
Subject: Re: how to solve a equation set automatically in IDL?

Posted by [Wout De Nolf](#) on Fri, 05 Jun 2009 08:07:30 GMT

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On Thu, 4 Jun 2009 09:29:12 -0700 (PDT), Hu <jhaohu@gmail.com> wrote:

> Hi, there

>

> I wonder whether there is some automatic method / function in IDL to

> solve an equation set.

>

> Supposing that I got an equation like: $A*x+B*y+C*z=E*m+F*n$, and

> I got five sample points (xi,yi,zi,mi,ni), (1<= i <=5). well, I can

> solve the equation set (including 5 equations) mathematically and got

> value for parameter A,B,C,D,E.

>

> How can I do it automatically without listing the expressions like $A=f$

> (x,y,z,m,n), $B=f(x,y,z,m,n)$, $C=f(x,y,z,m,n)$...?

>

> Thanks

So you're trying to solve a linear system of equations, right?

In your example, [A,B,C,E,F] are the unknowns? Then for one equation:

$$A*x+B*y+C*z = E*m+F*n$$

$$\Leftrightarrow A*x+B*y+C*z-E*m-F*n = 0$$

$$\Leftrightarrow [x,y,z,-m,-n] \text{##} \text{transpose}([A,B,C,E,F])=0$$

And for several equations:

$$M = \begin{bmatrix} x_0, y_0, z_0, -m_0, -n_0 \\ x_1, y_1, z_1, -m_1, -n_1 \\ \dots \end{bmatrix}$$

$$X = \text{transpose}([A,B,C,D,E])$$

$$M \text{ ## } X = 0$$

You can solve this numerically in many ways (e.g. use SVDC + SVSOL).

However, this is a homogeneous system of equations, so there are two possibilities for the solution X:

1. There is only 1 solution: $X = 0$

2. There are an infinite number of solutions, namely the Null space (or kernel) of the matrix M

So you find a solution X by finding the Null space of M. You can do this using SVD:

; Decompose M:

SVDC, M, W, U, V

```
; Find the null space of M (i.e. columns of V corresponding with
zero-valued singular values W)
pres=(machar(double=double)).eps
indNull=where(abs(W) le pres,nullity)
if nullity ne 0 then X = V[indNull,*] $
else X = V[0,]*0
```

When the nullity is not zero, X contains a basis for the infinite set of solutions. For example, nullity=2:
set of solutions = $a.X[0,*] + b.X[1,*]$ (where a and b is any real number)

Does this help?
