ZZZZ282 – Validation of the definition of a crack on a grid by DEFI_FISS_XFEM

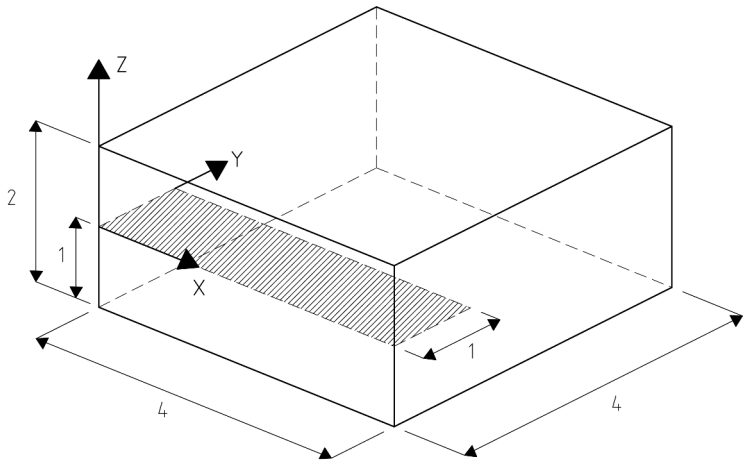
Summarized:

This test validates the computation of the functions of level (level sets) of a crack and an interface X-FEM on a grid for all the methods available in DEFI_FISS_XFEM.

1 Problem of reference

1.1 Geometry

One considers a parallelepiped of dimensions $4\text{x}4\text{x}2\,mm$ with a plane crack:



2 Principle of the test

In DEFI_FISS_XFEM one can define crack on a mesh by four different methods:

- by mesh groups which form crack and its bottom. To create these two groups, one uses by simplicity operator PROPA_FISS (method INITIALIZATION).
- by analytical functions which make it possible to calculate directly both level sets:
  $lsn = Z$
  $lst = Y - 1$
- by a catalog of preset forms. In this case one uses form DEMI_PLAN.
- by two fields at nodes which account for both level sets. By simplicity these two fields are extracted from crack defined by the catalog of the preset forms above.

One expects that the fields at nodes which characterize both level sets of crack on the grid are the same ones as those which give the level sets on the mesh of structure. So for the grid one uses the same mesh as that used for structure, one expects that the values of the two fields in each node of the grid are the same ones as those with the same node of the mesh of structure. For each method available one thus proceeds in the following way:

- one calculates the level sets on the mesh of structure and on the grid by DEFI_FISS_XFEM,
- for each node of the mesh of structure, one calculates the difference between the level set definite z norm and that with the same node of the mesh of the grid,
- for each node of the mesh of structure, one calculates the difference between the level set definite y tangent and that with the same node of the mesh of the grid,
- one checks that in each node the two calculated differences are equal to zero.

One makes the same thing for the interfaces with the difference as only one level set (the norm) is used to define an interface.

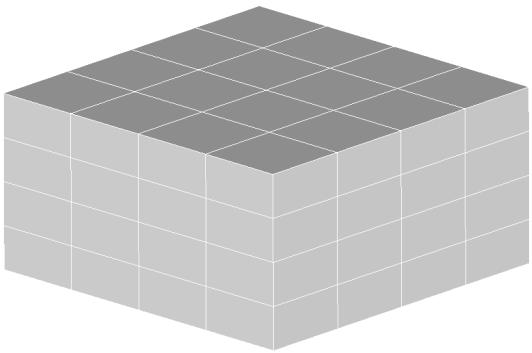
3 Modelization A

3.1 Characteristic of the modelization

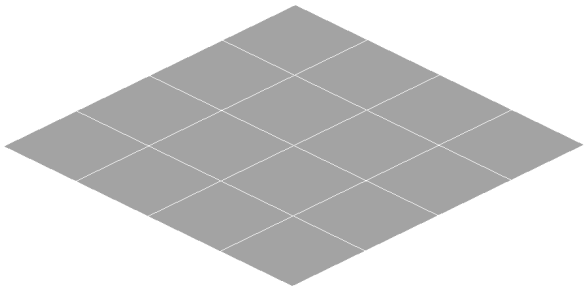
One uses a modelization 3D. For an interface and the only methods “catalogues preset forms” and “fields at nodes” of DEFI_FISS_XFEM, one uses a modelization D_PLAN of the same geometry limited to the plane (X, Y) because these methods are not available in 3D.

3.2 Characteristics of the mesh

The mesh 3D contains 64 elements of the type HEXA8 of dimension $1\text{x}1\text{x}0.5\,mm$:



The mesh D_PLAN contains 16 elements of the type QUAD4 of dimension $1\text{x}1\,mm$:



The same mesh is used at the same time for structure and the grid.

3.3 Quantities tested and results

One tests in each node the difference between the level set on the mesh of structure and the level set on the mesh of the grid. A value exactly equal to zero is obtained everywhere, which makes it possible to check the coincidence of the fields at nodes between structure and grid.

3.4 Remarks

In the test one is obliged to use a tolerance in TEST_TABLE. One takes this tolerance equalizes to 0.01. That does not affect the results of the test because one tests values which are always exactly equal to zero.

4 Summary of the results

the two fields at nodes calculated by DEFI_FISS_XFEM, at the same time on the mesh of structure and the resulting mesh of the grid, are always coïncidents independently of the selected method for the definition of crack or the interface.
That makes it possible to conclude that operator DEFI_FISS_XFEM correctly calculates the level sets on the grid.