Subject: Re: Smoothing 3D array with periodic boundaries: what am I missing? Posted by Jeremy Bailin on Fri, 25 Sep 2009 03:52:00 GMT

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On Sep 24, 1:19 pm, Luds < lud...@uvic.ca> wrote:
> I've been trying for a couple days now to write a Gaussian-smoothing
> algorithm to smooth a cube of (scalar) data with periodic boundary
> conditions (this is needed for my task since "structure" in the data
> that straddles an edge of the cube appears on two+ sides of the box).
> I've made it so far, but now can't seem to get around excessive For-
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  For example, say the box of scalars values runs from (0,1) in x,y, and
  z, and has N<sup>3</sup> points. To smooth at point (x,y,z) in the box I
  generate a 3-D Gaussian with its centroid (mean) at point x,y,z:
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  Gauss_field = rebin(periodic_gauss_func(X,[[sig],[x]]),N,N,N) * $
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  1,N),N,N,N) * $
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                 rebin(reform(periodic_gauss_func(X,[[sig],[z]]),
  1,1,N),N,N,N)
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  where periodic_gauss_func is a 1-D Gaussian kernel function that wraps
  around the box edge, X=(0,1,...N-1)... sig=sigma. (i.e. this just does
  separate Gaussian smoothing along each direction and combines the
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  Then the smoothed field at point (x,y,z) is something like
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  Smoothed(x,y,z) = TOTAL(TOTAL(scalar_field*Gauss_field,1))
> What I can't figure out is an efficient way to do this for all (x,y,z)
 - for a N=1024<sup>3</sup> grid it takes a couple seconds to generate
  Gauss_field. Realistically, I'll have N=1024<sup>3</sup>, so For-loops are
> pretty much useless(???), and memory is a bit of an issue too.
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> Does anyone know of any "canned" routines to do this type of Gaussian
> smoothing? Or of an efficient way to convolve my 3D Gaussian field
> with my scalar field for all (x,y,z)? (I must stress that the Gaussian
 kernel must not be affected by, or truncated at, the box edge)
>
  Many thanks!!
> Aaron
```

Wouldn't the Fourier convolution theorem approach work here? FFT your data cube, FFT your 3D Gaussian kernel, multiply them, and reverse FFT them back out? You may need to judiciously use TEMPORARY and/or the / -Jeremy.

Subject: Re: Smoothing 3D array with periodic boundaries: what am I missing? Posted by Luds on Mon, 28 Sep 2009 06:56:33 GMT View Forum Message <> Reply to Message

```
On Sep 25, 5:52 am, Jeremy Bailin <astroco...@gmail.com> wrote:
> On Sep 24, 1:19 pm, Luds < lud...@uvic.ca> wrote:
>
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Yeah, I guess this is the way to go after all.

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I guess I'll keep messing around with the IDL's fft. I've read on the help pages that the lowest frequencies in the fft should appear something like a spike in the middle of the fft'd image... I see a spike in the corner (0,0) of the image, which means I probably misinterpreting something simple.

Thanks!!

Subject: Re: Smoothing 3D array with periodic boundaries: what am I missing? Posted by pgrigis on Mon, 28 Sep 2009 14:10:57 GMT

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On Sep 28, 2:56 am, Luds <lud...@uvic.ca> wrote:

> On Sep 25, 5:52 am, Jeremy Bailin <astroco...@gmail.com> wrote:

> >

> On Sep 24, 1:19 pm, Luds <lud...@uvic.ca> wrote:

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Don't worry - the ordering of the frequencies in FFT nearly always is set like that - if that's confusing, a shift of half the size of the array will set them the way you expect them to be (with 0 frequency in the middle of the array).

To see the effect - take the 1-dim FFT of a gaussian. The result is also a gaussian - but you'll need a shift of half the size of the array to have it properly centered on the middle of the array.

Ciao, Paolo

>

> Thanks!!

Subject: Re: Smoothing 3D array with periodic boundaries: what am I missing? Posted by Luds on Mon, 28 Sep 2009 18:18:05 GMT View Forum Message <> Reply to Message

```
On Sep 28, 4:10 pm, Paolo <pgri...@gmail.com> wrote:

> On Sep 28, 2:56 am, Luds <lud...@uvic.ca> wrote:

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> of half the size of the array to have it properly centered
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>
> Ciao.
> Paolo
>
>
>> Thanks!!
>
```

Thank Paolo. Yeah, I figure out the shift of the fft frequencies and now everything is a expected.