
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 procedures.
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
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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.
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Coyote's Guide to IDL Programming: <http://www.dfanning.com/>
Toll-Free IDL Book Orders: 1-888-461-0155

Subject: Re: Does IDL has histogram matching function?
Posted by [Paul Sorenson](#) on Thu, 21 Nov 2002 22:23:30 GMT
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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

fcu = total(y, /cumulative)
gauss_image = hist_equal(image, fcu=fcu)

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(fcu), 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:

>

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>>

>> window, xsize=3*256, ysize=256

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>> tv, hist_equal(image), 1

>> tv, hist_equal(image, fcn=total(desired_hist, /cumulative)), 2

>> end

>

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>
> Cheers,
>
> David
>
>
> --
> David W. Fanning, Ph.D.
> Fanning Software Consulting, Inc.
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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
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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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Subject: Re: Does IDL has histogram matching function?
Posted by [aardvark62](#) on Fri, 06 Dec 2002 21:37:29 GMT
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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

fcu = total(y, /cumulative)
gauss_image = hist_equal(image, fcu=fcu, top=top) ;Request custom
dist.

d = total(histogram(gauss_image), /cum) ;Resulting distribution.

device, decomp=0
window, /free
loadct, 39
;
;Compare 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(fcu, 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.
;
;Compare 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:

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>> about it.

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> 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](#)

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

--

David W. Fanning, Ph.D.

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