Subject: Re: Multidimensional Interpolation
Posted by JD Smith on Mon, 21 Jul 2003 18:27:19 GMT
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On Mon, 21 Jul 2003 08:40:58 -0700, Ian Chapman wrote:

> Hi,
>
> I have created a 5 dimensional data cube (pressure, temperature,
> relative humidity, frequency, transmission) with a radiative transfer
> model. I have a user that will need to get transmission data for given
> values of the rest of the parameters, so I am currently planning to
> interpolate the cube to the input values of the user.
>
> Does anyone know of any multi-dimensional interpolation routines
> (similar to spline) that would be able to perform this task?
>

You could roll your own using VALUE_LOCATE to locate the point (p,t,h,f) within each of the 4 relevant axes (bracketed between i,j,k,l and i+1,j+1,k+1,l+1), and then perform quad-linear interpolation on the 16 nearby grid points bracketing the desired value. E.g., let:

```
a=(p-p[i])/(p[i+1]-p[i])
b=(t-t[i])/(t[j+1]-t[j])
c=(h-h[i])/(h[k+1]-h[k])
d=(f-f[i])/(f[l+1]-f[l])
```

The quad-linear interpolant over you whole data cube "z" would look like:

```
(1-a)(1-b)(1-c)(1-d) z[i  ,j  ,k  ,l  ] +
(1-a)(1-b)(1-c)   d  z[i  ,j  ,k  ,l+1] +
(1-a)(1-b)   c (1-d) z[i  ,j  ,k+1,l  ] +
(1-a)(1-b)   c    d  z[i  ,j  ,k+1,l+1] +
(1-a)   b (1-c)(1-d) z[i  ,j+1,k  ,l  ] +
(1-a)   b (1-c)   d  z[i  ,j+1,k  ,l+1] +
(1-a)   b    c (1-d) z[i  ,j+1,k+1,l  ] +
(1-a)   b    c    d  z[i  ,j+1,k+1,l+1] +
  a (1-b)(1-c)(1-d) z[i+1,j  ,k  ,l  ] +
  a (1-b)(1-c)   d  z[i+1,j  ,k  ,l+1] +
  a (1-b)   c (1-d) z[i+1,j  ,k+1,l  ] +
  a (1-b)   c    d  z[i+1,j  ,k+1,l+1] +
  a    b (1-c)(1-d) z[i+1,j+1,k  ,l  ] +
  a    b (1-c)   d  z[i+1,j+1,k  ,l+1] +
  a    b    c (1-d) z[i+1,j+1,k+1,l  ] +
```

a b c d) z[i+1,j+1,k+1,l+1]

The regularity of this pattern lends one to believe a generic n-linear interpolation code could be written. Fancier interpolation methods (cubic, spline, sinc) get much harder in higher dimensions.

JD
