Structure of Data `sd_ligrel` and `sd_modele`

Summary:

The structure D E given `sd_modele` repré sente le result of the assignment of finite elements on the meshs of a grid.

A stru cture of data `sd_ligrel` is U do not list groups of finite elements in the same way standard.

Note: `sd_modele` is not the only structure of data being able to contain one `sd_ligrel` .

Contents

1 Structures of data in a few words

In short:

- one `sd_ligrel` contains a set of finite elements and/or static substructures. A finite element being the formed couple of a mesh (mesh of the grid or “late” mesh) and of a kind of finite element (`type_elem`),
- one `sd_ligrel` can contain static substructures: “activation” of super-meshs of `sd_maillage` [D4.06.01 §2]. If one `sd_ligrel` does not contain finite elements, then it must contain substructures.
- the meshs supporting the finite elements can be meshs of the grid or meshs additional (or late),
- one `sd_modele` one contains `sd_ligrel` ; but it can also exist one `sd_ligrel` in other SD; for example in one `sd_char_meca` [D4.06.04],
- to allow the parallelism of elementary calculations and the assemblies, one arranges oneself so that one can, in general, “to go up” of one `sd_ligrel` until one `sd_modele` (which contains `sd_partition`).
- in one `sd_ligrel`, a mesh of the grid can carry only one finite element to more (the object `.REPE`),
- with one `sd_ligrel` is associated one `PHENOMENON` and only one: ‘`MECHANICS`’, ‘`THERMICS`’,…
- with each `PHENOMENON` is associated a particular mode_local: ‘`DDL_MECA`’, ‘`DDL_THER`’ or ‘`DDL_ACOU`’. This mode_local determines (via the catalogue of `type_element`) ddls of the finite elements of `sd_ligrel` (objects `.PRNM` and `.PRNS`),
- one `sd_ligrel` (like one `sd_modele`) is always associated with one `sd_maillage`.

2 Tree structures

```
sd_ligrel    (K19)   .: =record

    (O)    '.NBNO':      OJB         S    V      I
    (O)    '.LGRF':      OJB         S    V      K8      long=2
    (O)    '.PRNM':      OJB         S    V      I

    | % if the sd_ligrel contains finite elements
       (O)    '.LIEL':     OJB        XC   V      I      NAKED ()

       (F) % if the sd_ligrel contains elements on meshs of          grid:
             '.REPE':     OJB          S    V      I

       (F) % if the sd_ligrel contains elements on meshs
       late:
             '.NEMA':     OJB          XC   V      I      NAKED ()

       (F) % if the sd_ligrel contains late nodes:
             '.PRNS':     OJB          S    V      I
             '.LGNS':     OJB          S    V      I

    | % if the sd_ligrel contains static substructures
       (O)    '.SSSA:     OJB         S    V      I

    | % if the sd_ligrel contains elements needing the vicinity
       (O)    '.NVGE:     OJB         S    V      K16 (long=1)


sd_modele    (K8)    .: =record

    (O)    '.MODELE'    :    sd_ligrel

    (F) % if it sd_modele contains finite elements:
           '.MAILLE'    :    OJB         S      V      I

    (F) % if it sd_modele comes from the order MODI_MODELE_XFEM :
           '$VIDE'      :    sd_modele_XFEM

    (F) % if the user wishes parallel elementary calculations:
           '.PARTIT'    :    OJB         S      V      K8
```

3 Contents of the objects JEVEUX sd_ligrel

3.1 Object '.LGRF'

'.LGRF' : S V K8 (long=2)

V (1) : name of the grid associated with sd_ligrel.
V (2) : name of sd_modele giving access one sd_partition (parallelism of elementary calculations). If this information is missing, one cannot parallel elementary calculations (nor assemblies).

The attribute 'DOCU' of this object contains: 'MECA'/'THER'/'ACOU'. This information makes it possible to determine the ddls carried by the nodes (objects .PRNM and .PRNS)

3.2 Object '.NBNO'

'.NBNO' : S V I (long=1)

Contient the number of late nodes of sd_ligrel

3.3 Object '.PRNM'

'.PRNM' : S V I

This object describes the degrees of freedom carried by the nodes of sd_ligrel. He takes account of the degrees of freedom brought by the finite elements and of those brought by the substructures.

That is to say:

V = .PRNM

nbno = many nodes of the grid
nec = many coded entireties necessary to the fundamental size associated with sd_ligrel
nec = (number of CMP (fundamental size)/ 30) +1

for I = 1, nbno :

V (nec* (i-1) +1)	1er coded entirety of the node I
V (nec* (i-1) +2)	2ème coded entirety of the node I
…	
V (nec* (i-1) +nec)	last coded entirety of the node I

3.4 Object '.LIEL'

'.LIEL': XC V I NAKED ()

The collection `.LIEL` contains the numbers of the meshs supporting of the finite elements. The elements are gathered by groups of elements in the same way standard (`GREL`) [D0.04.02]. An object of the collection corresponds to one `GREL`.

That is to say `I` I^{ème} `GREL SD_LIGREL`

```
V =.LIEL (I)
N = LONG (V) = 1+nbre
```
meshs of I^{ème} `GREL`

`V (1)`	number of the mesh associated with the 1er element of `GREL`
`V (2)`	number of the mesh associated with the 2ème element of `GREL`
…	
`V (n-1)`	number of the mesh associated with the last element with `GREL`
`V (N)`	number of the type of element associated with `GREL I` (object `&CATA.TE.NOMTE` [D4.04.01])

Important conventions :

- if the mesh is a mesh of the grid its number is stored such as it is.
- if the mesh is a late mesh, its number is stored with the minus sign (cf object `.NEMA`),
- the number of `GREL` of one `sd_ligrel` is worth: `NUITOC ('.LIEL')` (Attention: the collection can be oversize: `NMAXOC` ≥ `NUTIOC`)

3.5 Object `'.REPE'`

`'.REPE': S V I`

That is to say

`V = '.REPE'`
`nbma` = many meshs of the grid associated with `sd_ligrel LONG (V) = 2*nbma`

for `I = 1, nbma`
`V (2 (i-1) +1)` : number of `GREL` associated with the mesh `I` grid
`V (2 (i-1) +2)` : position in `GREL` mesh `I` grid

This object is l" 'opposite" of L' object `.LIEL` concerning the meshs of the grid

If I am a nonaffected mesh: `V (2 (i-1) +1) = V (2 (i-1) +2) = 0`

3.6 Object '`.NVGE`'

`'.NVGE' : S V K16 (long=1)`

`V (1):` name of `sd_voisinage` affected to `ligrel`

3.7 Object '`.SSSA`'

`'.SSSA' : S V I`

That is to say:

V = '.SSSA'

nb_sm = many super-meshs of the grid
LENGTH (V) = nb_sm + 3

V (i=1, nbsm)	/ 1 if the super-mesh I is affected ("active" under-structuring) / 0 if not
V (nbsm+1)	many super-meshs of the grid
V (nbsm+2)	many active substructures
V (nbsm+3)	many nodes of Lagrange of the grid

Note:
V (nb_sm+1) and V (nb_sm+3) do not have to be used any more, information existing already in the grid (object . TITHE).

3.8 Object '.NEMA'

'.NEMA' : XC V I NAKED

This collection describes the late meshs of sd_ligrel .

Il exists an object of collection by late mesh.

Caution :
This collection is perhaps oversize. The real number of late meshs is obtained by NUTIOC (.NEMA) .

That is to say:

nbmas = many late meshs of sd_ligrel
nbmas = NUTIOC (.NEMA)

for I = 1, nbmas

V = .NEMA (I)
N = LONG (V) = (many nodes of the mesh) + 1

V (L)	number of the 1er node of the mesh I
V (2)	number of the 2ème node of the mesh I
…	
V (n-1)	number of the last node of the mesh I
V (N)	number of the type of the mesh I

If the number of a node is negative, it is the opposite of the number of a late node of sd_ligrel (cf object . NBNO).

3.9 Object '.PRNS'

'.PRNS' : S V I

This object describes the ddls carried by the late nodes of `sd_ligrel`.

That is to say:

`V = .PRNS`
`nbnos` = many late nodes of `sd_ligrel`
`nec` = many coded entireties necessary to the fundamental size associated with `sd_ligrel`
`nec` = (number of `CMP` (fundamental size)/ 30) +1

for `I = 1, nbnos` :

V (nec* (i-1) +1)	1er coded entirety of the node I
V (nec* (i-1) +2)	2ème coded entirety of the node I
…	
V (nec* (i-1) +nec)	last coded entirety of the node I

"The small" piece of `.PRNS` concerning the node `I` is what one calls a Descriptor-Size [D4.06.05].

3.10 Object '.LGNS'

`'.LGNS' : S V I`

The length of this vector is higher than the number of late nodes of `sd_ligrel` (the object on - is dimensioned).

`V (INO)` : number indicating how the late node of Lagrange `INO` must be numbered (see `sd_nume_ddl`).

V (INO): 0	the node INO is not a node of Lagrange
V (INO): +1	the node INO is a node of Lagrange of the type "1". Il must be numbered before the physical ddls that it constrained.
V (INO): - 2	the node INO is a node of Lagrange of the type "2". Il must be numbered after the physical ddls that it constrained.
V (INO): - 1	the node INO is a node of Lagrange of the type "1". Il must be numbered after the physical ddls that it constrained.
V (INO): +2	the node INO is a node of Lagrange of the type "2". Il must be numbered before the physical ddls that it constrained.

3.11 Notice on the redundant objects of sd_ligrel

Certain objects of `sd_ligrel` can result from other objects. The purpose of this redundant information is to accelerate certain treatments (from the point of view of time CPU).

The object.`REPE` can result from.`LIEL` Objects.`PRNM` and.`PRNS` can result from.`LIEL`.`SSSA` and.`LGRF`

The routine `cormgi.f` allows to calculate.`REPE` The routine `initel.f` allows to calculate.`PRNM` and.`PRNS`.

4 Contents of the objects JEVEUX sd_modele

4.1 Object '.MESH'

'.MESH' : S V I

That is to say V = '.MAILLE'
LENGTH (V) = many meshs of the grid = nbma

for I = 1, nbma
V (I): number of the type of element carried by the mesh I
(= 0 if the mesh is not affected by a finite element)

4.2 Object '.LEFT'

'.LEFT' : S V long K8 = 1

V (1) : name of sd_partitioN describing the parallelism of elementary calculations.

4.3 Object '.XFEM'

'.XFEM' : S V long K8 = 1

V (1): name of preprocessings X-FEM (pre-conditioner) necessary; this is information available in the sd_modele_xfem.

5 Examples

5.1 SD sd_modele

```
MOTH=AFFE_MODELE (  MAILLAGE=MAIL,
     AFFE=_F (ALL = 'YES', MODELING = 'AXIS',  PHENOMENON = 'THERMAL'))
```

product:

```
--------------------------------------------------------------------------------
SEGMENT IMPRESSION OF VALUES >MOTH    .MAILLE                 <
      1 -          289          289          300          300          300
--------------------------------------------------------------------------------
IMPRESSION OF THE COLLECTION: MOTH    .MODELE    .LIEL
OBJECT IMPRESSION OF COLLECTION CONTIGUE>MOTH    .MODELE    .LIEL<  OC:      1
      1 -            1            2          289
OBJECT IMPRESSION OF COLLECTION CONTIGUE>MOTH    .MODELE    .LIEL<  OC:      2
      1 -            3            4            5          300
--------------------------------------------------------------------------------
SEGMENT IMPRESSION OF VALUES >MOTH    .MODELE    .NBNO        <
      1 -            0
--------------------------------------------------------------------------------
SEGMENT IMPRESSION OF VALUES >MOTH    .MODELE    .LGRF        <
      1 - >MAIL    <
--------------------------------------------------------------------------------
SEGMENT IMPRESSION OF VALUES >MOTH    .MODELE    .PRNM        <
      1 -            2            2            2            2            2
      6 -            2            0            0            0            0
…
     41 -            0            0            2            2            0
     46 -            0            0            0            0            0
     51 -            0            0            0            0            0
     56 -            0            0            0            0            0
     61 -            0            0            0
--------------------------------------------------------------------------------
SEGMENT IMPRESSION OF VALUES >MOTH    .MODELE    .REPE        <
      1 -            1            1            1            2            2
      6 -            1            2            2            2            3
```

5.2 SD sd_ligrel (load)

```
CHTH=AFFE_CHAR_THER (  MODELE=MOTH,
          TEMP_IMPO=_F (NODE = 'N4', TEMP = 100.0))
```

product:

```
--------------------------------------------------------------------------------
 SEGMENT IMPRESSION OF VALUES >CHTH    .CHTH.LIGRE.LGNS        <
      1 -            1           -2            0            0            0
      6 -            0            0            0
--------------------------------------------------------------------------------
 IMPRESSION OF THE COLLECTION: CHTH    .CHTH.LIGRE.LIEL
 OBJECT IMPRESSION OF COLLECTION CONTIGUE>CHTH    .CHTH.LIGRE.LIEL<  OC:      1
      1 -           -1           92
--------------------------------------------------------------------------------
```

```
 SEGMENT IMPRESSION OF VALUES >CHTH    .CHTH.LIGRE.NBNO        <
      1 -           2
--------------------------------------------------------------------------------
 IMPRESSION OF THE COLLECTION: CHTH    .CHTH.LIGRE.NEMA
 OBJECT IMPRESSION OF COLLECTION CONTIGUE>CHTH    .CHTH.LIGRE.NEMA<  OC:      1
      1 -           4           -1           -2            4
--------------------------------------------------------------------------------
 SEGMENT IMPRESSION OF VALUES >CHTH    .CHTH.LIGRE.LGRF        <
      1 - >MAIL    <
--------------------------------------------------------------------------------
 SEGMENT IMPRESSION OF VALUES >CHTH    .CHTH.LIGRE.PRNM        <
      1 -           0            0            0            2            0
      6 -           0            0            0            0            0
…
     61 -           0            0            0
--------------------------------------------------------------------------------
 SEGMENT IMPRESSION OF VALUES >CHTH    .CHTH.LIGRE.PRNS        <
      1 -          16           16
--------------------------------------------------------------------------------
```