Subject: Question: Storage scheme of 2D-wavelet-coefficients
Posted by Christian Oehreneder on Fri, 29 Sep 1995 07:00:00 GMT
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Schalom!

I'm testing idl's 2D-wavelet-transform, but I could not find out how the wavelet-coefficienmts with different dilation level and displacement are stored in the result-matrix. Can anyone help?

Thanks
Christian
(coehrene@fbgeo1.tuwien.ac.at)

Subject: Re: Question: Storage scheme of 2D-wavelet-coefficients
Posted by agraps on Fri, 29 Sep 1995 07:00:00 GMT
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In article <44gheq$a69@news.tuwien.ac.at>, "Christian Oehreneder (PHOTO-Dissertand)" <coehrene> wrote:

> I'm testing idl's 2D-wavelet-transform, but I could not find out how the
> wavelet-coefficienmts with different dilation level and displacement are
> stored in the result-matrix. Can anyone help?
>
> Thanks
> Christian
> (coehrene@fbgeo1.tuwien.ac.at)

I haven't used the NR_WTN routine, but if it works like the usual Discrete Wavelet Transforms in the literature and textbooks, the output decomposition matrix, which contains the wavelet coefficients, works something like the following.

The algorithm goes like this.

- Coefficient matrix size is same is input size of matrix.
(square, length 2^n on each side, so a 64x64, or 128x128, or 256x256 matrix etc.)

- Choose a scale

- For the first row:
  Perform a down-sample, high-pass smoothing operation on 1/2 of the row.
  Perform a down-sample, low-pass operation (throw away every 2nd data point) of the other half of the row.

Increment row by one, and repeat until you've gone through all the rows.

-For the first column:
Perform a down-sample, low-pass operation (throw away every 2nd data point) of one half of the column.
Perform a down-sample, high-pass smoothing operation on the other 1/2 of the column.

Increment column by one, and repeat until you've gone through all the columns.

-Increment the scale by one (next 2^n) and repeat until you've covered all of your desired scales.

So the result is a square with squares-within-squares of low-pass (L) operations and high-pass operations (H). The filter operations always work in pairs ("Quadrature Mirror Filters"), the filters being the wavelets you've chosen (say the Daubechies wavelet).

Here is an ASCII sketch of some output filter operations. The sketch shows 3 scale levels of smoothing, downsampled operations. The square labelled all "HH" will be the most "bland", smoothed result.
The square with all "LL" will be the tiniest representation of your original image (just downsampled, with every other point thrown away several times). The others will show you different things.
Some combinations of LH will show the fine detail in your image.
Other combinations will show the sharp contrast portions of your image (those are the combinations that make wavelets good "edge detectors").

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|            |            |
|            |            |
|            |            |
|            |            |
|            |            |
|    L,H     |    H,H     |
|            |            |
|            |            |
|            |            |
|            |            |
-----------------------------------
|      |      |           |
| LL,LH |LH,LH |           |
|      |      |           |
|      |      |           |
```

```
|      |      |           |
|---------------|   H,L      |
|LLL|LLH,|      |           |
|LLH|LLH |      |           |
|-------| LH,LL  |           |
|LLL|LLH,|      |           |
|LLL|LLL |      |           |
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Hope this makes sense!! Your output coefficient matrix may have the squares flipped to have the smallest scale be at the top left corner, but this explanation should still apply.

Amara

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"Sometimes I think I understand everything... Then I regain consciousness."   --Ashleigh Brilliant