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## Operator PROPA\_FISS

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### 1 Drank

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the goal of operator `PROPA_FISS` is to make propagate a crack, this crack being defined with the method X-FEM. Two types of methods are available:

- a method by numerical integration of the equations of propagation of crack tip (`METHODE_PROPA='SIMPLEXE'` or `"UPWIND"`): this method available in for all element types is 2D and 3D finished. The initial crack can be defined on the mesh of the model or an auxiliary mesh. This last solution allows a reduction of the computing time and a better representation of crack.
- a method using a surface intermediate mesh of the lip of crack (`METHODE_PROPA='MAILLAGE'`): this method available in and in 3D for all element types is 2D finished. The initial crack must also be defined using a mesh.

Operator `PROPA_FISS` thus calculates crack resulting from a propagation in fatigue according to a local model of Paris, from preceding crack, and of the table of the factors of intensity of the stresses resulting from `CALC_G` or `POST_K1_K2_K3`.

For cracks in half-line (in 2D) or plane with rectilinear bottom (in 3D), the surface mesh of initial crack can be created by the operator `PROPA_FISS` (`METHODE_PROPA = "INITIALIZATION"`).

The produced operator:

- that is to say a concept of the `fiss_xfem` type defining propagated crack (case `METHODE_PROPA='SIMPLEXE'` or `"UPWIND"`);
- that is to say mesh of initial crack (case `METHODE_PROPA='INITIALIZATION'`);
- that is to say mesh of propagated crack (case `METHODE_PROPA='MAILLAGE'`).

The theoretical aspect of the propagation of the level-sets for the method X-FEM is approached in [R7.02.12].

## 2 Syntax

```
PROPA_FISS (

    ♦ METHODE_PROPA = "SIMPLEXE"
                    /"UPWIND"
                    /"MAILLAGE"
                    /"INITIALIZATION"
                    /"GEOMETRIQUE"

#Si METHODE_PROPA = "SIMPLEXE" or "UPWIND" or "GEOMETRIQUE"
    ♦ MODELS = Mo, [model]
    ♦ TEST_MAIL= /"NON" [DEFAULT]
                  /"OUI"
    # If TEST_MAIL=' OUI'
        ♦ ITERATIONS=/ iters, [I]
                          /5, [DEFAULT]
        ♦ TOLERANCE= /toler, [R]
                          /5.0, [DEFAULT]
    # Fine if
    ♦ ZONE_MAJ= /"TORE" [DEFAULT]
                /"TOUT"

    # If ZONE_MAJ=' TORE'
        ♦ RAYON_TORE= raytor, [R]

    ♦ CRACK = _F (
        ♦ FISS_ACTUELLE = fiss, [fiss_xfem]
        ♦ FISS_PROPAGEE = CO ("FISS"), [TXM]

        # If TEST_MAIL=' NON',
            sif ♦ TABLE= , [array]
                ♦ NB_POINT_FOND= nbptfd, [I]
        # End if
    ),

    ♦ DA_MAX = da, [R]
    ♦ RAYON= ray, [R]
    # If TEST_MAIL=' NON',
    ♦ COMP_LINE = F ( ♦COEF_MULT_MINI = cmin, [R]
                     ♦COEF_MULT_MAXI = cmax, [R]
    ),

#Si METHODE_PROPA = "MAILLAGE"
    ♦MAIL_STRUC=mast , [mesh]
    ♦ ITERATION= iter, [ I ]
    ♦DA_MAX = da, [R]

    ♦ CRACK = _F (
        ♦MAIL_ACTUEL =max1 [ mesh ]
        ♦FISS_ACTUELLE=FISS1 [
fiss_xfem]
        ♦MAIL_PROPAGE=CO ("max2"), [TXM]
        ♦GROUP_MA_FOND=/ "MELTS"
[DEFAULT]
        /grmaff [TXM]
        ♦GROUP_MA_FISS=/ "FISS" [DEFAULT]
        /grmafi , [TXM]
```

```

        ◆TABLE=sif , [array]

        ◆ MAIL_TOTAL=CO ("matot2"), [TXM]

        ◆ COMP_LINE = _F ( ◆COEF_MULT_MINI = cmin, [R]
                           ◆COEF_MULT_MAXI = cmax, [R]
                           ),
                           ),

#Si METHODE_PROPA = ' INITIALIZATION',
        ◆MAIL_STRUC=mast , [mesh]
        ◆FORMES_FISS = "DEMI_DROITE"
                    / "DEMI_PLAN"
                    / "ELLIPSE"
        ◇GROUP_MA_FOND=/ "MELTS"
[DEFAULT]
        /grmaff [TXM]
        ◇GROUP_MA_FISS=/ "FISS" [DEFAULT]
        /grmafi , [TXM]
        ◇MAIL_FISS=CO ("max2"), [TXM]
        ◆MAIL_TOTAL=CO ("matot2"), [TXM]

#Cas DEMI_DROITE (in 2D)
        ◆PFON= (xf, yf, zf), [1_R]
        ◆DTAN = (xt, yt, zt), [1_R]
#Cas DEMI_PLAN (in 3D)
        ◆POINT_ORIG= (xo, yo, zo), [1_R]
        ◆POINT_EXTR= (Xe, ye, ze), [1_R]
        ◆DTAN= (xt, yt, zt), [1_R]
        ◆NB_POINT_FOND=nbfond , [I]
#Cas ELLIPSE (in 3D)
        ◆CENTER= (xo, yo, zo), [1_R]
        ◆DEMI_GRAND_AXE=a , [R]
        ◆DEMI_PETIT_AXE=b , [R]
        ◆VECT_X= (vxx, vxy, vxz), [1_R]
        ◆VECT_Y= (vyx, vyy, vyz), [1_R]
        ◆ANGLE_ORIG=ango , [R]
        ◆ANGLE_EXTR=ange , [R]
        ◆NB_POINT_FOND=nbpf , [I]

#Fin if

# If (METHODE_PROPA = ' SIMPLEXE' or "UPWIND" and TEST_MAIL=' NON')
# or ( METHODE_PROPA = ' MAILLAGE')
◆LOI_PROPA=_F (
        ◆LOI=/ "PARIS",
        # If LOI=' PARIS'
        ◆ M = m, [R]
        ◆ C = C, [R]
        # End if

        ◆ MATER = my , [to subdue]
        ),
◇CRIT_ANGL_BIFURCATION=/ "SITT_MAX" [DEFAULT]
                    / "K1_MAX"
                    / "K2_NUL"
                    / "PLANE"
                    / "ANGLE_IMPO"

```

```
#Impression      of information
  ◇INFO=/0
                /1
                /2
)
```

[DEFAULT]

## 3 Operands commun runs with all the options

### 3.1 Operand METHODE\_PROPA

```
♦ METHODE_PROPA = "SIMPLEXE",  
/ "UPWIND",  
/ "MAILLAGE",  
/ "INITIALIZATION",  
/ "GEOMETRIQUE",
```

Three methods are available to make propagate a crack defined with the method X-FEM:

• **a method by numerical integration of the equations of propagation of crack tip** (METHODE\_PROPA=' SIMPLEXE' and "UPWIND"): for time method "UPWIND" is most reliable but it can be only applied to very regular meshes (see documentation of reference [R7.02.12]).

Method " SIMPLEXE " is not very robust yet but it can be applied to unspecified meshes. For more details concerning the algorithms relative to these methods, one will be able to refer to documentation of reference [R7.02.12].

• **a method using a surface intermediate mesh of the lip of crack** (METHODE\_PROPA=' MAILLAGE '): this method available in and in 3D for all element types is 2D finished.

The initial crack must also be defined using a mesh, with specific rules of naming. For example in 3D, the bottom is called FOND\_0 and contained the nodes NXA1 NXB1 ,...; the lip is called FISS\_0 and contained the meshes surface ones MXA1 MXB1 ,...; the surface mesh MXA1 contains the nodes NXA0 NXB0 , NXA1 and NXB1 .

• **a method using a purely geometrical approach** (METHODE\_PROPA=' GEOMETRIQUE '): this method using a vectorial propagation of the crack tip and its local base as well as an estimate of the distances compared to this last in this local base available in and in 3D for all element types is 2D finished without any restriction.

To facilitate the definition of this initial crack in the most usual cases (crack in half-line (in 2D) or planes with rectilinear bottom (in 3D)), it is necessary to use the method "INITIALIZATION".

#### Notice on the various methods:

*The method by numerical integration of the equations of propagation is theoretically most precise; the method of projection on an intermediate mesh is as for it more approximate, but it makes it possible to have very satisfactory results in particular for the propagations in mode I pure.*

*The purely geometrical method is a new method which was introduced recently. It is faster than the two other methods.*

These three methods are still in the course of validation.

### 3.2 Key word LOI\_PROPA

```
# If ( METHODE_PROPA = ' SIMPLEXE' or "UPWIND" or "GEOMETRIQUE" and  
RAFF_MAIL=' NON' )  
# or ( METHODE_PROPA = ' MAILLAGE' or "INITIALIZATION" )  
♦ LOI_PROPA=_F (   
    ♦ LOI=/ "PARIS",  
    # If LOI=' PARIS'   
    ♦ M = m, [R]
```

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

```
      ♦ C = C, [R]
      # End if
♦ MATER = my, [ to subdue ] ),
```

the key word factor `LOI_PROPA` defines the model of propagation used.

For time, the only model available is a model of Paris, in the following form:

$$\frac{da}{dN} = C \cdot \Delta K^m$$

The coefficients  $C$  and  $m$  of this model must obligatorily be indicated.

**The threshold of propagation of crack is not considered.**

**Note:**

*For time all the cracks of the model must propagate in the same material. In fact only one material can be given and it is used for all cracks of the model.*

*In more the model of Paris does not allow to consider the threshold of propagation of crack.*

**Caution:**

*The constants of the model of propagation must be given way such as the unit rate of advance  $da/dN$  is equal to  $L/cycles$ , where  $L$  is the unit used in the model for the length.*

### 3.3 Operand `DA_MAX`

```
♦DA_MAX=da, [R]
```

If there is only one crack in the model `Mo`, this operand defines the maximum advance of crack.

If there are several cracks in the model `Mo`, this operand defines the maximum advance of the crack which propagates more quickly. The number of cycles of fatigue is calculated by means of the velocity of the point of the bottom of the crack which propagates most quickly. This number of cycles is used for all cracks of the model.

### 3.4 Key word factor `COMP_LINE`

```
# If TEST_MAIL='NON',
♦ COMP_LINE = _F ( ♦ COEF_MULT_MINI= cmin, [R]
                  ♦ COEF_MULT_MAXI= cmax, [R]
),
```

parameters `COEF_MULT_MINI` and `COEF_MULT_MAXI` of operand `COMP_LINE` define the conditions of minimal and maximum loading of fatigue cycle. The two values are the constants by which one must multiply the loadings of the reference configuration to obtain the conditions of minimal and maximum loading of fatigue cycle. Thus if the selected reference configuration coincides with the condition of minimal or maximum loading, the value of `COEF_MULT_MINI` or `COEF_MULT_MAXI`, respectively, is equal to 1.

### 3.5 Key word factor `CRIT_ANGL_BIFURCATION`

```
◊CRIT_ANGL_BIFURCATION=/ "SITT_MAX" [DEFAULT]
/ "K1_MAX"
/ "K2_NUL"
/ "PLANE"
/ "ANGLE_IMPO"
```

This operand makes it possible to choose the criterion of computation of the angle of bifurcation:

*Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.*

- "SITT\_MAX" : criterion of the maximum circumferential stress (Maximum Hoop Stress criterion, [R7.02.05 §2.5.2]) it is the by default criterion. It is calculated starting from the values of K1 and K2. It is available in 2D and 3D.
- "K1\_MAX" , "K2\_NUL" : criteria of Amestoy, Bui and Dang-Van [R7.02.05 §2.5.1]. These 2 criteria are only available in 2D. The angle is given with a margin of 10 degrees. Attention, one notes that criterion "K2\_NUL" higher than does not function for an angle 60°.
- "PLANE" : defines a null angle corresponding to a plane propagation.
- "ANGL\_IMPO" : allows to choose an angle with beforehand calculated. In this case, one takes as angle that given in column BETA of the array in entry (array given under the key word COUNTS ). It is necessary thus for that the array in entry of PROPA\_FISS contains a column BETA .

## 3.6 Operand INFO

- /0 : printing on the file "MESSAGE"
  - of the stages of /1
- computati on : printing on the file "MESSAGE"
  - of same information as in INFO=1
  - method "UPWIND" and "SIMPLEXE": parameters of convergence of the loops and stages of enrichment of the SD fissures
  - method "MAILLAGE" and "INITIALIZATION": printing of the surface mesh of crack to the /2
- Aster format : Printing on the file "MESSAGE"
  - of very information as in INFO=1
  - method "UPWIND" and "SIMPLEXE": details of the computation of the fields and enrichment of the SD fissures
  - method "UPWIND": plugboard of the nodes of the grid of computation

## 4 Operands specific to methods SIMPLEXE, UPWIND and GEOMETRIQUE

### 4.1 Operand MODELE

◆ MODELE= Mo, [model]

Name of the model on which the crack to be propagated is defined.

### 4.2 Operand TEST\_MAIL

◆ TEST\_MAIL=/ "NON" [DEFAULT]  
/"OUI"

The mesh used for the representation of the level sets (mesh of the model  $M_0$ ) must be sufficiently refined for representing crack well. One can check it by means of operand TEST\_MAIL.

In case TEST\_MAIL=' OUI ', the same propagation velocity is assigned to all the points of the crack tips defined on the model  $M_0$ . All the cracks thus advance length given by operand DA\_MAX. If the mesh is sufficiently refined, the crack tip after the propagation must be homothetic at the bottom before the propagation. If that is not checked, the mesh must be refined.

The operand calculates several propagations of cracks of the model  $M_0$  (see operands DA\_MAX, ITERATIONS and TOLERANCE) and for each propagation it calculates the distance between the new bottom after the propagation and the bottom at the beginning of the propagation (see FISS\_ACTUELLE in the operand FISSURES). If the mesh of the model  $M_0$  or the auxiliary grid `griaux one` used for the representation of the level sets is sufficiently refined, the calculated distance must be equal in advance imposed DA\_MAX multiplied by the number of the current iteration. A small tolerance is used for this checking (see operand TOLERANCE). If that is not checked, a message of alarm is resulting by PROPA\_FISS.

**The resolution of the fissured model and the computation of the factors of intensity of the stresses are not necessary when this operand is used. The checking is thus very fast (see case test zzzz255a and zzzz255b).**

### 4.3 Operand ITERATIONS

# If TEST\_MAIL=' OUI '  
◆ ITERATIONS=/ iters, [I]  
/5, [DEFAULT]

This operand is used to give the iteration count (propagations) calculated during the test of the mesh (see operand TEST\_MAIL). For each iteration, the crack is propagated and outdistances it between the propagated crack tip and the bottom at the beginning of the propagation (see FISS\_ACTUELLE in the operand FISSURES ) is calculated and checked. It is strongly advised to use an equal nombre of iterations or higher than 5 because the numerical errors accumulate with each iteration.

### 4.4 Operand TOLERANCE

# If TEST\_MAIL=' OUI '  
◆ TOLERANCE= /toler, [R]  
/5.0, [DEFAULT]

This operand is used to give the tolerance, expressed like percentage, used in the test of the mesh (see operand `TEST_MAIL`). For each iteration of the test (see operand `ITERATIONS`), the maximum and minimal distance between the propagated bottom and the bottom at the beginning of the propagation (see `FISS_ACTUELLE` in the operand `FISSURES`) are calculated. Theoretically these distances are identical and their value is equal in advance imposed `DA_MAX` multiplied by the number of the current iteration. One thus calculates the difference between the distances maximum and minimal and the theoretical distance and one checks that the two calculated differences are lower than a limiting value. This limiting value is calculated like percentage length of the smallest edge of the elements of the mesh used for the representation of level sets. The percentage used is given by operand `TOLERANCE`.

## 4.5 Operand `ZONE_MAJ`

```
◇ ZONE_MAJ=/          "TORE"          [DEFAULT]  
                    /"TOUT"
```

This operand makes it possible of level sets. to select the zone used for the update One can choose to calculate on all the nodes of the model `M0` by means of `ZONE_MAJ=' TOUT'` or to limit the zone of computation to the nodes of the model `M0` which are in a torus built around the bottom of crack by means of `ZONE_MAJ=' TORE'`.

This last choice makes it possible to reduce strongly the computing time even if the mesh used for the representation of the level sets is not formed by a large number of meshes. In the case of propagation in mixed mode, the use of the restriction of update zone is strongly advised to improve the performance of computation and of the level sets to avoid the distortion, which can cause a fatal error during the update.

The computation radius of the torus of localization and its update with each propagation are made in an automatic way. However, if the size of the elements in the zone of propagation is not uniform, the calculated radius can be too small and an error message is resulting by the operator `PROPA_FISS`. In this case the user is obliged to give a value of the radius explicitly (see operand `RAYON_TORE`).

**The restriction of update zone can generate problems of convergence of the method simplex.** In this case the user must forcing use a radius of the larger torus of localization compared to that which was calculated automatically (written in card-indexing it `.mess`) (see operand `RAYON_TORE`) or to use all the mesh for computation (`ZONE_MAJ=' TOUT'`). On the other hand the method upwind is very stable and powerful and is not affected by this kind of problem.

## 4.6 Operand `RAYON_TORE`

```
# If ZONE_MAJ=' TORE'  
  ◇ RAYON_TORE= raytor,          [R]
```

This operand makes it possible to give the value of the radius of the torus used for the restriction of update zone of the level sets (see operand `ZONE_MAJ`). The radius of the torus is calculated automatically by the operator `PROPA_FISS` and the user is not obliged to use this operand. However the computed value can be too small in certain case, for example when the sizes minimal and maximum of the elements in the zone of propagation are very different between them. In all these cases, the user must forcing give the radius of the torus while following advise them contained in the error messages resulting by `PROPA_FISS`.

It should be noticed that the value of the radius cannot change much between two successive propagations (see R7.02.12 documentation for more details). Thus it is strongly advised to use the same value with each call of `PROPA_FISS` by giving the maximum value envisaged. The value of the radius must be always higher than a minimal value which can be estimated by calculating the addition of the values of the projection of crack (see operand `DA_MAX`) and of the radius of convergence (see operand `RADIUS`). However this value is also dependant in keeping

with elements in the torus and thus it is strongly advised not to use a value lower than that which was calculated automatically by PROPA\_FISS . An error is resulting by PROPA\_FISS if the radius given is not good compared to the propagation to be simulated and in keeping with elements of the mesh.

Caution: in the cases of cracks with several crack tips (for example in the case of a crack of type segment, in 2d, which have 2 crack tips); it is not necessary that T ore includes the other funds of crack (even if these other funds are “apart from the mesh”).

## 4.7 Key word factor FISSURES

This compulsory operand makes it possible to indicate the cracks of the model  $M_0$  which propagate.

### 4.7.1 Syntax FISSURES

```
♦ CRACK = _F (
  ♦ FISS_ACTUELLE = fiss, [fiss_xfem]
  ♦ FISS_PROPAGEE = CO ("FISS"), [TXM]

  # If RAFF_MAIL= "NON",
  #   if ♦ TABLE= , [array]
  #     ♦ NB_POINT_FOND= nbptfd, [I]
  # End if
),
```

### 4.7.2 Operand FISS\_ACTUELLE

```
♦ FISS_ACTUELLE = fiss, [ fiss_xfem ]
```

One gives the name of current crack to propagate. This crack must be already affected with the model  $M_0$  by means of operator MODI\_MODELE\_XFEM.

### 4.7.3 Operand FISS\_PROPAGEE

```
♦ FISS_PROPAGEE = CO ("FISS"), [ TXM ]
```

This operand makes it possible to define the name of propagated crack produces PROPA\_FISS by the operator. Result the product is a concept of the fiss\_xfem type defining propagated crack.

### 4.7.4 Operand COUNTS

```
# If ♦TABLE=sif TEST_MAIL='
NON' , [array]
```

This operand must be indicated with the table of the factors of intensity of the stresses out of bottom of crack given by operand FISS\_ACTUELLE. This table comes from operators CALC\_G. or POST\_K1\_K2\_K3.

In the basic case of multiple crack (see R7.02.12, paragraph “multiple Crack tip”), for which the bottom of crack is trained by several pieces, operator CALC\_G/POST\_K1\_K2\_K3 must be called several times, once for each piece (operand NUME\_FOND of CALC\_G/POST\_K1\_K2\_K3). One thus has several tables, a table for each piece, which must be combined in only one table which will be given to PROPA\_FISS in the operand COUNTS. For that, one can use operator CALC\_TABLE. For example, if the crack is formed by two pieces, the combination of the two tables can be realized in the following way:

```
SIF1 = CALC_G (THETA=_F (...
                                NUME_FOND= 1 , ),
                ...)
SIF2 = CALC_G (THETA=_F (...
                                NUME_FOND= 2 , ),
                ...)

SIF = CALC_TABLE (TABLE=SIF1,
                  ACTION= (_F (OPERATION=' COMB',
                                TABLE=SIF2,
                                NOM_PARA= ("NUME_ORDRE", "NUME_FOND"), ),
                            ),
                  );
```

and one uses SIF for operator PROPA\_FISS . This table is formed by the union of the two tables resulting by CALC\_G . An unspecified order can be used in the combination of the tables.

## 4.7.5 Operand NB\_POINT\_FOND

```
# If TEST_MAIL=' NON'
◇ NB_POINT_FOND =nbptfd , [I]
```

If operand NB\_POINT\_FOND were used in CALC\_G for the computation of the factors of intensity of the stresses, one must inevitably use this operand in PROPA\_FISS too.

**Operator PROPA\_FISS cannot check if this operand were used or not in CALC\_G or if the values given are correct. The user must thus pay attention to use this operand correctly!**

Operand NB\_POINT\_FOND accepts a list of values of integers. For each piece (see operand COUNTS ) of crack given by FISS\_ACTUELLE one must give a value of NB\_POINT\_FOND equal to the value used in CALC\_G . If the operand were not used in CALC\_G for a piece, one uses zero value. The order of the values of NB\_POINT\_FOND in the list is given by operand NUME\_FOND of CALC\_G . Examples are given at the end of this document.

## 4.8 Operand RADIUS

```
◇RAYON=ray , [R]
```

This operand is used to define the radius of the torus around the crack tip in which the residues will be estimated for the stages of rebootstraping and reorthogonalisation of level sets. This torus defines the zone where the level sets must be sufficiently close to functions of signed distances.

**The value of this radius must be always higher than the higher radius of integration of operator CALC\_G . Operator PROPA\_FISS cannot check if this condition is observed! The user must thus pay attention to use this operand correctly!**

## 5 Operands specific to the method MAILLAGE

### 5.1 Operands MAIL\_STRUC

◆MAIL\_STRUC=mast , [mesh]

This operand makes it possible to define the mesh of healthy structure (i.e without crack). Operand

### 5.2 ITERATION ◆

ITERATION=iter , [I] This

operand makes it possible to define the number of the iteration of the computation of propagation. The first iteration (propagation of initial crack) is iteration 1. This

operand facilitates the realization of computations: it is thus possible to start again a computation of propagation on a crack having already been propagated Nb\_init time . Operand

### 5.3 MAIL\_TOTAL ◆

MAIL\_TOTAL=CO ( "matot2"), [TXM] This

operand makes it possible to define the name of the total mesh, i.e the concatenation of the mesh of healthy structure (cf operand MAIL\_STRUC ) and of the mesh of propagated crack MAIL\_PROPAGATES. It is

this total mesh matot 2 which must be used to define the model and the new crack in DEFI\_FISS\_XFEM. Key word

### 5.4 factor FISSURES This compulsory

operand makes it possible to indicate the cracks of the model Mo which propagate . Syntax

#### 5.4.1 FISSURES ◆ CRACK

```
=_F (
    ◆MAIL
    _ACTUEL=max1 [ mesh ] ◆ FISS
    _ACTUELLE=FISS1 [ fiss_ xfem] ◆MAIL
    _PROPAGE=CO ("max2 " ), [TXM] ◆GROUP
    _MA_FOND=/ "MELTS " [DEFAULT] /grmaff
    [TXM] ◆GROUP
    _MA_FISS=/ "FISS " [DEFAULT] /grmafi
    , [TXM] =sif
    ◆TABLE , [ array ] ] CURRENT
```

#### 5.4.2 Operand MAIL\_ ◆MAIL

\_ACTUEL=max1 , [ mesh ] This operand

makes it possible to define crack which one wants to propagate using his surface mesh max1. The mesh of the crack max1 must comply with certain rules of naming, cf §4. CURRENT5

#### 5.4.3 operands FISS\_ , ARRAY See

the paragraphs §4.7.24.7.2 4.7.4.4.7.4

## 5.4.4 MAIL\_PROPAGATES ◇GROUP

```
_MA_FOND=/ "MELTS " [DEFAULT ] /grmaff
            [TXM] ◇GROUP
_MMA_FISS=/ "FISS " [DEFAULT ] /grmafi
            , [TXM] These operands
```

make it possible to indicate how will be called the mesh groups of the bottom and the lips (which will be successively, FOND\_0 etc FOND\_1 ). These keywords are essential to be able to use an unspecified mesh for the initial crack; and to be able to treat the case of multi-cracking. A value by default exists. Operands

## 5.4.5 GROUP\_MA\_FOND and GROUP\_MA\_FISS ◇MAIL

```
_PROPAGE=CO ("max2 " ), [TXM] This
```

operand makes it possible to define the name of the surface mesh corresponding to propagated crack. Operands

## 6 specific to the method INITIALIZATION Operands

### 6.1 MAIL\_STRUC ♦MAIL

`_STRUC=mast` , [ mesh ] This operand makes it possible to define the mesh of healthy structure (i.e without crack). Operands

### 6.2 FORM\_FISS ♦ FORM\_FISS

```
= "DEMI_DROITE          "/"DEMI_PLAN
      "/"ELLIPSE
      " This operand
```

make it possible to define the type of crack: a half-line in 2D or a crack planes with rectilinear bottom in 3D, or an elliptic crack in 3D. Case DEMI\_DROITE

### 6.3 : operands PFON and DTAN \_DTAN ♦PFON=

```
(xf,   yf, zf   ), [l_R] ♦          DTAN
= (xt , yt,  zt), [l_R] These       operands
```

make it possible to define the initial crack in 2D by giving the coordinate of the point of crack tip PFON and the direction of propagation of this one DTAN. Case DEMI\_PLAN

### 6.4 : operands PFON, POINT\_ORIG , POINT\_EXTR and NB\_POINT\_FOND ♦POINT

```
_ORIG= (xo, yo, zo   ), [l_R] ♦          POINT_EXTR
= (Xe, ye,   ze), [l_R] ♦          DTAN
= (xt , yt,   zt), [l_R] ♦          NB_POINT_FOND
=nbfond, [ I] These                operands
```

make it possible to define the initial crack in 3D by giving the coordinates of the points origin and end of the crack tip and the direction of propagation of this one DTAN. The crack tip will be discretized with nbfond nodes. Case ELLIPSE

### 6.5 : operands CENTER, DEMI\_GRAND\_AXE, DEMI\_PETIT\_AXE , VECT\_X, VECT\_Y, ANGLE\_ORIG, ANGLE\_EXTR and NB\_POINT\_FOND ♦CENTER

```
= (xo , yo, zo   ), [l_R] ♦          DEMI_
GRAND_AXE=a, [R] ♦          DEMI_
PETIT_AXE=b, [R] ♦          DEMI_
X= (vxx , vxy   , vxz), [l_R] ♦          VECT_
Y= (vyx , vyy   , vyz), [l_R] These ♦          VECT_
                                         operands
```

make it possible to define initial elliptic crack in 3D by giving the coordinates of the center of the ellipse, the values of the half-small axis and equatorial radius, of the vectors of directional sense of the plane of the ellipse. For more details concerning these key word, to see U4.82.08. ♦ANGLE

```
_ORIG=ango , [R] ♦          ANGLE
_EXTR=ange , [R] ♦          NB_POINT_FOND
= nbpf, [ I] ANGLE_ORIG
```

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

gives the position (in degrees) first point in reference (VECT\_X, VECT\_Y ) . ANGLE\_EXTR  
gives the position (in degrees) last point in reference (VECT\_X, VECT\_Y ) . NB\_POINT\_FOND  
indicates the number of point to be created along the crack tip. Operands

## 6.6 GROUP\_MA\_FOND , GROUP\_MA\_FISS See §

5.4.5 Operands 5.4.5

## 6.7 MAIL\_TOTAL see §

5.3 Operands 5.3

## 6.8 MAIL\_FISS Idem that

MAIL\_PROPAGE , to see § 5.4.4 Examples 5.4.4

## 7 of crack propagation with X-FEM Several

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benchmarks make it possible to validate the crack propagation with X-FEM in a plate: sslv315

- : propagation in 3D of a tilted crack; sslp318
- : propagation of a crack X-FEM not emerging solicited in mode; sslp319
- : propagation of two emerging cracks X-FEM solicited in mode; sslv319
- : propagation planes of a semi-elliptic crack