SSLP109 - Validation of a functionality of Summarized `option`

DDL_STAB:

This test allows the validation of a functionality of option `DDL_STAB` of `CRIT_STAB`, which evaluates the stability of the states of equilibrium found by the computational simulation of the nonconservative problems like the problems of damage. What requires to apply an algorithm of optimization under stresses of inequalities. The option can be applied to a list containing any degree of freedom available in *Code_Aster.*

1 Problem of reference

1.1 Tallies theoretical

In the case of a conservative problem, one defines the stability of the state of equilibrium by the strict positivity of all the eigenvalues of the tangent operator. What is written, in the case of a symmetric tangent $\boldsymbol{K}$ operator:

$$\underset{x}{Min}\left(\frac{\boldsymbol{x}^{T}.\boldsymbol{Kx}}{\boldsymbol{x}^{T}.\boldsymbol{x}}\right)>0$$

In the case of the nonconservative problems, of the unilateral conditions of irreversibility are imposed on certain components of the vector x. The preceding inequality then becomes sufficient but nonnecessary to deduce the stability of a state from equilibrium.

One of the features developed in the algorithm of optimization under stresses makes it possible to be limited to the computation of the smallest eigenvalue (quantity which one reaches quickly), when this one is of positive sign. In this precise case, the value referred for the criterion of stability is exactly that of the smallest eigenvalue, recomputed from the method of the powers. One does not carry out additional stages of projection to determine the exact value of the minimum under stresses of inequalities. What allows a time-saver of computation.

One is interested in the case test presented here, with a bar in uniform tension, whose behavior is purely elastic. The elastic character is conservative and ensures the strict positivity of the smallest eigenvalue of the tangent operator. One is thus in the precise case where the functionality described previously is started.

1.2 Geometry

One considers a bar 2D length $L=4\,m$ is height $h=0.5\,m$

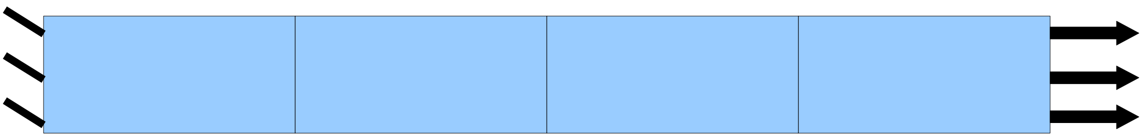

Figure 1 : Representation of the problem

1.3 Properties of the elastic

1.3.1 material Model: material ELAS

Characteristics: $E=1\,\mathrm{Pa}$, $\nu=0.$

1.4 Boundary conditions and loadings

Fixed support : Null imposed displacements $DY=0\,m$. on all the nodes and $DX=0\,m$. on the left face ($x=0.$). See figure1.
Loading 1 : Linear displacement imposed U_1 on the right face ($x=4.$): $U_1=t\cdot 10^{-6}\,\mathrm{m}$

2 Reference solution

the smallest eigenvalue of tangent operator, calculated by the operator CRIT_STAB, is worth 0.146447 .

3 Modelization A

3.1 Characteristic of the modelization

One uses a modelization D_PLAN.

3.2 Characteristics of the mesh

The mesh contains 4 elements QUAD4.

3.3 Quantities tested and Results

NUMERO	TYPE_REFERENCE	VALE_REF	TOLERANCE
1	"NON_REGRESSION"	0.14644700	5.0E-04%

Table 1: Comparison of the estimate of the criterion of stability with the value of reference

4 Summary of the results

One finds with option DDL_STAB a value of the criterion of stability equal to that of the smallest eigenvalue by CRIT_STAB. The algorithm developed for the specified functionality is thus validated.