of temperature (variables of orders)
•pas de piloting,
•pas de searches linear,
•pas de contact,
•NUME_DDL do not change during step of time (in particular, the nodes whose displacement is imposed do not vary).