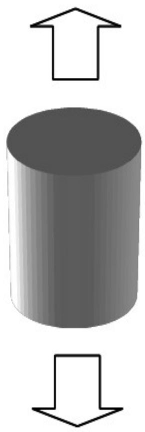
ZZZZ159 - Retiming of an elastoplastic law of behaviour on a tensile test

Summary:

Macro retiming is tested `MACR_RECAL` on the simple case of the identification of an elastoplastic law of behavior of Von Mises on a simple tensile test controlled in displacements. The readjusted parameters are the Young modulus, the elastic limit and the slope of work hardening starting from the knowledge of the constraints and the plastic deformation cumulated in the test-tube.

1 Problem of reference

1.1 Geometry



Traction of $5.E-3\ mm$

1.2 Properties of material

The initial values of the parameters are the following ones:

- $E=100000.\ MPa$
- $\sigma_y=1000.\ MPa$
- $E_T=30.\ MPa$

The values which one wishes to obtain are (see method of calculating of the reference solution):

- $E=200000.\ MPa$
- $\sigma_y=200.\ MPa$
- $E_T=2000.\ MPa$

1.3 Boundary conditions and loadings

A homogeneous state of stresses is sought: one imposes only one vertical displacement of $5.10^{-3}\ mm$.

2 Reference solution

2.1 Method of calculating

This calculation is a validation the macro one `MACR_RECAL`. With this intention, the approach is the following one:

- one chooses a value (known as "value to be identified") for each parameter and one calculates. One thus obtains a history of constraint and cumulated plastic deformation,
- it is supposed now that the values to be identified preceding are unknown for us. Our only information is the history of constraint and cumulated plastic deformation which we will thus regard as an experimental measurement,
- one then launches optimization on this pseudonym measures experimental by taking for each parameter an arbitrary value,
- it is checked that the values identified by the algorithm are well the values to be identified.

This approach is very classical in optimization where it makes it possible to validate the algorithms.

2.2 Sizes and results of reference

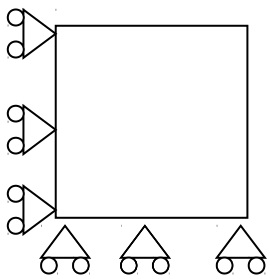
The reference variables are the values of the parameters with convergence is:

- $E=200000.MPa$
- $\sigma_y=200.MPa$
- $E_T=2000.MPa$

3 Modelings

3.1 Characteristics of modelings

Axisymmetric modeling on the following grid:



In these modelings, the initial values and the acceptable fields of the various parameters are:

- Young modulus: $100000.\in[50000.,500000.]$
- Slope of work hardening: $1000.\in[500.,10000.]$
- Elastic limit: $30.\in[5.,500.]$

3.2 Characteristics of the grid

Many nodes: 4
Numbers and types of meshs: 4 `SEG2`, 1 `QUAD4`

3.3 Alternatives

Modeling A uses the mode by default (inclusion).

Modeling B is based on A but share of a different starting point, uses the distributed mode but has a criterion of stop on the functional calculus (TOLE_FONC) voluntarily very high (0.9) in order to make only one iteration.

Modeling C is based on A but uses different weights on the two experimental curves.

Modeling D is based on C but generates graphs with format XMGRACE.

Modeling E is based on C but uses the algorithm of BFGS (FMINBFGS).

Modeling F is particular because it does not use MACR_RECAL but mode EXTERNAL : it uses same calculation slave as other modeling but the command file zzzz159f.comm uses programming Python to handle the profile and to simulate a call in external mode with the routine Recal.py.

Modeling G is based on D but calculations slaves are launched in MPI.

3.4 Sizes tested and results

Sizes tested	Analytical values
Young modulus	200000.00
Elastic limit	2000.00
Slope of work hardening	200.00

4 Summary of the results

The results of optimization are got in a small number of iterations (5) and are of very good quality.