NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

School of Science

Information Technologies in Medicine and Biology

Direction: ***Bioinformatics***

Image Processing and Analysis

Postgraduate Student: *Begetis Nikolaos* Professor: *Cavouras Dionisis*

Deadline Date: *11/03/2013*

Assignment 2

Comparison results using the formulas of Simple Window, Broken Window and Double Window

Initially the original matrix is:

30	31	12	9
17	12	25	9
12	8	17	9
31	12	26	22

The displayed matrix when displaying in the grey tone values is:

7	7	3	2
4	3	6	2
3	2	4	2
7	3	6	5

To infer the above matrix we used the function:

$$tone = \frac{(tones_{max} - tones_{\min}) * (Vm - Va)}{Vb - Va} + 0 = \frac{(7-0) * (Vm-0)}{31-0} + 0,$$

$where\ Vm\ is\ the\ value\ of\ each\ cell.$

Simple Window

In order to extract the matrix output from the simple window function, we apply in the original matrix the simple window function:

$$tone = \frac{(tones_{max} - tones_{\min}) * (Vm - Va)}{Vb - Va} + 0 = \frac{(7-0) * (Vm - Va)}{Vb - Va} + 0, (1)$$

$where\ Va\ and\ Vb\ are\ given\ respectively\ from\ the\ formulas$:

$$WW = Vb - Va$$

$$WC = \frac{Vb - Va}{2}, (2)$$

From the above two formulas we can conclude:

$$(1) \overset{(2)}{\Rightarrow}\ tone = \frac{(7-0)*(Vm-10)}{30-10} + 0, for\ WW = 20\ and\ WC = 20$$

The resulted matrix is shown below and is identical to the output matrix of MATLAB:

7	7	1	0
2	1	5	0
1	0	2	0
7	1	6	4

Broken Window

In the same way as we did previously, having to extract the matrix output from the broken window function, we apply in the original matrix the broken window function:

$$if\ Im_{val} < Vm$$

$$tone = \frac{(Gray_{val})*(Vm-Va)}{Im_{val}-Va} + 0 == \frac{(5-0)*(Vm-0)}{21-0} + 0, (1)$$

$$else\ if\ Im_{val} > Vm$$

$$tone = \frac{(tones_{max} - tones_{\min})*(Vm - Im_{val})}{Vb - Im_{val}} + 0 =$$

$$= \frac{(7-0)*(Vm-21)}{31-21} + 0, (2)$$

$where$
$Vb\ is\ the\ \max image\ depth,$
$Va\ is\ the\ \min image\ depth$
$Gray_{val}\ is\ the\ given\ value\ of\ grayscale\ applied\ a\ cell's\ value\ is\ less\ than\ Im_{val}$
$Im_{val} is\ the\ given\ value\ where\ the\ function\ of\ broken\ window\ changes$

$$so, for\ Vb = 31, Va = 0, tones_{max} = 7, Gray_{val} = 5\ and\ Im_{val} = 21$$
$$we\ inferred\ the\ above\ (1)\ and\ (2)$$

The resulted matrix is shown below and is identical to the output matrix of MATLAB:

6	7	3	2
4	3	3	2
3	2	4	2
7	3	4	1

Double Window

Finally, as we did in the above two function, having to extract the matrix output from the double window function, we apply in the original matrix the double window function, which is pretty alike the function of the simple window:

$$if\ Va_1 \leq Vm \leq Vb_1$$

$$tone = \frac{(tones_{max} - tones_{\min}) * (Vm - Va_1)}{Vb_1 - Va_1} + 0, (1)$$

$$else\ if\ Vb_1 \leq Vm \leq Va_2$$

$$tone = \left\lfloor \frac{(tones_{max} - tones_{\min})}{2} \right\rfloor, (2)$$

$$else\ if\ Va_2 \leq Vm \leq Vb_2$$

$$tone = \frac{(tones_{max} - tones_{\min}) * (Vm - Va_1)}{Vb_1 - Va_1} + 0, (3)$$

$where\ Va_x\ and\ Vb_x\ are\ given\ respectively\ from\ the\ formulas$:

$$ww_x = Vb_x - Va_x$$

$$wc_x = \frac{Vb_x - Va_x}{2}, (4)$$

$So,$

$$(1) \overset{(4)}{\Rightarrow} tone = \frac{(7-0) * (Vm - 5)}{15 - 5} + 0,$$

and

$$(3) \overset{(4)}{\Rightarrow} tone = \frac{(7-0) * (Vm - 20)}{30 - 20} + 0,$$

$for\ ww1 = 10, ww2 = 10, wc1 = 10\ and\ wc2 = 25.$

The resulted matrix is shown below and is identical to the output matrix of MATLAB:

7	7	5	3
3	5	4	4
5	2	3	3
7	5	4	1