

## Data structures sd\_fonction

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### Summarized:

The types of concepts `sd_fonction` represent functions (with the mathematical meaning of the term) of one or two variables.

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

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

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

### Note:

*A formula can be tabulated (for certain values of its variable) by the command `CALC_FONC_INTERP`. For a tabulated function, the evaluating 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 tabulated functions can only have 0, 1 or 2 variables. One will speak then about "constant function", "function" or "three-dimensions function". The variables of a function (as its result) "are typified": "TEMP", "INST", "EPSI",... One will speak then about the name of the parameters and result.*

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## 1 Data format

---

```
Function (k19):
  F          "$VIDE": TITER
  ◆          ".PROL": OJBS      V K16

  | % if the function is interpreted (formula):
  ◆          ".NOVA": OJBS      V K8

  | % if the function is tabulated:
  /% if constant function or function:
  ◆          ".VALE": OJBS      V R

  /% if three-dimensions function:
  ◆          '.PARA' : OJBS      V R
  ◆          '.VALE' : OJBXC     V R
```

## 2 Contained basic objects

---

### 2.1 Object .PROL

object ".PROL" is length 6 for the tabulated functions of 0 or 1 variable and the formulas. It is length  $7+2*nf$  for the three-dimensions functions, if  $nf$  is the number of functions composing the three-dimensions function.

**.PROL (1)**

Standard of the function.

"CONSTANT" : constant function  
"FONCTION" : fonction\_1 real  
"FONCT\_C" : fonction\_1 complex  
"THREE-  
DIMENSIONS  
FUNCTION" : function with 2 variables (three-  
dimensions function)  
"INTERPRE" : interpreted function (formula)

**.PROL (2) = "XXX FF"**

Standard of interpolation wished between the points of tabulation. Relate to only the tabulated functions. XXX relates to the parameter and FF the function. The possibilities are:

- "NON": interpolation is prohibited,
- "LIN": 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 "LIN LOG", one will use  $x$  and  $\log(f)$ .

**Note:**

| For a three-dimensions function, *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 three-dimensions function, "
- " (vacuum) for a formula. .PROL

## (4) name

- (or type) of result of the function, TOUTRESU
- ". .PROL

## (5) "

Prolongation" desired with the function apart from its field of tabulation (extrapolation). Relate to only the tabulated 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 greater 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 three-dimensions function, these prolongations relate to the second parameter (values of L" object .PARA ) . It does not exist of prolongation "logarithmic curve". .PROL

## (6) Name

of the function or the three-dimensions function. 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 the coded material). .PROL

## (7) Only

for the three-dimensions functions: name of the parameter of the functions composing three-dimensions function (NOM\_PARA\_FONC of DEFI\_NAPPE) . .PROL

## (8) Standard

of interpolation wanted for the first function composing the three-dimensions function (" LIN LOG", "LOG LOG `,...) (see ".PROL (2) "). .PROL

## (9) Standard

of prolongation wanted for the first function composing the three-dimensions function (" EL', "DC", ...) (see ".PROL (5) "). .PROL

## (10) Standard

of interpolation wanted for the second function composing the three-dimensions function... and following. Object

## 2.2 “.PARA” This

object contains the values of the second variable of the three-dimensions function. A each value of this second variable corresponds an object of the collection ".VALE" which contains the values of the function associated with this variable. Object

## 2.3 “.VALE” Case

### 2.3.1 of a function For

a function, this object contains the numerical values of the points of tabulation. That is to say :  $n$  the number of points of tabulation: X-coordinates

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

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

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

The number of points of discrétisationpeut ( $n$ ) to be obtained by division by 2 (or 3) of attribute "LONMAX" of the object. ".VALE" Cas

### 2.3.2 of a three-dimensions function For

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

## 2.4 “.NOVA” This

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

## 3 Function

### 3.1 examples: f1 Command file

#### 3.1.1 f1

```
=DEFI_CONSTANTE (VALE=1.2, NOM
                 _RESU=' nom_res1',) IMPR
                 _CO (CONCEPT=_F (NOM=f1,)); Contents
```

#### 3.1.2 of the objects ==

```
==> IMPR_CO OF Data structure: f1??      ?????????????????? ATTRIBUT
: F CONTENU : T BASE : >G< MANY
OBJECTS (OR COLLECTIONS) FIND: 3      ==
```

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

```
-----
PRINTING
```

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

```
-----
PRINTING
```

```
SEGMENT OF VALUES >f1 .TITR          <          >>
>>> 1
- >ASTER 9.02 .12 CONCEPT f1 CALCULE LE 3/4/2008 A 13:38: 41 OF TYPE <
2
- >FONCTION_SDASTER <
```

```
-----
PRINTING
```

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

## 3.2 real function: f2 Command file

### 3.2.1 will 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 (TITER=' this is a titer', INTERPOL
                = ' NON', NOM      _PARA=' DX', NOM      _RESU=' nom_res2',
PROL
                _GAUCHE=' EXCLU', PROL_DROITE=' CONSTANT', VALE
will _PARA=lpara, VALE      _FONC=lfonc,) IMPR

_CO (CONCEPT=_F (NOM=f2,)) Contained
```

### 3.2.2 objects ==

```
==> IMPR_CO OF Data structure: f2??          ???????????????? ATTRIBUT
: F CONTENU : T BASE : >G< MANY
OBJECTS (OR COLLECTIONS) FIND: 3              ==
```

=====

PRINTING

OF THE CONTENU OF THE OBJECTS FIND:

-----

PRINTING

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

-----

PRINTING

```
SEGMENT OF VALUES >f2 .TITR          <          >>
>>> 1
- >ceci is a title <
```

-----

PRINTING

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

## 3.3 complex function: f3 Command file

### 3.3.1 f3

```
=DEFI_FONCTION (INTERPOL= ("LIN", "LIN",), 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,)); Contents
```

### 3.3.2 of the objects ==

```
==> IMPR_CO OF Data structure: f3??          ?????????????????? ATTRIBUT  
: F CONTENU : T BASE : >G< MANY  
OBJECTS (OR COLLECTIONS) FIND: 3          ==
```

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

```
-----  
PRINTING
```

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

```
-----  
PRINTING
```

```
SEGMENT OF VALUES >f3 .TITR          <          >>  
>>> 1  
- >ASTER 9.02 .12 CONCEPT f3 CALCULE LE 3/4/2008 A 13:38: 41 OF TYPE  
FONCTION_C <
```

```
-----  
PRINTING
```

```
SEGMENT OF VALUES >F3 .VALE          <          >>  
>>> 1  
- 0.00000 D+00 1.00000 D+00 2.00000 D+00 3.00000 D+00 1.20000 D+00 6  
- 2.20000 D+00 3.70000 D+00 4.70000 D+00 5.60000 D+00 6.60000 D+00 11  
- 3.50000 D+00 4.50000 D+00 ==  
==> FIN IMPR_CO OF DATA STRUCTURE: f3??          ?????????????????? Real
```

## 3.4 three-dimensions function defined by functions: nap1 Command file

### 3.4.1 f21

```
=DEFI_FONCTION (NOM_RESU=' bid1', NOM_PARA=' TEMP', INTERPOL
  = ("LIN", "LIN",), 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", "LIN",), PROL_GAUCHE=' LINEAIRE', VALE
  = (11.2, 31.7,41.2      , 61.7,),      ); nap

1=DEFI_NAPPE (INTERPOL
  = ("LIN", "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,)); Contents
```

### 3.4.2 of the objects ==

```
==> IMPR_CO OF Data structure: nap1??      ??????????????? ATTRIBUT
: F CONTENU : T BASE : >G< MANY
OBJECTS (OR COLLECTIONS) FIND: 4          ==
```

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

```
-----
PRINTING
```

```
SEGMENT OF VALUES >NAP1 .PARA          <          >>
>>> 1
- 8.90000 D+00 1.29000 D+01 1.79000 D+01
```

```
-----
PRINTING
```

```
SEGMENT 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 LIN <          13
- >LE <
```

```
-----
PRINTING
```

```
SEGMENT OF VALUES >nap1 .TITR          <          >>
>>> 1
- >ASTER 9.02 .12 CONCEPT nap1 CALCULE LE 3/4/2008 A 14:52: 03 OF TYPE <
```

```
2
```

# Code Aster

Version  
default

Titre : Structures de données sd\_fonction  
Responsable : Mathieu COURTOIS

Date : 01/04/2011 Page : 11/17  
Clé : D4.02.02 Révision : 5960

- >NAPPE\_SDASTER <

-----  
PRINTING

OF THE COLLECTION: nap1 .VALE PRINTING

OBJET OF CONTIGUE>nap1 COLLECTION .VALE < OC : 1 >>  
>>> 1

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

OBJET OF CONTIGUE>nap1 COLLECTION .VALE < OC : 2 >>  
>>> 1

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

OBJET OF CONTIGUE>nap1 COLLECTION .VALE < OC : 3 >>  
>>> 1

- 1.12000 D+01 4.12000 D+01 3.17000 D+01 6.17000 D+01 ==  
==> FIN IMPR\_CO OF DATA STRUCTURE: nap1?? ??????????????? Real

## 3.5 three-dimensions function defined by functions: nap2 Command file

### 3.5.1 nap

```
2=DEFI_NAPPE (INTERPOL
  = ("LIN", "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,)); Contents
```

### 3.5.2 of the objects ==

```
==> IMPR_CO OF Data structure: nap2??      ?????????????????? ATTRIBUT
      : F  CONTENU      : T  BASE      : >G< MANY
      OBJECTS (OR COLLECTIONS) FIND: 4      ==
```

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

PRINTING

```
SEGMENT OF VALUES >NAP2 .PARA          <          >>
>>> 1
      - 8.90000 D+00 1.29000 D+01
-----
```

PRINTING

```
SEGMENT 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 <
```

PRINTING

```
SEGMENT OF VALUES >nap2 .TITR          <          >>
>>> 1
  - >ASTER 9.02 .12 CONCEPT nap2 CALCULE LE 3/4/2008 A 14:52: 03 OF TYPE <
2
  - >NAPPE_SDASTER <
```

PRINTING

```
OF THE COLLECTION: nap2 .VALE          PRINTING
```

```
OBJET OF CONTIGUE>nap2 COLLECTION .VALE          < OC : 1          >>
```

*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.*

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

```
OBJET OF CONTIGUE>nap2 COLLECTION .VALE < OC : 2 >>
>>> 1
```

```
- 1.20000 D+00 4.20000 D+00 3.70000 D+00 6.70000 D+00 ==
==> FIN IMPR_CO OF DATA STRUCTURE: nap2?? ?????????????? Function
```

## 3.6 formulates to 1 variable: ff1 Command file

### 3.6.1 FF

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

### 3.6.2 of the objects ==

```
==> IMPR_CO OF Data structure: ff1??      ?????????????????? ATTRIBUT
: F CONTENU : T BASE : >G< MANY
OBJECTS (OR COLLECTIONS) FIND: 2      ==
```

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

```
-----
PRINTING
```

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

```
-----
PRINTING
```

```
SEGMENT OF VALUES >ff1 .PROL          <          >>
>>> 1
- >INTERPRE <>          INTERPRE <          3
- > <>          TOUTRESU <          5
- >II <>          ff1 <          ==
==> FIN IMPR_CO OF Data structure: ff1??      ?????????????????? Function
```

## 3.7 formulates with 2 variables: ff2 Command file

### 3.7.1 FF

```
2 = 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,,)); Contents
```

### 3.7.2 of the objects ==

```
==> IMPR_CO OF Data structure: ff2??          ?????????????????? ATTRIBUT
: F CONTENU : T BASE : >G< MANY
OBJECTS (OR COLLECTIONS) FIND: 2                ==
```

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

```
-----
PRINTING
```

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

```
-----
PRINTING
```

```
SEGMENT OF VALUES >ff2 .PROL                <          >>
>>> 1
- >INTERPRE <>          INTERPRE <>          <          4
- >TOUTRESU <>          II <>          ff2 <          ==
==> FIN IMPR_CO OF Data structure: ff2??          ?????????????????? Formulate
```

## 3.8 to 1 variables: ff3 tabulated thereafter Command file

### 3.8.1 FF

```
31 = FORMULA (NOM_PARA=' X', VALE=' sqrt (X) `',);
      FF
3=CALC_FONC_INTERP (FONCTION=ff31, PROL
      _DROITE=' LINEAIRE"', VALE
      _PARA= (1,4,9,16,,));
      IMPR

      _CO (CONCEPT=_F (NOM=ff3,,)); Contents
```

### 3.8.2 of the objects ==

```
==> IMPR_CO OF Data structure: ff3??      ?????????????????? ATTRIBUT
      : F CONTENU      : T BASE      : >G< MANY
      OBJECTS (OR COLLECTIONS) FIND: 3      ==
```

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

```
-----
PRINTING
```

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

```
-----
PRINTING
```

```
SEGMENT OF VALUES >ff3 .TITR      <      >>
>>> 1
      - >ASTER 9.02 .01 CONCEPT ff3 CALCULE LE 12/17/2007 A 14:38: 46 OF TYPE <
2
      - >FONCTION_SDASTER <
```

```
-----
PRINTING
```

```
SEGMENT OF VALUES >FF3 .VALE      <      >>
>>> 1
      - 1.00000 D+00 4.00000 D+00 9.00000 D+00 1.60000 D+01 1.00000 D+00 6
      - 2.00000 D+00 3.00000 D+00 4.00000 D+00 ==
```

```
==> FIN IMPR_CO OF DATA STRUCTURE: ff3??      ?????????????????? Tabulated function
```

## 3.9 from another function Command file

### 3.9.1 FF

```
41 = FORMULA (NOM_PARA=' X', VALE=' sqrt (X) `'); FF
42 = FORMULA (NOM_PARA=' X", VALE=' 2.*ff41 (X) *sqrt (X) `'); FF
4=CALC_FONC_INTERP (FONCTION
    =ff42, NOM_RESU=' nom_res4", INTERPOL
    = ("LOG", "LIN"), PROL
    _DROITE=' EXCLU', PROL_GAUCHE=' LINEAIRE', VALE
    _PARA= (1.6, 2.6,3.6,4.6,)),);
    IMPR
    _CO (CONCEPT=_F (NOM=ff4,)); Contents
```

### 3.9.2 of the objects ==

```
==> IMPR_CO OF Data structure: ff4??      ?????????????????? ATTRIBUT
: F CONTENU : T BASE : >G< MANY
OBJECTS (OR COLLECTIONS) FIND: 3          ==
```

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

```
-----
PRINTING
```

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

```
-----
PRINTING
```

```
SEGMENT OF VALUES >ff4 .TITR          <          >>
>>> 1
- >ASTER 9.02 .12 CONCEPT ff4 CALCULE LE 3/4/2008 A 13:38: 41 OF TYPE <
2
- >FONCTION_SDASTER <
```

```
-----
PRINTING
```

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