SSNV171 – Intercomparison of the behaviors MONOCRYSTAL AND POLYCRYSTAL

Summary:

The purpose of this test is to validate them behaviors MONOCRYSTAL and POLYCRYSTAL by intercomparison, in a typical location: only one grain for MONOCRYSTAL and only one phase for POLYCRYSTAL. The crystalline behavior is of the type MONO_VISC1, MONO_CINE1, MONO_ISOT1 (Meric-Cailletaud).

The treated geometry is a material point, and the crystal is not parallel to the axes of coordinates.

3 modelings make it possible to compare:

- behaviors MONOCRYSTAL (various algorithms of integration implicit, modelings A and B)
- behaviors MONOCRYSTAL and POLYCRYSTAL with a grain, with explicit integration, like the postprocessing of Weibull (modeling C).

1 Problem of reference

1.1 Geometry

Not material.

1.2 Properties of materials

Young modulus: $E=145200 MPa$
Poisson's ratio: $\nu=0.3$

MONO_VISC1
$N=10$
$K=40$
$C=1$

MONO_ISOT1
$R_0=75.5$
$B=19.34$
$Q=9.77$
$H=0$

MONO_CINE1
$D=36.68$

WEIBULL with :
$M=24.$
VOLU_REFE=1.E-3
SIGM_REFE=2630.

The selected orientation is $(30,0,0)$.

1.3 Boundary conditions and loadings

The loading consists in imposing a component of constraints σ_{xx} increasing, worthless at moment 0. and varying linearly up to 210 MPa at moment 1.5.

2 Reference solution

2.1 Method of calculating

This test proceeds by intercomparison: behaviors MONOCRYSTAL (for only one grain) on the one hand, and POLYCRYSTAL in addition must give the same results.

Modeling A provides the values of reference used by modeling B to compare the various implicit algorithms.

With regard to modeling C, with integration clarifies, the selected reference is the solution provided by EXPLICIT MONOCRYSTAL, with which the case is compared POLYCRYSTAL. These values are slightly different from those obtained into implicit (modelings A and B) because of the relatively coarse temporal discretization.

3 Modeling A

3.1 Characteristics of modeling

Not material; the selected orientation is $(30,0,0)$.
The behavior is MONOCRYSTAL with implicit integration.

3.2 Sizes tested and results

Results of MONOCRYSTAL into implicit (Newton)

Identification	Reference
σ_{xx} of SIEF_ELGA	210
ε_{xx} of EPSI_ELGA	1.8913169223994E-03
ε_{yy} of EPSI_ELGA	-5.0273159559248E-04
V_2 of VARI_ELGA	-6.884729831599E-05
V_{58} of VARI_ELGA (rotation of network)	-1.8809431585402E-04

Note: Values of nonregression used as reference for modeling B.

4 Modeling B

4.1 Characteristics of modeling

Not material; the selected orientation is $(30,0,0)$.
The behavior is MONOCRYSTAL with implicit integration (other algorithms).

4.2 Sizes tested and results

The values of reference are those obtained with MONOCRYSTAL implicit (ALGO_INTE=' NEWTON') modeling A.

Results got with ALGO_INTE=' NEWTON_PERT'

Identification	Reference	Tolerance (%)
σ_{xx} of SIEF_ELGA	210	1.E-4
ε_{xx} of EPSI_ELGA	1.8913169223994E-03	1.E-4
ε_{yy} of EPSI_ELGA	-5.0273159559248E-04	1.E-4
V_2 of VARI_ELGA	-6.884729831599E-05	1.E-4
V_{58} of VARI_ELGA	-1.8809431585402E-04	1.E-4

Results got with ALGO_INTE=' NEWTON_RELI'

Identification	Reference	Tolerance (%)
σ_{xx} of SIEF_ELGA	210	1.E-4
ε_{xx} of EPSI_ELGA	1.8913169223994E-03	1.E-4
ε_{yy} of EPSI_ELGA	-5.0273159559248E-04	1.E-4
V_2 of VARI_ELGA	-6.884729831599E-05	1.E-4
V_{58} of VARI_ELGA	-1.8809431585402E-04	1.E-4

5 Modeling C

5.1 Characteristics of modeling

Not material; the selected orientation is $(30,0,0)$.
The behavior is MONOCRYSTAL or POLYCRYSTAL with explicit integration.

5.2 Sizes tested and results

Results got with MONOCRYSTAL into explicit, ALGO_INTE=' RUNGE_KUTTA'

Identification	Reference	Tolerance (%)
σ_{xx} of SIEF_ELGA	210	0.1
ε_{xx} of EPSI_ELGA	1.8913169223994E-03	0.6
ε_{yy} of EPSI_ELGA	-5.0273159559248E-04	0.4

Results got with POLYCRYSTAL into explicit, ALGO_INTE=' RUNGE_KUTTA'

Identification	Reference	Tolerance (%)
σ_{xx} of SIEF_ELGA	210	0.1
ε_{xx} of EPSI_ELGA	1.8913169223994E-03	0.6
ε_{yy} of EPSI_ELGA	-5.0273159559248E-04	0.4

6 Summary of the results

The results got with implicit integration are identical some is the algorithm used, and in concord with the solution of explicit integration (0.6 % of maximum change). Moreover, results got with the behavior POLYCRYSTAL are identical (in the case of an only phase) to those obtained with MONOCRYSTAL.