Subject: DERIVSIG derivation problems
Posted by asdf on Mon, 23 May 2011 16:20:30 GMT
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Hi,
Looking through the code for DERIVSIG, I'm a little confused about its derivation.
From DERIV, it uses a 3-point Lagrange interpolant, so (as is in the code), for inner points (ignoring end points for now)
;df/dx = y0*(2x-x1-x2)/(x01*x02)+y1*(2x-x0-x2)/(x10*x12)+y2*(2x-x0-x1)/(x20*x21)
; Where: x01 = x0-x1, x02 = x0-x2, x12 = x1-x2, etc.

In IDL, this is how it is written (from DERIV line 69-71,74-76):

```
      x12 = x - shift(x,-1)   ;x1 - x2
      x01 = shift(x,1) - x    ;x0 - x1
      x02 = shift(x,1) - shift(x,-1) ;x0 - x2
   d = shift(y,1) * (x12 / (x01*x02)) + $ ;Middle points
     y * (1./x12 - 1./x01) - $
     shift(y,-1) * (x01 / (x02 * x12))
```

If I do a standard error propagation formula (sigma^2=sum(sigma_i^2*(\frac{\partial{f},\partial{i}),i)), then I get (in the terms defined above)

sigma_dfdx = sqrt((2x-x1-x2)^2/(x01*x02)^2*sig_y0^2 + (2x-x0-x2)^2/(x10*x12)^2*sig_y1^2 + (2x-x0-x1)^2/(x20*x21)^2*sig_y2^2)

In IDL, making use that x=x1, and since all the xij terms are squared in the error propagation formula, we set xij=xji, I would get:

```
x01=shift(x,1)-x
x02=shift(x,1)-shift(x,-1)
x12=x-shift(x,-1)
sig_y0sqr=shift(sigy,1)*shift(sigy,1)
sig_y1sqr=sigy*sigy
sig_y2sqr=shift(sigy,-1)*shift(sigy,-1)
sigd=(x12^2/(x01*x02)^2*sig_y0sqr + (2*x-shift(x,-1)-shift(x,1))^2/(x01*x12)^2*sig_y1sqr + x01^2/(x02*x12)^2*sig_y2sqr)
```

Yet in DERIVSIG, this is the equation used:

```
dsq=shift(x,-1)-shift(x,1)
dsq=dsq*dsq
dy=shift(y,-1)-shift(y,1)
sigd=(shift(sigy,-1)*shift(sigy,-1) + shift(sigy,1)*shift(sigy,1))/dsq
sigd=sqrt(sigd)
```

In the notation I used above, this is equivalent to saying:

sigd = sqrt(1./x20^2*sig_y0^2 + 1./x20^2*sig_y2^2)

Working through how this compares with the equation I have above, the only way I could get them to match is if DERVSIG is ASSUMING that x1-x0 = x2-x1, or that the spacing is uniform (not unity, but equal on each side of a point). This appears to be incorrect (the documentation certainly doesn't mention that the spacing needs to be uniform). Have I missed something somewhere?

Michael
