## Subject: Does IDL has histogram matching function? Posted by tianyf\_cn on Fri, 08 Nov 2002 06:36:25 GMT

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I want to do a histogram matching work between two images with several bands. But IDL does not provide such functions or procudures. How can I achieve this?

Thanks in advance.

Sincerely, Tian.

Subject: Re: Does IDL has histogram matching function? Posted by David Fanning on Mon, 18 Nov 2002 23:49:41 GMT View Forum Message <> Reply to Message

Paul Sorenson (aardvark62@msn.com) writes:

- > There is an undocumented keyword to HIST\_EQUAL that looks like it
- > might do the same thing as Davids HistoMatch. Here is an example:
- > filename = filepath('ctscan.dat', subdir=['examples', 'data'])
- image = read\_binary(filename, data\_dims=[256, 256])
- > desired\_hist = histogram(hist\_equal(image), min=0, max=255)
- > window, xsize=3\*256, ysize=256
- > tv, image, 0
- > tv, hist\_equal(image), 1
- > tv, hist\_equal(image, fcn=total(desired\_hist, /cumulative)), 2
- > end

>

>

I think this is probably right, but I think both this function and the code that I threw off in a couple of minutes earlier in the week suffers from a deficiency.

As it happens, I need a histogram-match-by-region capability. In other words, the user wants to select a region in an image, and use the histogram of that region to adjust the histogram of the entire image.

This example and my previous code work if the histograms are taken from images of the same size. They do not work correctly (I think) if the histograms use images of different sizes. In that case, you must normalize the histograms to the

same "total number" of pixels. I'll probably have this on my web page soon, with the corrections in it. I just didn't want anyone getting too far down the wrong road here. :-)

Cheers,

David

--

David W. Fanning, Ph.D. Fanning Software Consulting, Inc.

Phone: 970-221-0438, E-mail: david@dfanning.com

Coyote's Guide to IDL Programming: http://www.dfanning.com/

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Subject: Re: Does IDL has histogram matching function? Posted by Paul Sorenson on Thu, 21 Nov 2002 22:23:30 GMT View Forum Message <> Reply to Message

I'm not sure if the implementation of FCN is correct. I'm still thinking about it. Here is an example:

```
pro histogram test
  filename = filepath('ctscan.dat', subdir=['examples', 'data'])
  image = read_binary(filename, data_dims=[256, 256])
  x = findgen(256)/255.
                            :Ramp from 0 to 1.
  y = \exp(-((x-.5)/.2)^2) ; Gaussian curve
  fcn = total(y, /cumulative)
  gauss_image = hist_equal(image, fcn=fcn)
  d = total(histogram(gauss_image, min=0, max=255), /cum);density
function
  device, decomp=0
  loadct, 39
  ;When we request a custom distribution curve, the result (in white)
  ;doesn't touch the ideal curve (in red). Is this an indication
  that the implementation of keyword FCN is incorrect?
! p.multi = [0, 2, 1]
  plot, bytscl(d)
  oplot, bytscl(fcn), color=254; red
```

```
uniform image = hist equal(image)
  d = total(histogram(uniform_image, min=0, max=255), /cum); density
function
  :When we request the default uniform distribution, the result (in white)
  ;touches the ideal curve (in red).
  plot, bytscl(d)
  oplot, bindgen(256), color=254; red
  end
"David Fanning" <david@dfanning.com> wrote in message
news:MPG.18432a801e0db738989a2e@news.frii.com...
> Paul Sorenson (aardvark62@msn.com) writes:
>
>> There is an undocumented keyword to HIST_EQUAL that looks like it
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>>
>> filename = filepath('ctscan.dat', subdir=['examples', 'data'])
   image = read_binary(filename, data_dims=[256, 256])
>> desired hist = histogram(hist equal(image), min=0, max=255)
>>
>> window, xsize=3*256, ysize=256
>> tv, image, 0
>> tv, hist_equal(image), 1
>> tv, hist equal(image, fcn=total(desired hist, /cumulative)), 2
>> end
>
> I think this is probably right, but I think
> both this function and the code that I threw off
> in a couple of minutes earlier in the week suffers
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> a region in an image, and use the histogram of that
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> This example and my previous code work if the histograms
> are taken from images of the same size. They do not work
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> same "total number" of pixels. I'll probably have this on
```

```
my web page soon, with the corrections in it. I just didn't
want anyone getting too far down the wrong road here. :-)
Cheers,
David
David
--
David W. Fanning, Ph.D.
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```

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Subject: Re: Does IDL has histogram matching function? Posted by David Fanning on Thu, 21 Nov 2002 23:57:44 GMT View Forum Message <> Reply to Message

Paul Sorenson (aardvark62@msn.com) writes:

- > I'm not sure if the implementation of FCN is correct. I'm still thinking
- > about it.

I don't know. According to what I read about this, the method is -- at best -- an approximation with digital images. It seems to be doing approximately what I expect it to. Close enough for government work, anyway.

Cheers,

David

--

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I think I have found a more accurate algorithm for the FCN keyword. The algorithm in hist\_equal.pro IDL 5.5 and 5.6 is:

```
if keyword_set(fcn_in) then begin
    y2 = bytscl(total(histogram(bytscl(fcn_in)), /CUM), TOP=top)
    p = y2[bytscl(p)]
  endif else begin
    p = BYTSCL(TEMPORARY(p), TOP = top)
  endelse
I changed that to:
  p = BYTSCL(TEMPORARY(p), TOP = top)
  if keyword_set(fcn_in) then begin
    y2 = bytarr(top + 1)
    f = bytscl(fcn in, top=top)
    f = congrid(f, top+1)
    for i=0,top do begin; invert curve f.
       y2[i] = (where(f ge i))[0]
    end
    p = y2[p]
  endif
```

With that change the resulting output fits the requested FCN more closely. I used procedure HISTOGRAM\_TEST (below) to assess output. This version of HISTOGRAM\_TEST has some fixes from the previous one that I posted in this thread (I think).

The algorithm that I am proposing yeilds images with grayscales that don't always reach TOP. This is dictated by the shape of the FCN curve, and by the fact that caluculations are BYTSCLed. If you really want to reach TOP, you would have to slightly distort the curve (or operate at a higher resolution than bytes). I have not tested this, but one way to reach TOP might be to change...

```
f = bytscl(fcn_in, top=top)
...to...

f = bytscl(fcn_in, top=top-1)
f[n_elements(f)-1] = top
```

...which distorts the curve a little.

## -Paul Sorenson pro histogram\_test, top=top ;Purpose: visually examine the output of HIST\_EQUAL by plotting :cumulative distribution functions. filename = filepath('ctscan.dat', subdir=['examples', 'data']) image = read binary(filename, data dims=[256, 256]) x = findgen(256)/255. ;Ramp from 0 to 1. $y = \exp(-((x-.5)/.2)^2)$ ; Gaussian curve fcn = total(y, /cumulative) gauss\_image = hist\_equal(image, fcn=fcn, top=top); Request custom dist. d = total(histogram(gauss image), /cum); Resulting distribution. device, decomp=0 window, /free loadct, 39 ;Comepare the ideal requested distribution curve (in red) to the actual resulting distribution curve (in white). !p.multi = [0, 2, 1]xrange = [0, top+10]; Somewhat arbitrary. ;xrange = [0, 80]; An interesting alternative. plot, bytscl(d), xrange=xrange oplot, bytscl(congrid(fcn, top+1)), color=254; red print, 'max(gauss\_image) = ', max(gauss\_image) uniform\_image = hist\_equal(image, top=top); Request uniform distribution. d = total(histogram(uniform image), /cum); Resulting distribution. ;Comepare the ideal requested distribution curve (in red) to the actual resulting distribution curve (in white). plot, bytscl(d), xrange=xrange oplot, bytscl(bindgen(top + 1)), color=254 ;red

## end

David Fanning <david@dfanning.com> wrote in message news:<MPG.184720e7d16d5cd5989a41@news.frii.com>...

> Paul Sorenson (aardvark62@msn.com) writes:

>

- >> I'm not sure if the implementation of FCN is correct. I'm still thinking
- >> about it.

>

- > I don't know. According to what I read about this,
- > the method is -- at best -- an approximation
- > with digital images. It seems to be doing approximately
- > what I expect it to. Close enough for government work,
- > anyway.

>

> Cheers.

>

> David

Subject: Re: Does IDL has histogram matching function? Posted by David Fanning on Thu, 12 Dec 2002 23:20:32 GMT View Forum Message <> Reply to Message

Tien i eram meedage ip respij te meedage

Paul Sorenson (aardvark62@msn.com) writes:

- > There are some things in that Gonzalez and Woods book that really hurt my
- > brain. On page 96, they say that G(z) = T(r). Get out of town! :-) How
- > can this be? They don't \*look\* the same in the plots shown on page 98
- > (Figure 3.19).

Well, they both are set equal to "s". :-)

- > G(z) is the desired cumulative distribution and T(r) is the
- > cumulative distribution of the input image. All of this appears in their
- > discussion of Histogram Matching.

Yeah, it hurts my brain, too. But I've e-mailed Dr. Gonzales a couple of times when I've been really stuck, and he is always nice enough to explain to me where I'm going wrong. (I've even discovered a couple of errors no one else had yet pointed out. This could be one of them.)

Cheers,

David

--

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