Data format sd_compor

Summarized:

One describes the data structure sd_compor here , resulting from L `call to command DEFI_COMPOR . Its contents vary according to the 3 use potential of the command:

- MONOCRISTAL;
- POLYCRISTRAL;
- MULTIFIBRE.

Contents

1 the data structure sd_compor for the monocrystals

command DEFI_COMPOR make it possible to build behaviors of monocrystals in "kit" in the following way: to a family of system of sliding, one associates a material, flow a model, an isotropic hardening, a kinematic hardening (possible), a kind of elasticity [U4.43.06]:

```
MONOCRISTAL = (_F (
    ♦ MATER= mat1, [to subdue]
    ♦ ECOULEMENT =        /"MONO_VISC1"
                          /"MONO_VISC2"
                          /"MONO_DD_KR"
                          /"MONO_DD_CFC"
                          /"MONO_DD_CC"
                          /"MONO_DD_FAT"
    ♦ ECRO_ISOT=          /"MONO_ISOT1"
                          /"MONO_ISOT2"
    ♦ ECRO_CINE=          /"MONO_CINE1"
                          /"MONO_CINE2"
    ♦ ELAS=               /"ELAS"
                          /"ELAS_ORTH"
    ♦ FAMI_SYST_GLIS =    /"BCC24",
                          /"OCTAEDRIQUE",
                          /"CUBIQUE1",
                          /"CUBIQUE2",
                          /"ZIRCONIUM",
                          /"UNIAXIAL"
   ◊ TABL_SYST_GLIS= tabsys,                          [array]
  ),),
◊ MATR_INTER=tabinter                                 [array]

◊ ROTA_RESEAU =   "NON"                             [DEFAULT]
                 /"POST"
                 /"CALC"
```

a monocrystal can be defined by several occurrences of key word MONOCRISTAL (5 at the most). That is used in practice to associate several sliding system families with a monocrystal.

The data structure sd_compor , transmitted to the routines of integration of these constitutive laws, contains this information:

```
sd_compor (K19) :: = record

              ".CPRK":       OBJ  S  V  K24
              ".CPRI":       OBJ  S  V  I          long=13
              ".CPRR":       OBJ  S  V  R          long= NBSYST*NBSYST
```

⇒ the object ". CPRI " contains 8 integers:

v (1)	Standard = 1 (means: monocrystal)
v (2)	Nb_phases = 1 (useless for the monocrystal)
v (3)	NVI = many local variables: NVI=9+3*NBSYS , NBSYS being the number of sliding systems total (sum amongst systems of each family) [R5.03.11].
v (4)	= 0 per default, 1 if a matrix of interaction is given via MATR_INTER
v (5)	Many occurrences of monocrystal = number from sliding system families
v (6)	= 1 if ROTA_RESEAU=' POST', 2 if ROTA_RESEAU=' CALC', 0 if not

v (7)	NVI
V (8)	Number of sliding systems total
V (9)	Many systems of the family 1, if TABL_SYST_GLIS is provided, 0 if not
V (10)	Many systems of the family 2, if TABL_SYST_GLIS is provided, 0 if not
V (11)	Many systems of family 3, if TABL_SYST_GLIS are provided, 0 if not
V (12)	Many systems of the family 4, if TABL_SYST_GLIS is provided, 0 if not
V (13)	Many systems of the family 5, if TABL_SYST_GLIS is provided, 0 if not

for example (test SSNV172):

```
PRINTING SEGMENT OF VALUES >COMPORZ4.CPRI                    <
 >>>>>
      1 -            1            1           99            1            5
      6 -            0           99           30            3            3
     11 -            6           12            6
```

⇒ the object ". CPRK " is the image (in the form of a vector of K16) of an array containing for each occurrence of key word MONOCRISTAL information below.

```
  FAMI_SYST_GLIS  NOM_MATER  ECOULEMENT  ECRO_ISOT  ECRO_CINE
  FAMI_SYST_GLIS  NOM_MATER  ECOULEMENT  ECRO_ISOT  ECRO_CINE
```

```
for example (test SSNV172):
 PRINTING SEGMENT OF VALUES >COMPORZ4.CPRK                     <
 >>>>>
      1 - >UTIL1___prism_a1<>ACIER1          <>MONO_VISC1      <
      4 - >MONO_ISOT1      <>MONO_CINE1      <>UTIL2___bas1    <
      7 - >ACIER2          <>MONO_VISC1      <>MONO_ISOT1      <
     10 - >MONO_CINE1      <>UTIL3___pyr_a   <>ACIER3          <
     13 - >MONO_VISC1      <>MONO_ISOT1      <>MONO_CINE1      <
     16 - >UTIL4___pyr_c_a <>ACIER4          <>MONO_VISC1      <
     19 - >MONO_ISOT1      <>MONO_CINE1      <>UTIL5___pyr2_c_a<
     22 - >ACIER5          <>MONO_VISC1      <>MONO_ISOT1      <
     25 - >MONO_CINE1      <>ELAS            <
```

One adds then the name of the elastic behavior (single for the monocrystal). The length of this object is thus 5*NBOCCM + 1 .

⇒ the object ". CPRR " is length 1800 (30*30 + 5*6*30). It contains:

-for each family of sliding systems, if TABL_SYST_GLIS is provided, definitions of the corresponding systems (6*nbsys values)
-the matrix of interaction given via MATR_INTER (dimension NBSYST*NBSYST)

```
for example (test SSNV172):
PRINTING SEGMENT OF VALUES >COMPORZ4.CPRR                    <
 >>>>>
      1 -  5.00000D+00  1.93000D+02  3.00000D+00  1.30000D+01  3.00000D+00
      6 -  3.10000D+01  6.00000D+00  4.90000D+01  1.20000D+01  8.50000D+01
     11 -  6.00000D+00  1.57000D+02  1.00000D+00  0.00000D+00  0.00000D+00
     16 -  0.00000D+00 -1.00000D+00  0.00000D+00 -5.00000D-01  8.66025D-01
….                                   Stamp interaction
    191 -  7.33481D-01  5.31671D-01  1.00000D+00  0.00000D+00  0.00000D+00
```

```
     196 -  0.00000D+00  0.00000D+00  0.00000D+00  0.00000D+00  0.00000D+00
     201 -  0.00000D+00  0.00000D+00  0.00000D+00  0.00000D+00  0.00000D+00
     206 -  0.00000D+00  0.00000D+00  0.00000D+00  0.00000D+00  0.00000D+00
...
```

2 the data structure sd_compor for the polycrystals

command DEFI_COMPOR allows to build polycrystalline behaviors (homogenized), built from monocrystals (s.d sd_compor), of the definition of the proportions of each single-crystal phase, with its directional sense, and of a model of localization/homogenization. POLYCRISTAL

```
= (_F
       (♦ MONOCRISTAL = mono1, [sd                    _compor] ♦
          FRAC_VOL = fvol, [R                        ] ♦
          /◊ ANGL_REP =   [L (α,β,γ)                _R]/
           ◊ ANGL_EULER = (phi1, phi, phi2) [L        _R]) LOCALIZATION
          =/"BZ",/
                        "BETA", #
                         if LOCALIZATION = BETA ♦
                            DL = dl, [R             ] ♦
                            DA = da, [R             ]),)
```

a polycrystal (homogenized) is defined by several occurrences of key word POLYCRISTAL . For each occurrence a single-crystal phase, definite corresponds by:

- the name of the s.d sd_compor resulting from a DEFI_ COMPOR precedent , proportion
- defined by the key word FRAC_VOL , down the direction
- of this monocrystal, laid by key words ANGL_REP (nautical angles) or ANGL_EULER . One defines

moreover the method of localization and possibly the parameters associated. The data structure

sd_compor , transmitted to the routines of integration of constitutive law POLYCRISTAL , contains this information: sd_compor

```
(K19):: = record ".CPRK
                ": OBJ    S V  K24  "  .CPRI
                ": OBJ    S V  I  ".CPRR
                ": OBJ    S V  R  ⇒  L
```

"object ". CPRK " stores information below: One defines
moreover the method of localization and possibly the parameters associated. V (1)

loca	= name of the method of localization V (1+1
) mono1	= name of monocrystal 1, C" is to be said sd_compor associated V (1+2
) nbfam	1 = number of sliding system families with mono1 V (1+2
+1) beginning	of the recopy of the object mono1 .CPRK…
V (1+2	
+5*nbfam1+1) fine of	the recopy of the object mono2 .CPRK V (1+2
+5*nbfam1+2)	= name of monocrystal 2, i.e. sd_compor associated V (1+2

mono2	
+5*nbfam1+3) nbfam	2 = number of sliding system families with mono2 V (1+2
+5*nbfam1+4) beginning	of the recopy of the object mono2 .CPRK etc…
dimension	

of this object is: 1 + sum (2+ length of the .CPRK of mono_i) the number of different monocrystals is noted nbmono . for example

```
(test SSNV172): PRINTING
SEGMENT OF VALUES >COMPORZ5.CPRK < >>>                    >>
 1 - >
      BETA <>COMPORZ            4 <> 5        < 4               - >
      UTIL1___prism_a1<>ACIER1 <>MONO          _VISC1 < 7 -       >
      MONO_ISOT1 <>MONO       _CINE1 <>UTIL     2___bas1 < 10     -
     >ACIER2 <>MONO           _VISC1 <>MONO     _ISOT1 < 13       -
     >MONO_CINE1 <>UTIL       3___pyr_a <>ACIER  3 < 16           -
     >MONO_VISC1 <>MONO       _ISOT1 <>MONO     _CINE1 < 19       -
     >UTIL4___pyr_c_a <>ACIER4 <>MONO          _VISC1 < 22       -
     >MONO_ISOT1 <>MONO       _CINE1 <>UTIL     5___pyr2_c_a< 25 -
     >ACIER5 <>MONO           _VISC1 <>MONO      _ISOT1 < 28      -
     >MONO_CINE1 <>ELAS       < ⇒           L
```

"object ". CPRI " is length 7+3*nbphases : V (1)

Standard	= 2 (means : polycrystal) V (2)
nbphases	= many phases: number D" occurrences of key word POLYCRISTAL V (3)
NVITOT	= total number of local variables V (4)
many	different monocrystals V (4+1
) nbfam	1: number of sliding system families of phase 1 (occurrence 1) V (4+2
) number	of the monocrystal associated with phase 1 (including between 1 and nbmono) V (4+3
) NVI1	many local variables of the monocrystal associated with phase 1 V (4+3
+1) nbfam	2: number of sliding system families of phase 2 (occurrence 2) V (4+3
+2) number	of the monocrystal associated with the phase 2 (including between 1 and nbmono) V (4+3
+3) NVI2	many local variables of the monocrystal associated with the phase 2… etc
.	V (4+3
*nbphases+1) dimension	of the object. CPRK V (4+3
*nbphases+2) many	parameters associated with the model with localization. for example

```
(test SSNV172): PRINTING

SEGMENT OF VALUES >COMPORZ5.CPRI < >>>                    >>
```

```
 1 -
      2 1            110                    1 5            6 -
      1 99            29          2           0            ⇒              L
```

“object “. CPRR ″ is length 2+4*nbphases (+ nbsyst *nbsyst if TABL_ SYST_GLIS is provided , therefore so V (4+3 *nbphases+3) is non-zero). V (1)

frac_	vol_1: voluminal fraction of phase 1 V (2)
1st phase	1 V (3)
2nd	phase 1 V (4)
3rd	phase 1 V (4+1
) frac_	vol_2: voluminal fraction of phase 2 V (4+2
) 1st phase	2 V (4+3
) 2nd	phase 2 V (4+4
) 3rd	phase 2… etc
.	V (4*nbphases
+1) dl =	parameter of localization (for method BETA) V (4*nbphases
+2) da =	parameter of localization (for method BETA) for example

```
(test SSNV172): PRINTING

SEGMENT OF VALUES >COMPORZ5.CPRR < >>>                    >>
 1 -
      1.00000  D+00 0.00000  D+00 0.00000  D+00 0.00000  D+00 0.00000  D+00
6 -
      0.00000  D+00 Note
```

: angles

stored in L” object. CPRR are measured in degrees and they correspond to the nautical angles. The data structure

3 sd_compor for the multifibre beams In

the case of the multifibre beams, command DEFI_ COMPOR makes it possible to associate with each group of fibers a behavior, a material, and assumptions on the strains and the processing of the relations 1D. For an example of use of key word MULTIFIBRE to see the test ssnl119 A. the data structure

sd_compor , transmitted to the routines of integration of the constitutive laws for each fiber, contains following information: sd_compor
(K19):: = record ".CPRK
": OBJ S V K24 " .CPRI
": OBJ S V I ⇒ L

"object ". CPRK " is a vector of K24, containing for each occurrence of key word MULTIFIBRE , (thus each constitutive law) and for each well informed group of fibers D" an occurrence information above: •grfib
1 = name of the group of fibers defined by DEFI_ GEOM_FIBRE •MATER
1= name of the material associated with the group with fibers grfib 1 •loifib
1= associated name of the constitutive law •Algorithm
1D = processing of the behavior 1D •DEFORMATION
= assumption on the strains •nfib
= many fibers of the group of fibers grfib 1 For

the groups of fibers which are not indicated in any occurrence of key word MULTIFIBRE , grfib 1 contains the name of the group well, but MATER 1 contains "vacuum " AND LOIFIB 1, Algorithme1 D, DEFORMATION and nfib are empty. During the checking of the coherence of data structure have makes sure that if MATER 1 is "empty ", LOIFIB 1, Algorithme1 D, DEFORMATION , nfib are also "empty ". THE LAST

element of this table is the name of the material containing the useful characteristics for torsion. The length of the object. CPRK is thus : 6*nbgmax +1. ⇒ L
"object ". CPRI " contains 3 integers: •Type
= 3 (means : MULTIFIBRE) • Maximum
NVIMAX = many local variables for L" together of the affected constitutive laws •NBGMAX
= maximum number of groups of fibers (= many groups of fibers present in the concept geom_ fiber in entry of DEFI_ COMPOR). Command file

4 examples

4.1 for MONOCRISTAL the commands

below make it possible to illustrate the contents of the sd_compor for a behavior monocrystal: COMPOR

```
1=DEFI_COMPOR (MONOCRISTAL
            = (_F (MATER
                =ACIER, ECOULEMENT
                   = ' MONO_VISC1', ECRO_
                   ISOT=' MONO_ISOT1', ECRO_
                   CINE=' MONO_CINE1', ELAS=
                   "ELAS", FAMI_
                   SYST_GLIS=' OCTAEDRIQUE',),),); Printing
```

4.2 of the data structure ====>

```
IMPR_CO OF Data structure: COMPOR1?????????????? ATTRIBUT
 : F CONTENU   : T BASE   : >G< MANY
 OBJECTS (OR COLLECTIONS) FIND: 2 ===                    ==

========================================================================== PRINTING
  OF THE CONTENU OF THE OBJECTS FIND:
--------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >COMPOR1 .CPRI < >>>                  >>
 1 -
      1 1            44            1           1            6 -
      1 44
--------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >COMPOR1 .CPRK < >>>                  >>
 1 - >
      OCTAEDRIQUE <>ACIER     <>MONO           _VISC1 < 4 -      >
      MONO_ISOT1 <>MONO       _CINE1 <>ELAS     < ===            =>
 FIN IMPR_CO OF DATA STRUCTURE: COMPOR1?????????????? Command file
```

4.3 for POLYCRISTAL the commands

below make it possible to illustrate the contents of the sd_compor for a behavior homogenizes polycrystal (test SSNV171 B) leaning on the preceding monocrystal: COMPORP

```
=DEFI_COMPOR (POLYCRISTAL= (_F (MONOCRISTAL
                                =COMPOR1, FRAC_
                                   VOL=0.25, ANGL_
                                   REP= (30. , 0. , 0.)), _F (MONOCRISTAL
                                =COMPOR1, FRAC_
                                   VOL=0.25, ANGL_
                                   REP= (20. , 0. , 0.)), _F (MONOCRISTAL
                                =COMPOR1, FRAC_
                                   VOL=0.25, ANGL_
                                   REP= (10. , 0. , 0.)), _F (MONOCRISTAL
                                =COMPOR1, FRAC_
                                   VOL=0.25, ANGL_
```

```
                                        REP= (40. , 0. , 0.)),), LOCALIZATION

                                  = ' BETA', DA=0., DL=0.,); Printing
```

4.4 of the data structure ====>

```
IMPR_CO OF Data structure: COMPORP???????????????? ATTRIBUT
 : F CONTENU   : T BASE   : >G< MANY
 OBJECTS (OR COLLECTIONS) FIND: 3 ===                    ==

================================================================================
PRINTING
  OF THE CONTENU OF THE OBJECTS FIND:
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >COMPORP .CPRI < >>>                    >>
 1 -
      2 4            176                      1 1            6 -
      1 44            1           1             44            11           -
     1 1             44           1             1            16            -
     44 9            2
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >COMPORP .CPRK < >>>                    >>
 1 - >
      BETA <>COMPOR            1 <> 1         < 4                - >
      OCTAEDRIQUE <>ACIER     <>MONO           _VISC1 < 7 -       >
      MONO_ISOT1 <>MONO      _CINE1 <>ELAS      <
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >COMPORP .CPRR < >>>                    >>
 1 -
      2.50000  D-01 3.00000  D+01 0.00000  D+00 0.00000  D+00 2.50000  D-01 6 -
      2.00000  D+01 0.00000  D+00 0.00000  D+00 2.50000  D-01 1.00000  D+01 11 -
     0.00000  D+00 0.00000  D+00 2.50000  D-01 4.00000  D+01 0.00000  D+00 16 -
     0.00000  D+00 0.00000  D+00 0.00000  D+00 ====>
 FIN IMPR_CO OF DATA STRUCTURE: COMPORP???????????????? Command file
```

4.5 for MULTIFIBRE the commands

below make it possible to illustrate the contents of the sd_compor for a multifibre behavior (test SSNL119 A): GF=DEFI

```
_GEOM_FIBER (FIBER = (_F (GROUP_FIBRE=' SACI', CARA
                          = "DIAMETRE", COOR_AXE_POUTRE
                          = (0. , 0. ,), VALE
                          = (0.066,-0.218,32.E-3, -0.066
                                , -0.218,32.E-3, 0.066
                                 , 0.218,8.E-3, -0.066
                                , 0.218,8.E-3,),),), SECTION

                    = _F (GROUP_FIBRE=' SBET', MAILLAGE_SECT
                          = MASEC, TOUT_SECT
                          = "OUI', COOR_AXE_POUTRE
                          = (0. , 0. ,),),) MOPOU
```

```
=AFFE_MODELE (MAILLAGE=MAPOU, AFFE=
                  _F (TOUT=' OUI', PHENOMENE
                  = ' MECANIQUE', MODELISATION
                  = ' POU_D_EM',),); BETON

=DEFI_MATERIAU (ELAS=_F (E=3.7272000000E10, NU=0.0, RHO=2400.0  ,), LABORD
     _1D=_F (Y01 = 310. , Y02 = 0.070E+5, A1 = 9.E  - 3, A2 =  .52  E-5, B1
=
1.2  , B2 =  2.  , BETA1 = .1E  +7, BETA2  = -.4  E+  8, SIGF = 3.5E+6))
ACIER

=DEFI_MATERIAU (ELAS=_F (E=2.E11, NU=0.0  , RHO=7800.0,), ECRO_
                    LINE=_F (D_SIGM_EPSI=3.28E9, SY=4.E8,),); MATOR

=DEFI_MATERIAU (ELAS=_F (E=2.E11, NU=0.0  , RHO=7800.0,),); POUCA


=AFFE_CARA_ELEM (MODELE=MOPOU, INFO=1, POUTRE
           =_F (GROUP_MA= (“POUTRE”), SECTION
                    = ' RECTANGLE', CARA=
                    (“HY”, “HZ”), VALE=
                    (0.2, 0.5), PREC_
                    AIRE=5., PREC_
                    INERTIE=10.,), ORIENTATION

           =_F (GROUP_MA= (“POUTRE”), CARA=
                         “ANGL_VRIL”, VALE=
                         - 90.0,), GEOM_
           FIBER=GF, MULTIFIBRE
           = (_F (GROUP_MA= (“POUTRE”), GROUP
                        _FIBER= (“SBET”, “SACI”)),));
                     COMPPMF


=DEFI_COMPOR (GEOM_FIBRE=GF, MATER
                   _SECT=MATOR, MULTIFIBRE
                    = (_F (GROUP
                                 _FIBER=' SACI', MATER
                                    =ACIER, RELATION
                                    = ' VMIS_CINE_LINE'), _F (GROUP
                                 _FIBER=' SBET', MATER
                                    =BETON, RELATION
                                    = ' LABORD_1D'),),)
                                  IMPR
                     _

CO (CONCEPT=_F (NOM=COMPPMF)) Printing
```

4.6 of the data structure ====>

```
IMPR_CO OF Data structure: COMPPMF???????????????? ATTRIBUT
 : F CONTENU   : T BASE   : >G< MANY
 OBJECTS (OR COLLECTIONS) FIND: 2 ===                    ==

================================================================================
PRINTING
```

```
  OF THE CONTENU OF THE OBJECTS FIND:
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >COMPPMF .CPRI < >>>                    >>
 1 -

      3 7            2
--------------------------------------------------------------------------------
PRINTING

 SEGMENT OF VALUES >COMPPMF .CPRK < >>>                    >>
 1 - >
      SBET <>BETON            <>LABORD            _1D < 4 -       >
      ANALYTIQUE <>PETIT      <> 40           < 7               - >
      SACI <>ACIER            <>VMIS            _CINE_LINE < 10  -
     >ANALYTIQUE <>PETIT      <> 4            < 13               -
     >MATOR < ===           =>
 FIN IMPR_CO OF Data structure: COMPPMF???????????????
```