SSLP109 - Validation of a functionality of the option DDL_STAB

Summary:

This test allows the validation of a functionality of the option DDL_STAB of CRIT_STAB, which evaluates the stability of the states of balance found by the digital simulation of the nonconservative problems like the problems of damage. What requires to apply an algorithm of optimization under constraints 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 Tally theoretical

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

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

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

One of the features developed in the algorithm of optimization under constraints makes it possible to be limited to the calculation of the smallest eigenvalue (size 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 starting from the method of the powers. One does not carry out additional stages of projection to determine the exact value of the minimum under constraints of inequalities. What allows a time-saver of calculation.

One is interested in the case test presented here, with a bar in uniform traction, 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

A bar is considered 2D of length $L=4\,m$ is height $h=0.5\,m$

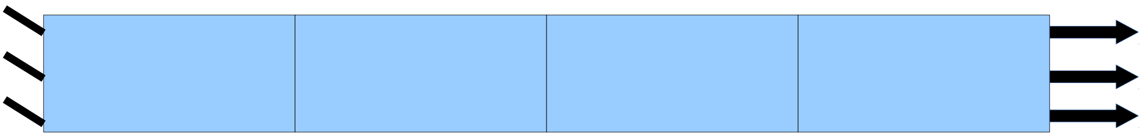

Figure 1 : Representation of the problem

1.3 Properties of material

1.3.1 Elastic law: material ELAS

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

1.4 Boundary conditions and loadings

Embedding : Worthless imposed displacements $DY=0\,m$. on the whole of the nodes and $DX=0\,m$. on the left face ($x=0.$). See figure1.
Loading 1 : Imposed linear displacement U_1 on the right face ($x=4.$) : $U_1=t\cdot10^{-6}\,\text{m}$

2 Solutione of reference

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

3 Modeling A

3.1 Characteristics of modeling

A modeling is used D_PLAN.

3.2 Characteristics of the grid

The grid contains 4 elements QUAD4.

3.3 Sizes tested and Results

NUMBER	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 the option DDL_STAB a value of the criterion of stability equalizes with that of the smallest eigenvalue calculated by CRIT_STAB. The algorithm developed for the specified functionality is thus validated.