Subject: Re: Least square fitting
Posted by wlandsman on Tue, 20 May 2008 17:28:32 GMT
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On May 20, 5:41 am, MichaelT <michael.theus...@googlemail.com> wrote:

> The basic problem is the following:
> I have an astronomical image of a star field and try to relate the sky
> coordinates (right ascension, declination) of the stars to the pixel
> coordinates (x, y).
>

I have performed a lot of this type of astrometry, and your problem
seems very strange to me.

> The function to relate the two depends on the not accurately known
> parameters focal length of the lens (f), the rotation of the field of
> view with respect of the north direction (beta) and the center sky
> coordinates of the image (bc, lc).

A minor note is that if you really have such a large distortions then
a single beta does not make sense -- the rotation from North will vary
slightly across the image.

>
> Generally, the function is as follows (equivalent for ys', but the
> functions f1-f5 are slightly different):
>
> xs' = f1(xc, f2(f, f3(ls, lc, bs, bc)), f4(ls, lc, bs, bc, f5(ls, lc,
> bs, bc)), beta)
>
> The functions f1-f5 look rather complicated and contain many sines,
> cosines and acos etc.
>
> I then did the following as I didn't know better:
> First I minimized all this with respect of beta, then lc and bc and
> after that f starting with some initial values for the four
> parameters. Then I started all over again, beta, lc, bc, f (in a loop)
> until the difference between the known coordinates (xs, ys) and the
> calculated ones (xs', ys') reached a minimum.
>

I have no idea what your functions f1, f2, f3, f4 ,f5 might be, but do
you really care about them?   All you want is a function that maps
the known coordinates to the calculated ones.   Often what one does
is to find a quadratic or cubic function that will linearize the x,y
coordinates (i.e. so that they line up with RA, Dec)

xp = x + axy + by^2 + c*x^2 + ..
yp = y + dxy + ey^2 + f*x^2

You then use least squares to determine the a,b,c.. coefficients. This is the 'SIP' convention discussed in http://ssc.spitzer.caltech.edu/postbcd/doc/shupeADASS.pdf and used e.g. by the astrometry.net software for handling distortions. Of course, it would be nice to know the true functional form of the distortions but whatever functions you are using don't seem very useful. You can think of the quadratic or cubic equations as a Taylor series approximation to whatever the true functional form is.

--Wayne