

Data structures SD_FETI

Summarized:

Description of the data-processing objects allowing to represent decomposition in subdomains of a mesh (cf operator of decomposition `DEFI_PART_FETI` [U4.23.05]). This partitioning is intended to nourish a linear solver multidomaine of the type `FETI` (cf `FETI` solver [U4.50.01] [R6.01.03]).

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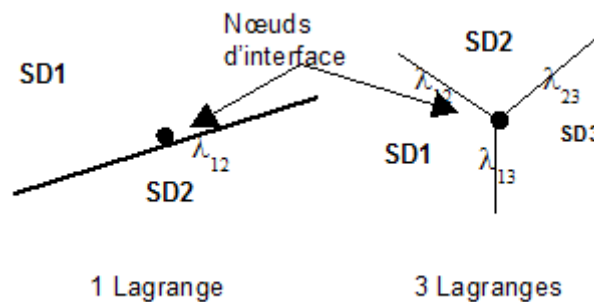
1 General information

an object of SD_FETI type are created by the operator `DEFI_PART_FETI` [U4.23.05] on the global database in order to represent decomposition in subdomains of a mesh. It must be provided the linear solver multi-fields `FETI` (key word `SOLVEUR/PARTITION`).

The size of this object is about $nb_ma_tot + 2 \times nb_no_tot + 12 \times nb_no_int + nb_sd$ (cf object. `DIME` for the notations).

This notion of partitioning `FETI` requires some explanations on the described entities. In short:

- **Meshes** of the `ligrel` of the **model** are divided into several **subdomains**. The latter thus consist of a set of meshes listed in object `.FETA`. A mesh can thus belong only to one subdomain: no the mesh divided into pieces or commune with several subdomains.
- The new borders generated by this cutting constitute **the interface**. **The nodes of interface** describing it are shared with at least two subdomains (**geometrical multiplicity of `FETI`**). The variables of interface `FETI` associated with these nodes ensure the continuity of the field of displacement between two subdomains (list `.FETJ`). It is all the difference between the primal interface (geometrical definition) and that dual (definition by connectivity) (cf [R6.01.03] §4.2).
- The resolution of problem `FETI` is carried out on a vector of unknowns, **Lagranges of interfaces `FETI`** (not to be confused with other Lagranges intervening in `Code_Aster`: conditions of Dirichlet, contacts...) (object. `FETI`), which lean on the nodes of interface. A node of interface corresponds as much of Lagranges "than it is necessary" to control continuity between the subdomains. For time, one retained a redundant definition of this dual interface: for example, in 2D, a node shared by 4 SD will produce 6 variables `FETI` instead of the 3 minimum. A Lagrange east required for each binomial of subdomains.



Appear 1-a: Illustration of Lagranges of interfaces in 2D with 2 and 3 subdomains

Notices important on the interfaces :

For time, one highly disadvises the use of an interface of size $N2$ compared to the dimension N of the problem. For example, a problem 3D ($n=3$), an interface of type segment enters a hexahedral subdomain and a penny S -field made up of shells.

*In addition, it is to better avoid "polluting" these interfaces by loadings, limiting conditions of Dirichlet type generalized, cracks, contact zones... **The developments** of `FETI` currently industrialized in the code, **ensures us of the good unfolding of the things only when these interfaces are relatively virgin of any particular processing**.*

2 Tree structures

```
SD_FETI (K19) :: =record
```

```

♦ ".FETG"           :           OJB           XD V I
♦ ".FETH"           :           OJB           S V I
♦ ".FETI"           :           OJB           S V I
♦ ".FDIM"           :           OJB           S V I
♦ ".FETA"           :           OJB           XD V I
♦ ".FETB"           :           OJB           XD V I
♦ ".FETJ"           :           OJB           S V I
♦ ".FLII"           :           OJB           XD V I
♦ ".FILM"           :           OJB           XD V I
♦ ".FLIN"           :           OJB           XD V K24
♦ ".FCFI"           :           OJB           XD V I
♦ ".FCFL"           :           OJB           XD V K24
♦ ".FCFM"           :           OJB           XD V I
♦ ".FCFN"           :           OJB           XD V I
♦ ".FREF"           :           Temporary      OJB S V

```

K8 % total objects of work to all process FETI (cf remarks §4)

```

♦ "&FETI.FINF"           :           OJB S V K24
♦ "&FETI.INFO.STOCKAGE.FID": OJB S V I ♦ "&FETI.INFO.STOCKAGE.
FVAF " :
OJB S V I ♦ "&FETI.INFO.STOCKAGE.FVAL": OJB S V I ♦
" &FETI.INFO.STOCKAGE.FNBN": OJB S V I ♦ " & FETI.INFO.CPU.FACN "
: OJB
S V R ♦ "&FETI.INFO.CPU.FACS": OJB S V R ♦ "
&FETI.INFO.CPU.ASSE ": OJB S V R ♦ " &FETI.INFO.CPU.ELEM " :
OJB
S V R ♦ "FETI.MAILLE.NUMSD": OJB S V I ♦ "
CALCUL.FETI.NUMSD": OJB S V L ♦ LIGREL _DE _CHARGE ( K19 ).
"FEL 1": OJB S V K24 ♦ LIGREL _DE _CHARGE
(K19). "FEL2": OJB S V I ♦ LIGREL
_DE_CHARGE (K19). "FEL3 " : OJB S V
| ♦ LIGREL_DE_CHARGE (K19). "FEL4" : OJB S V
| ♦ LIGREL_DE_CHARGE (K19). "FEL5": OJB S V
| ♦ "& FETI.LISTE.SD.MP I": OJB S V I ♦ "
& FETI.LISTE.SD.MP IB": OJB S V I ♦ " &FETI.PAS.TEMPS"
: OJB S V I ♦ "&FETI.MULTIPLE.SM.K24": OJB S V K24 ♦
" & FETI.MULTIPLE.SM.IN" : OJB S V I
♦ "&&FETI.MULT": OJB S V I Contained

```

Description JEVEUX objects of SDs and
interface .FDIM: S V I dim=5 Vector listing
of the quantities characteristic of the cut out model

```
. FDIM (1) = many nb_sd
```

3 subdomains. FDIM (2) = many

3.1 Lagranges of interface nb_no_int

. **FDIM** (3) = nombre total

of meshes of the mesh nb_ma_tot. FDIM (4) = number of DDLs of

interface nb_ddl_int. FDIM (5) = nombre total
of nodes of the mesh nb_no_tot. .FETA : XD V I LONG
= Nb_sd dispersed Collection enumerating the list of
meshes by subdomains (meshes voluminal and meshes
of skin associated to which apply a loading

) That is to say V I = .FETA (I

) VI (J) = number of the jème mesh of the ième subdomain. The LONMAX of VI is equal to the
number of meshes of the selected subdomain. .FETB: XD V I LONG=nb_sd dispersed

Collection describing

the nodes of the subdomains . That is to say VI = . FETB (I) VI (2 (

j-1) +1) = the number of the jème node of the ième subdomain. This number

is preceded by a sign

– if it is about a node of interface (VI (2 (j-1) +1) <

0), of a sign

+ if not . VI (2 (j-1) +2) = the number of DDLs jusqu' "to this node included. Thus
number of DDLs of the jème node S" written: If j=1nb_ddl_j=Vi (2), If not Nb_ddl_j=Vi (2
(j-1) + 2) – VI (2 (j-2) +2). The LONMAX
of VI is equal to twice the number of nodes of the selected subdomain: nb_no_j=LONMAX
/2. .FETG: XD V

I LONG =nb_sd dispersed
Collection simulating the action of the
operators

of restriction / prediction. That is to say Wi=.FETG (I) Wi (2 (j-1) +1) =indice of the jème
Lagrange of interface of

the ième subdomain in

the object. FETI This number must be signed louse to check the continuity of the unknown
field

to the interface

. Can imports sign convention provided that its logic is respected everywhere. One can
for example
make precede this index by a sign – if this Lagrange is divided with another

subdomain of number $k > j$ ($W_i(2(j-1)+1) < 0$), of a sign + if not. This convention is that selected by the operator `DEFI_PART_OPS [U4.23.05]`. $W_i(2(j-1)+2)$ = index of the same Lagrange in all the nodes (it is supposed coinciding with one of the nodes of interface of the mesh) of the selected subdomain `VI = '.FETB (I) "`

(thus `VI (W_i(2(j1)+2)) < 0`). The `LONMAX` of W_i is equal to twice the number of Lagrange "D" interfaces selected subdomain: `nb_no_int_j=LONMAX/2`.
`.FETH: S V I dim=nb_sd` Vector listing the numbers of DDLs per

subdomain (of the physical nodes and the late nodes of Dirichlet and contact continuous method). That is to say `X=.FETG X (I)`

= **number** of DDLs of the ième

subdomain. `.FETI: S V I dim= 4 * nb_no_int` Vector describing Lagranges of interface. That is to say `Y=.FETI Y (4(j-1)+1)` = number of the jème

Lagrange of interface . It must thus be present in two

". Negative FETB" (they exist

K, L, m and N such as `Y (4(j-1)+1) =-FETB`

`(K) (2(l-1)+1)`

= - `FETB (m) (2(N-1)+1)) Y (4(j-1)+2)` = its geometrical multiplicity `mult_j. Y (4(j-1)+3) =`

the number of DDLs until this node included . Thus number of DDLs is written: If `j=1nb_ddl_j=Y (3)`, If not `nb_ddl_j=Y (4(j-1)+3)` there `(4(j-2)+3)`. `Y (4(j-1)+4)` = index , in L "object. `FETJ` , of the first of the 2 subdomains comprising this Lagrange on one their interfaces

The other subdomains are after. `.FETJ: S V I dim`

= `somme_mult = 2*nb_no_int` Vector describing the list of the subdomains containing Lagranges "D" interfaces (dual interface). The access to this vector of storage

indirect and is carried out via pointer `.FETI`

`(4(j-1)+4)`. Description of the late entities related on Dirichlets and the nodal forces. `FLII: XD V I LONG=nb_sd` For l ème subdomain, is `X I =.FLII (I)` and J varying of 1 to `LONMAX (.FLIN`

3.2 (I) $X_i(2(j-1)+1)$ = number of meshes late of the J ème LIGREL of `.FLIN (I)`

, $X_i(2(j-1)+2)$ = many

these meshes late concerning this subdomain (because a LIGREL of load can be shared

between several subdomains). `.FILM : XD V I LONG =nb_sd` Liste of

the absolute values of meshes late concerning subdomain I, in the order preceded by the two preceding objects. FLIN and. FILM. This

object of collection is thus

length: .FLIN: XD V K24 LONG=nb_sd For a given subdomain, names of LIGRELS of load comprising of meshes late with late nodes (condition of Dirichlet...) or not (nodal force).

See
$$\left[\sum_{j=1}^{LONMAX(.FLIN(i))} X_i(2(j-1)+2) \right]$$

also objects .FEL1/

3 (cf § objets_connexes). Description of the physical entities related to contact-friction continuous method .FCFI: XD V I LONG=nb_sd For the ième subdomain, is Zi=.FCFI (I) and J varying of 1 to LONMAX (.

3.3 FCFL (I) Zi (2 (j-1) +1) = physiques number of meshes of contact (main and slaves

) of jème LIGREL of.

FCFL (I), Zi (2 (j-1) +2) = number of these meshes concerning this subdomain (because a LIGREL

of contact can be shared between several subdomains). .FCFL: XD V K24 LONG =nb_sd For a given subdomain, names of the LIGREL S of load dealing with the contact-CONTINUE 1). .FCFM : XD V I LONG=nb_sd Lists the meshes physical ones of contact (Masters

and slaves) concerning

subdomain I, in the order preceded by the two preceding objects. FCFL

and. FCFI . This object of collection

is thus length: .FCFN: XD V I LONG=nb_sd Lists physical nodes of contact (Masters and slaves) concerning subdomain I, in the order preceded by two objects preceding FCFL and

$$\left[\sum_{j=1}^{LONMAX(.FCFL(i))} Z_i(2(j-1)+2) \right]$$

. FCFI . Various .FREF: S

V K8 dim= 1 + nb_char (many loadings) listing Vector of the general characteristics of partitioning for possible checks (key word solver

3.4 VERIF

`_SDFETI`). FREF (1) = name of the model ,... FREF (1+i) = name

of l ème loading. Related objects Certain temporary objects of the volatile base exist during a good part of a resolution

FETI (i.e apart from the routine

leader `ALFETI.f`). They

4 are described in

D4.01.02 (underground data structures). Examples In the case test FETI009A, partitioning in 3 subdomains builds following `SD_FETI` named " SDFETI PRINTING"

5

=====

===== OF the CONTENU OF the OBJECTS FIND:

PRINTING OF THE COLLECTION: SDFETI .FCFI PRINTING SEGMENT OF VALUES
>SDFETI .FCFI\$\$NOM < >>>> NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD1 <>SD2 <>SD3 < PRINTING OBJET OF
COLLECTION >SDFETI .FCFI< OC: 1 > >>>>
1 - 12 4 PRINTING OBJET OF COLLECTION >SDFETI .FCFI
< OC: 2 >>>> 1 - 12 4 PRINTING OBJET OF
COLLECTION >SDFETI .FCFI
< OC: 3 >>>> 1 - 12 4 -----

PRINTING OF THE COLLECTION
: SDFETI
.FCFL PRINTING SEGMENT OF VALUES >SDFETI .FCFL \$\$NOM
< >>>>
> NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD1 <>SD2 <>SD3 < PRINTING OBJET OF
COLLECTION >SDFETI .FCFL< OC: 1 > >>>>
1 - >CH3 .CHME.LIGRE < PRINTING OBJET OF COLLECTION
>SDFETI .FCFL< OC: 2 >>>> 1 - >CH3 .CHME.
LIGRE < PRINTING OBJET
OF COLLECTION >SDFETI .FCFL< OC: 3 > >>>> 1 - >CH3
.CHME.LIGRE
< -----

PRINTING OF THE COLLECTION
: SDFETI .FCFM PRINTING SEGMENT OF VALUES >SDFETI
.FCFM
\$\$NOM < >>>> NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD1 <>SD2 <>SD3 < PRINTING OBJET OF
COLLECTION >SDFETI .FCFM< OC: 1 > >>>>
1 - 11 12 9 10 PRINTING OBJET OF COLLECTION > SDFETI
.FCFM< OC: 2 >>>> 1 - 15 16 13 14 PRINTING
OBJET OF COLLECTION
>SDFETI .FCFM< OC: 3 >>>> 1 - 19 20 17 18

PRINTING
OF THE COLLECTION :

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Code Aster

Version
default

Titre : Structures de données sd_feti
Responsable : Olivier BOITEAU

Date : 14/10/2010 Page : 9/11
Clé : D4.06.21 Révision : 4225

```
SDFETI .FCFN PRINTING SEGMENT OF VALUES          >SDFETI      .FCFN
$$$NOM
<          >>>>          > NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD1 <>SD2 <>SD3 < PRINTING OBJET OF
COLLECTION >SDFETI .FCFN< OC: 1 >          >>>>
1 - 28 8 21 7 26 6 - 6 27 5 PRINTING          OBJET
OF COLLECTION >SDFETI .FCFN< OC: 2 >>>> 1 -
    32 12 33      11 13      6 -      14
29 34 PRINTING OBJET OF COLLECTION          >SDFETI      .FCFN      <
OC:
    3 >>>          >>          1 -          19          38
    20 39          17 6          -
40 18 37 -----
```

```
                PRINTING
SEGMENT OF VALUES >SDFETI .FDIM < >          >>>> 1 - 3      12
218
    36 92 -----
```

```
PRINTING OF THE COLLECTION: SDFETI
.FETA PRINTING SEGMENT OF VALUES          >SDFETI
.FETA
$$$NOM          <          >>>          >> NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD1 <>SD2 <>SD3 < PRINTING OBJET OF
COLLECTION >SDFETI .FETA< OC: 1 >          >>>>
1 - 21 22 23 24 25 6 - 26 27 28          29 30 11 -
    31 32 33 34 35 16 - 36 37 38 39 40 21 -
    41 42 43      44 45      26 -      46
47 48 49 50 31 - 51 52 53 54          55 36 - 56 57
58 59
    60          41 -          61          62          63          64
    65          46          - 66          67          68
    69 70          51          - 71          72          73
    74 75          56          - 76          77          1          2
    3 61          -          4 9          10          11          12
PRINTING          OBJET          OF          COLLECTION
                >SDFETI          .          FETA          <
OC:          2 >>          >>>          1 -          78          79
80          81          82          6 -          83          84
85          86          87 11          -          88          89
90          91          92 16          -          93          94
95          96          97 21          -          98
99 100          101          102          26          -
103 104 105 106 107 31 - 108 109          110 111 112
36 - 113
    114          115          116          117          41
    -          118          119          120          121
122 46          -          123          124          125
126          127          51 -          128          129
130          131          132          56 -          133          134
13          14          15 61          - 16          PRINTING
OBJET          OF          COLLECTION          >SDFETI
.FETA          <          OC:          3 >>          >>>          1 -
135          136          137          138          139 6          -
140 141          142          143          144          11          -
145 146          147          148          149          16          -
150 151          152          153          154          21
- 155          156
157 158 159 26 - 160 161 162 163          164 31 -          165
166
    167          168          169          36 -          170          171
    172          173          174          41 -          175          176
    177          178          179          46 -          180          181
    182          183          184          51 -          185          186
    187          188          189          56 -          190          191
    192          193          194          61 -          195          196
    197          198          199          66 -          200          201
    202          203          204          71 -          205          206
    207          208          209          76 -          210          211
    212          213          214          81 -          215          216
    217          218          17          86 -          18          19
    20 5          6 91          - 7          8
-----
```

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.

```

          PRINTING          OF          THE COLLECTION
          :
          SEGMENT          SDFETI          .FETB          PRINTING          SDFETI
          FETB          OF          VALUES          >          >>
          FETB          $$NOM          <          >>>
          > NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD1 <>SD2 <>SD3 < PRINTING OBJET OF
COLLECTION >SDFETI .FETB< OC: 1 > >>>>
1 - 1 3 2 6 -3 6 - 9 -4 12 5          15 11 - 6 18
7 21 8 16 - 24 21 27 22 30 21 - 23 33 -24
36 -25 26 - 39 26
42 27 45 31 - 28 48 41 51 42 36 -          54 -43 57 49
60 41
-          50          63          -51          66
57          46          - 69          58          72
59 75          51          -          60          78
61 81          75          56          - 84          76
87 77          90          61          - 78          93          79
96 PRINTING          OBJET          OF
COLLECTION          >SDFETI          .FETB
< OC          : 2          >>>>          > 1          -          -3
3 -4          6          -9          6 -          9 -10
12 11          15          11          -          12          18
13 21          14          16          -          24          -24
27          -25          30          21 -          29          33
-30          36          -31          26          -
39 32 42 33 45 31 - 34 48 -43 51          44 36 - 54
-45 57
-51          60          41          -          52          63
-53          66          62          46          - 69
63 72          64          75          51          - 65
78 66          81          80          56 -          84          81
87          82          90 61          -          83          93
84 96          PRINTING          OBJET          OF
COLLECTION          >          SDFETI          .          FETB
< OC          :          3 >>>>          >>>          1 -          -9
3 -10          6          15          6 -          9          16
12 17          15          11          -          18          18
19 21          20          16          -          24          -30
27          -31          30          21 -          35          33
36          36          37          26 -          39
38 42 39 45 31 - 40 48 -45 51          46 36 - 54          47
57 48
60          41          -          -53          63          54
66          55          46          - 69          56
72 67          75          51          - 68          78
69 81          70          56 -          84          71          87
72          90 61          -          73          93          74
96          85 66          -          99          86          102
87          105          71          - 88          108
89 111          90          76          -          114          91
117          92          120

```

```

          PRINTING
          OF          THE COLLECTION          :
          SDFETI          .FETG          PRINTING          SEGMENT
          OF VALUES          >SDFETI
          FETG$$          NOM          < >>          >>> NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD1 <>SD2 <>SD3 < PRINTING OBJET OF
COLLECTION >SDFETI .FETG< OC: 1 > >>>>
1 - -1 3 -2 4 -5 6 - 12 -6 13          -9 19 11 - -11
22 PRINTING OBJET OF COLLECTION >SDFETI .FETG
< OC: 2 >>>>> 1 - 1
1 2 2 -3 6 - 3 -4 4 5 9 11 - 6          10 -7 12 -8
16 -
13 9          17          -10          19          21
- 11          20          -12          22          PRINTING
OBJET          OF
COLLECTION >SDFETI .FETG< OC: 3 >>>>          >> 1 - 3 1 4
2 7
6 -          9          8          10          10          17
11          -          12          21

```

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```
PRINTING SEGMENT OF VALUES >SDFETI          .FETH < >    >>
>> 1 -
      100          100          160
```

```
PRINTING SEGMENT OF VALUES >SDFETI
.FETI < >>>> 1 - 3 2 3 1 4 6 -          2 6          3
  9 2
    11 -          9 5          10          2
12 16 - 7 24 2 15 9 21 - 25 2 18 11 30 26 - 2 21 13 31 2 31 - 24
15 43 2 27 36 - 17 45 2 30 19          41 - 51
  2 33
    21          53          46          -          2          36
    23
```

```
                                PRINTING
                                OF          VALUES
                                >SDFETI          .FETJ          <
>>>>          1 -          1          2          1          2
  2 6 -          3          2          3 1          2          11
  - 1          2          2 3          2
16 - 3 1 2 2 3 21 - 1 2 2 3
```

```
PRINTING
OF
  THE COLLECTION          : SDFETI
  .FLII          PRINTING
SEGMENT          OF          VALUES          >
SDFETI          .          FLII          $$          NOM
< >>>>          > NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD3 < PRINTING OBJET OF COLLECTION >SDFETI
.FLII< OC: 1 >>>> 1 - 18          18
```

```
PRINTING OF THE COLLECTION
: SDFETI
.FILM PRINTING SEGMENT OF VALUES >SDFETI          .FILM $$NOM
< >>>
>> NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD3 < PRINTING OBJET OF COLLECTION >SDFETI
.FILM< OC: 1 >>>> 1 - 1          2 3
4 5 6 - 6 7 8 9 10 11 - 11 12          13 14 15 16
- 16 17 18
```

```
PRINTING          OF THE COLLECTION
: SDFETI
          .          FLIN          PRINTING
          SEGMENT          OF          VALUES
>SDFETI          .          FLIN          $$NOM
< >>>>          > NAME DIRECTORY
OF THE COLLECTION: SDFETI 1 - >SD3 < PRINTING OBJET OF COLLECTION >SDFETI
.FLIN< OC: 1 >>>> 1 - >CH2          .CHME
.LIGRE < -----
PRINTING SEGMENT
OF          VALUES
>SDFETI .FREF < >>>> 1 - >MODM          <>CH1 <>CH2
<>CH3
<
```