Opticafe - Reférence Guide

Loïc Huguel

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1 Deeling with Opticafe

1.1 Introduction

Opticafe is design to solve Non-Linear problèmes in order to fit a **model to data** or **find non trivial zeros** of a funtion. It implements severals famous algorithms (Gauss-Newton,Levenberg-Marquards or DogLeg) to optimise a system of equations witch the global form are:

1.1.1 With external measures

$$\hat{Y}_i = f(P, \hat{X}_i)$$

Where

- $\hat{Y}_i$ are the outputs vectors of measures provide by user (see 1.3)
- $\hat{X}_i$ are the inputs vectors of measures provide by user (see 1.3)
- P the vector of parameters you're trying to optimise.

$$\boxed{\text{In this case Opticafe will try to minimise : } \sum |f(P, \hat{X}_i) - \hat{Y}_i|^2 = 0}$$

1.1.2 Without external measures

$$Y = f(P)$$

Where

- Y is the output vector
- P the vector of parameters you're trying to optimise.

$$\boxed{\text{In this case Opticafe will guess the zeros of the function ie it will try to minimise : } |f(P)|^2 = 0}$$

1.2 Step 1: Define a system of equations

So the first step consist in writing your system of equations. Write "yj" to specifie the component "j" of the Y vector($j \in [0, 9]$). Write "xk" to specifie the component "k" of the X vector ($k \in [0, 9]$). Write "pl" to specifie the component "l" of the P vector ($k \in [0, 9]$).

For instances:

y0=sin(p0)	$R^1 \Rightarrow R^1$ with no measures
y0=sin(p0) y1=cos(p0)	$R^1 \Rightarrow R^2$ with no measures
y0=sin(p0+p1)	$R^2 \Rightarrow R^1$ with no measures
y0=sin(p0+p1*x0)	$R^2 \Rightarrow R^1$ with measures
y0=sin(p0+p1*x0) y1=cos(p0+p1*x0)	$R^2 \Rightarrow R^2$ with measures
y0=sin(p0+p1*x0) y1=cos(p0+p1*x0)-1 y2=tan(p0+p1/p3*x0+x2)	$R^3 \Rightarrow R^3$ with measures

1.3 Step 2: Loading measures

Maybe you have define a system with measures so it may be useful to load them. To deel with this you just have to write $data = Path/measures.txt$ after you defined the system.

The format of measures.txt as to be:

```
y1;y2;...;yn ; x1;x2;...;xn
y1;y2;...;yn ; x1;x2;...;xn
y1;y2;...;yn ; x1;x2;...;xn
y1;y2;...;yn ; x1;x2;...;xn
....
```

And must match the system defined, so for instance if you have defined:

```
y0=sin(p0+p1*x0)
y1=cos(p0+p1*x0)-1
y2=tan(p0+p1/p3*x0+x2)
data=./measures.txt
```

You need to measure file witch could be:

```
0;0;0 ; 1;2;2
1;0;0 ; 1;2;2
1;1;0 ; 1;2;2
0;0;0 ; 1;2;3
```

1.4 Step 3: Minimise the system of equations

Now you want to minimise or find the roots. The most important step is to define the initial vector of parameters (p_init). Just write "p_init=0,0" if P has to dimensions. If non specified p_init=0.

Sélect an algorithm in the menu, press "Minimise" and see the results.

For instance:

2 Simples Exemples

2.1 Linear regression

2.2 Polynomial regression

2.3 Multiple regression

3 Advanced Exemples

3.1 Rosenbrock function

3.2 Newton optimisation