

Structures of data sd_fonction

Summary:

Types of concepts `sd_fonction` functions (with the mathematical direction of the term) of one or two variables represent.

`functions` actual values, they have `fonction_C` complex values. In the continuation of this document, one will speak only about the functions with actual values (`function`) by knowing that all can be transposed to `fonction_C`.

A function is by "tabulée" nature: i.e. that it is known only in certain points. In this case, its evaluation can require an interpolation or an extrapolation.

A formula "is interpreted": its representation (structure of data) then contains the mathematical expression of the function.

Notice :

A formula can be tabulée (for certain values of its variable) by the order `CALC_FONC_INTERP`. For a tabulée function, the evaluation in a point different from the points of tabulation can be done by interpolation or extrapolation. A formula can have variables as many as necessary. On the other hand, the tabulées functions can only have 0, 1 or 2 variables. One will speak then about "constant function", "function" or "tablecloth". The variables of a function (as its result) "are typified": 'TEMP', 'INST', 'EPSI', ... One will speak then about the name of the parameters and the result.

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1 Structure of data

```
Function (k19):
  F          '$VIDE': TITLE
  ◆          '.PROL': OJB      S V K24

  | % if the function is interpreted (formula):
  ◆          '.NOVA': OJB      S V K24

  | % if the function is tabulée:
  / % if constant function or function:
  ◆          '.VALE': OJB      S V R

  / % if tablecloth:
  ◆          '.PARA'   : OJB      S V R
  ◆          '.VALE'   : OJB      XC V R
```

2 Contents of the basic objects

2.1 Object .PROL

The object “.PROL ” is length 6 for the tabulées functions of 0 or 1 variable and the formulas. It is length $7+2*nf$ for the tablecloths, if nf is the number of functions composing the tablecloth.

.PROL (1)

Type of the function.

```
'CONSTANT'   : constant function
'FUNCTION'    : fonction_1 real
'FONCT_C'     : fonction_1 complex
'TABLECLOTH' : function with 2 variables (tablecloth)
'INTERPRE'    : interpreted function (formula)
```

.PROL (2) = 'XXX FF'

Type of interpolation wished between the points of tabulation. Relate to only the tabulées functions. XXX relate to the parameter and FF the function. The possibilities are:

- 'FLAX': linear interpolation,
- 'LOG': interpolation logarithmic curve.

That is to say a function $f(x)$.

One will make a linear interpolation between the two points framing the sought point, but for this linear interpolation, one will use possibly the logarithm of x or of f .

For example if 'FLAX LOG', one will use x and $\log(f)$.

Note:

| For a tablecloth, XXX relate to also the second parameter of the function.

.PROL (3)

Name of the parameter.

- 'TOUTPARA' for a constant function,
- name of the parameter (i.e of the variable) for a function,
- name of the second parameter for a tablecloth,
- " (vacuum) for a formula.

.PROL (4)

- name (or type) of the result of the function,
- TOUTRESU'.

.PROL (5)

"Prolongation" desired with the function apart from its field of tabulation (extrapolation). Relate to only the tabulées functions.

'xy' where X and there = 'E' or 'L' or 'C'.

X : prolongation "on the left" (for a parameter lower than the smallest parameter of the tabulation),
there : prolongation "on the right" (for a parameter higher than the greatest parameter of the tabulation).

'E': excluded prolongation, 'C': constant prolongation, 'L': linear prolongation (starting from the two first or of the last two points).

For a tablecloth, these prolongations relate to the second parameter (values of the object . PARA). There does not exist prolongation "logarithmic curve".

.PROL (6)

Name of the function or the tablecloth. This is used at the fine bottoms of the code to clarify error messages or alarms whereas one does not have any more access to the concept function of the user (case of coded material).

.PROL (7)

Only for the tablecloths: name of the parameter of the functions composing the tablecloth (NOM_PARA_FONC of DEFI_NAPPE).

.PROL (8)

Type of interpolation wanted for the first function composing the tablecloth ('FLAX LOG', 'LOG LOG',...) (see ".PROL (2)").

.PROL (9)

Type of prolongation wanted for the first function composing the tablecloth ('EL', 'DC',...) (see ".PROL (5)").

.PROL (10)

Type of interpolation wanted for the second function composing the tablecloth... and following.

2.2 Object “. PARA“

This object contains the values of the second variable of the tablecloth. With each value of this second variable corresponds an object of the collection ".VALE " who contains the values of the function associated with this variable.

2.3 Object “. VALE“

2.3.1 Case of a function

For one function, this object contains the digital values of the points of tabulation. That is to say n : number points of tabulation,

- $V(1, \dots, n)$: X-coordinates of the points,
- $V(n+1, \dots, 2*n)$: values of the function at the points.

Note: If the function is with complex values, storage is the following:

- $V(n+1)$: real part function at the 1st point,
- $V(n+2)$: imaginary part function at the 1st point,
- $V(n+3)$: real part function at the 2nd point,
- $V(n+4)$: imaginary part function at the 2nd point,
- ...
- $V(3*n)$: imaginary part function at the last point.

The number of points of discretization (n) can be obtained by division by 2 (or 3) of the attribute "LONMAX" object. ".VALE "

2.3.2 Case of a tablecloth

For a tablecloth, this object is a contiguous numbered collection. Each object i of collection the same structure has as the " object.VALE " functions (above). It describes the function attached to the value i second variable of the tablecloth.

2.4 Object “. NOVA“

This object contains the name of the variables of the function "formulates".

3 Examples

3.1 Constant function: f1

3.1.1 Command file

```
f1=DEFI_CONSTANTE (VALE=1.2,  
                  NOM_RESU=' nom_res1',)  
  
IMPR_CO (CONCEPT=_F (NOM=f1,),);
```

3.1.2 Contents of the objects

```
=====> IMPR_CO OF THE STRUCTURE OF DATA: f1      ??????????????????  
ATTRIBUTE: F CONTENTS: T BASE: >G<  
MANY OBJECTS (OR COLLECTIONS) FIND:                3
```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

```
SEGMENT IMPRESSION OF VALUES >F1                .PROL          <  
  
1 - >CONSTANT                <> LIN LIN          <  
3 - >TOUTPARA                <>nom_res1        <  
5 - >CC                      <>f1              <
```

```
SEGMENT IMPRESSION OF VALUES >F1                .TITR          <  
  
1 - >ASTER  9.02.12 CONCEPT f1 CALCULATES 3/4/2008 A 13:38: 41 OF TYPE  
<  
2 - >FONCTION_SDASTER  
<
```

```
SEGMENT IMPRESSION OF VALUES >F1                .VALE          <  
  
1 - 1.00000D+00 1.20000D+00  
=====> FINE IMPR_CO OF STRUCTURE OF DATA: f1      ??????????????????
```

3.2 Tabulée real function: f2

3.2.1 Command file

```
lpara=DEFI_LISTE_REEL (DEBUT=3.0, INTERVALLE=_F (JUSQU_A=6.0, NOMBRE=3,))  
lfonc=DEFI_LISTE_REEL (DEBUT=3.2, INTERVALLE=_F (JUSQU_A=6.2, NOMBRE=3,))  
  
f2=DEFI_FONCTION (TITRE=' this is a titre',  
                  INTERPOL='FLAX',          NOM_PARA=' DX',          NOM_RESU='  
nom_res2',  
                  PROL_GAUCHE=' EXCLU',    PROL_DROITE=' CONSTANT',  
                  VALE_PARA=lpara,        VALE_FONC=lfonc,)  
  
IMPR_CO (CONCEPT=_F (NOM=f2,))
```

3.2.2 Contents of the objects

```
=====> IMPR_CO OF THE STRUCTURE OF DATA: f2      ??????????????????  
ATTRIBUTE: F CONTENTS: T BASE: >G<  
MANY OBJECTS (OR COLLECTIONS) FIND:                3
```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

```
SEGMENT IMPRESSION OF VALUES >F2                .PROL          <  
  
1 - >FONCTION                <>FLAX FLAX          <  
3 - >DX                      <>mom_res2          <  
5 - >EC                      <>f2                <
```

```
SEGMENT IMPRESSION OF VALUES >F2                .TITR          <  
  
1 - >ceci is a title  
<
```

```
SEGMENT IMPRESSION OF VALUES >F2                .VALE          <  
  
1 - 3.00000D+00 4.00000D+00 5.00000D+00 6.00000D+00 3.20000D+00  
6 - 4.20000D+00 5.20000D+00 6.20000D+00  
=====> FINE IMPR_CO OF STRUCTURE OF DATA: f2      ??????????????????
```

3.3 Tabulée complex function: f3

3.3.1 Command file

```
f3=DEFI_FONCTION (INTERPOL= ('FLAX', 'FLAX',),, NOM_PARA=' INST', NOM_RESU='  
nom_res3',  
                    PROL_GAUCHE=' LINEAIRE', PROL_DROITE=' CONSTANT',  
                    VALE_C= (0. , 1.2,2.2, 1. , 3.7, 4.7, 2. , 5.6,6.6, 3. ,  
3.5,4.5,))  
IMPR_CO (CONCEPT=_F (NOM=f3,));
```

3.3.2 Contents of the objects

```
====> IMPR_CO OF THE STRUCTURE OF DATA: f3      ??????????????????  
ATTRIBUTE: F CONTENTS: T BASE: >G<  
MANY OBJECTS (OR COLLECTIONS) FIND:           3
```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

```
SEGMENT IMPRESSION OF VALUES >F3              .PROL      <  
  
1 - >FONCT_C          <> LIN LIN          <  
3 - >INST              <>mom_res3        <  
5 - >LC                <>f3              <
```

```
SEGMENT IMPRESSION OF VALUES >F3              .TITR      <  
  
1 - >ASTER 9.02.12 CONCEPT f3 CALCULATES 3/4/2008 A 13:38: 41 OF TYPE  
FONCTION_C <
```

```
SEGMENT IMPRESSION OF VALUES >F3              .VALE      <  
  
1 - 0.00000D+00 1.00000D+00 2.00000D+00 3.00000D+00 1.20000D+00  
6 - 2.20000D+00 3.70000D+00 4.70000D+00 5.60000D+00 6.60000D+00  
11 - 3.50000D+00 4.50000D+00
```

```
====> FINE IMPR_CO OF STRUCTURE OF DATA: f3      ??????????????????
```


3.4 Real tablecloth defined by functions: nap1

3.4.1 Command file

```
f21=DEFI_FONCTION (NOM_RESU=' bid1', NOM_PARA=' TEMP',
                  INTERPOL= ('FLAX', 'FLAX',), PROL_DROITE=' LINEAIRE',
                  VALE= (1.2,3.7, 4.2,6.7,      ),);

f22=DEFI_FONCTION (NOM_RESU=' bid2', NOM_PARA=' INST',
                  INTERPOL= ('LOG', 'LOG',), PROL_DROITE=' CONSTANT',
                  VALE= (10.2, 30.7,      40.2,60.7,      ),);

f23=DEFI_FONCTION (NOM_RESU=' bid2', NOM_PARA=' INST',
                  INTERPOL= ('LOG', 'FLAX',), PROL_GAUCHE=' LINEAIRE',
                  VALE= (11.2, 31.7,      41.2,61.7,      ),);

nap1=DEFI_NAPPE (
  INTERPOL= ('FLAX', 'LOG',), NOM_PARA=' PULS', NOM_RESU='
nom_nap1',
  PROL_GAUCHE=' EXCLU', PROL_DROITE=' CONSTANT',
  PARA= (8.9, 12.9, 17.9,), FONCTION= (f21, f22, f23,));

IMPR_CO (CONCEPT=_F (NOM=nap1,));
```

3.4.2 Contents of the objects

```
=====> IMPR_CO OF THE STRUCTURE OF DATA: nap1      ??????????????????
ATTRIBUTE: F CONTENTS: T BASE: >G<
MANY OBJECTS (OR COLLECTIONS) FIND:                4
```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

SEGMENT IMPRESSION OF VALUES >NAP1 . PARA <

1 - 8.90000D+00 1.29000D+01 1.79000D+01

SEGMENT IMPRESSION OF VALUES >NAP1 . PROL <

1 - >NAPPE <>LIN LOG <
3 - >PULS <>mom_nap1 <
5 - >EC <>nap1 <
7 - >INST <> LIN LIN <
9 - >EL <>LOG LOG <
11 - >EC <>LOG FLAX <
13 - >LE <

SEGMENT IMPRESSION OF VALUES >NAP1 . TITR <

1 - >ASTER 9.02.12 CONCEPT nap1 CALCULATES 3/4/2008 A 14:52: 03 OF TYPE
<
2 - >NAPPE_SDASTER
<

IMPRESSION OF THE COLLECTION: nap1 . VALE

Code_Aster

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```
OBJECT IMPRESSION OF CONTIGUE>nap1 COLLECTION .VALE< OC: 1

      1 - 1.20000D+00 4.20000D+00 3.70000D+00 6.70000D+00

OBJECT IMPRESSION OF CONTIGUE>nap1 COLLECTION .VALE< OC: 2

      1 - 1.02000D+01 4.02000D+01 3.07000D+01 6.07000D+01

OBJECT IMPRESSION OF CONTIGUE>nap1 COLLECTION .VALE< OC: 3

      1 - 1.12000D+01 4.12000D+01 3.17000D+01 6.17000D+01
====> FINE IMPR_CO OF STRUCTURE OF DATA: nap1 ???????????????????
```

3.5 Real tablecloth defined by functions: nap2

3.5.1 Command file

```

nap2=DEFI_NAPPE (
  INTERPOL= ('FLAX', 'LOG'),
  NOM_PARA=' PULS',
  NOM_RESU=' nom_nap2',
  PROL_GAUCHE=' EXCLU', PROL_DROITE=' CONSTANT',
  PARA= (8.9, 12.9,),
  NOM_PARA_FONC=' EPSI',
  DEFI_FONCTION= ( _F (PROL_DROITE=' LINEAIRE',
                       VALE= (1.2, 3.5,2.2, 4.5, 3.2, 6.5,,)),
                  _F (PROL_GAUCHE=' CONSTANT',
                       VALE= (1.2, 3.7, 4.2, 6.7,,)),),
);

IMPR_CO (CONCEPT=_F (NOM=nap2,,));

```

3.5.2 Contents of the objects

```

====> IMPR_CO OF THE STRUCTURE OF DATA: nap2      ??????????????????
ATTRIBUTE: F CONTENTS: T BASE: >G<
MANY OBJECTS (OR COLLECTIONS) FIND:                4

```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

```

SEGMENT IMPRESSION OF VALUES >NAP2                .PARA      <

1 - 8.90000D+00 1.29000D+01

```

```

SEGMENT IMPRESSION OF VALUES >NAP2                .PROL      <

1 - >NAPPE          <>LIN LOG          <
3 - >PULS           <>nom_nap2        <
5 - >EC             <>nap2            <
7 - >EPSI           <> LIN LIN        <
9 - >EL             <> LIN LIN        <
11 - >CE            <

```

```

SEGMENT IMPRESSION OF VALUES >NAP2                .TITR      <

1 - >ASTER 9.02.12 CONCEPT nap2 CALCULATES 3/4/2008 A 14:52: 03 OF TYPE
<
2 - >NAPPE_SDASTER
<

```

```

IMPRESSION OF THE COLLECTION: nap2                .VALE

OBJECT IMPRESSION OF CONTIGUE>nap2 COLLECTION      .VALE< OC:    1

1 - 1.20000D+00 2.20000D+00 3.20000D+00 3.50000D+00 4.50000D+00
6 - 6.50000D+00

```

Code_Aster

Version
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OBJECT IMPRESSION OF CONTIGUE>nap2 COLLECTION .VALE< OC: 2

1 - 1.20000D+00 4.20000D+00 3.70000D+00 6.70000D+00
====> FINE IMPR_CO OF STRUCTURE OF DATA: nap2 ????????????????????

3.6 Function formulates to 1 variable: ff1

3.6.1 Command file

```
ff1 = FORMULA (NOM_PARA=' INST',  
              VALE=' 2.3* (cos (3.2+sqrt (INST)))- heavysid (INST-PI) ',  
              );  
IMPR_CO (CONCEPT=_F (NOM=ff1,),);
```

3.6.2 Contents of the objects

```
====> IMPR_CO OF THE STRUCTURE OF DATA: ff1      ??????????????????  
ATTRIBUTE: F CONTENTS: T BASE: >G<  
MANY OBJECTS (OR COLLECTIONS) FIND:                2
```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

```
SEGMENT IMPRESSION OF VALUES >FF1                .NOVA      <  
  
1 - >INST      <
```

```
-----
```

```
SEGMENT IMPRESSION OF VALUES >FF1                .PROL      <  
  
1 - >INTERPRE      <>INTERPRE      <  
3 - >                <>TOUTRESU      <  
5 - >II            <>ff1            <
```

```
====> FINE IMPR_CO OF STRUCTURE OF DATA: ff1      ??????????????????
```

3.7 Function formulates with 2 variables: ff2

3.7.1 Command file

```
ff2 = FORMULA (NOM_PARA= ('X', 'Y',),  
              VALE=' 2.3* (cos (3.2+sqrt (X)))- (ff1 (Y) +3.4*f2 (X))',  
              );  
IMPR_CO (CONCEPT=_F (NOM=ff2,),);
```

3.7.2 Contents of the objects

```
====> IMPR_CO OF THE STRUCTURE OF DATA: ff2      ??????????????????  
ATTRIBUTE: F CONTENTS: T BASE: >G<  
MANY OBJECTS (OR COLLECTIONS) FIND:                2
```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

```
SEGMENT IMPRESSION OF VALUES >FF2                .NOVA      <  
  
1 - >X          <>Y          <
```

```
SEGMENT IMPRESSION OF VALUES >FF2                .PROL      <  
  
1 - >INTERPRE          <>INTERPRE          <>          <  
4 - >TOUTRESU          <>II          <>ff2          <
```

```
====> FINE IMPR_CO OF STRUCTURE OF DATA: ff2      ??????????????????
```

3.8 Formula with 1 variables: ff3 tabulée thereafter

3.8.1 Command file

```
ff31 = FORMULA (NOM_PARA=' X', VALE=' sqrt (X) ',  
              );  
ff3=CALC_FONC_INTERP (FONCTION=ff31,  
                     PROL_DROITE=' LINEAIRE',  
                     VALE_PARA= (1,4,9,16,),  
                     );  
  
IMPR_CO (CONCEPT=_F (NOM=ff3,),);
```

3.8.2 Contents of the objects

```
=====> IMPR_CO OF THE STRUCTURE OF DATA: ff3      ??????????????????  
ATTRIBUTE: F CONTENTS: T BASE: >G<  
MANY OBJECTS (OR COLLECTIONS) FIND:                3
```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

```
SEGMENT IMPRESSION OF VALUES >FF3                .PROL          <  
  
1 - >FONCTION          <> LIN LIN          <>X          <  
4 - >TOUTRESU          <>EL          <>ff3          <
```

```
SEGMENT IMPRESSION OF VALUES >FF3                .TITR          <  
  
1 - >ASTER  9.02.01 CONCEPT ff3 CALCULATES 12/17/2007 A 14:38: 46 OF TYPE  
<  
2 - >FONCTION_SDASTER  
<
```

```
SEGMENT IMPRESSION OF VALUES >FF3                .VALE          <  
  
1 -  1.00000D+00  4.00000D+00  9.00000D+00  1.60000D+01  1.00000D+00  
6 -  2.00000D+00  3.00000D+00  4.00000D+00  
=====> FINE IMPR_CO OF STRUCTURE OF DATA: ff3      ??????????????????
```

3.9 Function tabulée starting from another function

3.9.1 Command file

```
ff41 = FORMULA (NOM_PARA=' X', VALE=' sqrt (X) ',);  
ff42 = FORMULA (NOM_PARA=' X', VALE=' 2.*ff41 (X) *sqrt (X) ',);  
ff4=CALC_FONC_INTERP (  
    FONCTION=ff42, NOM_RESU=' nom_res4',  
    INTERPOL= ('LOG', 'FLAX'),  
    PROL_DROITE=' EXCLU', PROL_GAUCHE=' LINEAIRE',  
    VALE_PARA= (1.6, 2.6,3.6,4.6,),  
);  
IMPR_CO (CONCEPT=_F (NOM=ff4,));
```

3.9.2 Contents of the objects

```
====> IMPR_CO OF THE STRUCTURE OF DATA: ff4      ??????????????????  
ATTRIBUTE: F CONTENTS: T BASE: >G<  
MANY OBJECTS (OR COLLECTIONS) FIND:                3
```

=====

IMPRESSION OF THE CONTENTS OF THE LOST PROPERTY:

```
SEGMENT IMPRESSION OF VALUES >FF4                .PROL      <  
  
1 - >FONCTION                <>LOG FLAX      <  
3 - >X                        <>nom_res4     <  
5 - >LE                        <>ff4         <
```

```
-----  
SEGMENT IMPRESSION OF VALUES >FF4                .TITR      <  
  
1 - >ASTER  9.02.12 CONCEPT ff4 CALCULATES 3/4/2008 A 13:38: 41 OF TYPE  
<  
2 - >FONCTION_SDASTER  
<
```

```
-----  
SEGMENT IMPRESSION OF VALUES >FF4                .VALE      <  
  
1 - 1.60000D+00  2.60000D+00  3.60000D+00  4.60000D+00  3.20000D+00  
6 - 5.20000D+00  7.20000D+00  9.20000D+00  
====> FINE IMPR_CO OF STRUCTURE OF DATA: ff4      ??????????????????
```