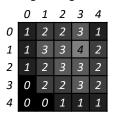
Aula 3c – Transformações de intensidade

Prof. João Fernando Mari joaof.mari@ufv.br

Equalização de histograma

Imagem original:



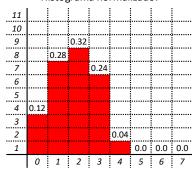
5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

Imagem original:

	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

Histograma normalizado:



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Equalização de histograma

Imagem original:

	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

Histograma normalizado:

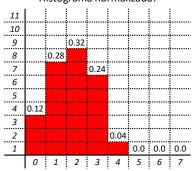
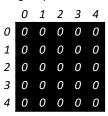


Imagem processada:



Histograma normalizado:

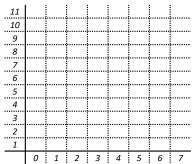
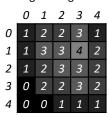


Imagem original:



5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

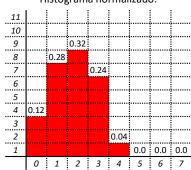
	k
$s_k = T(r_k) :$	$=L-1\sum_{i}p_{r}(r_{j})$
	1=0

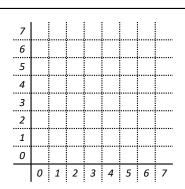
Imagem processada:

1 2 3 4

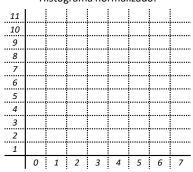
0 0 0 0

Histograma normalizado:





Histograma normalizado:



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Equalização de histograma

Imagem original:

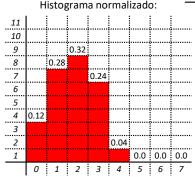
	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

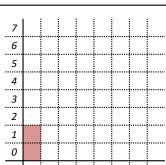
5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7] $s_k = T(r_k) = L - 1 \sum_{j=0}^k p_r(r_j)$

k	p'	$s_k = T(r_k)$
0 7×(0.12)	= 0.84	= 1
1		
2		
3		
4		
5		
6		
7		

Imagem processada:

Histograma normalizado:





Histograma normalizado: 10

Imagem original:

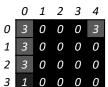
	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

$s_k =$	$T(r_k) =$	$L-1\sum_{i=0}^{k}p_{r}(r_{j})$)
		i=0	

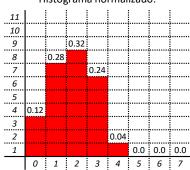
k		p'	$s_k = T(r_k)$
0	7 × (0.12)	= 0.84	= 1
1	7 × (0.12 + 0.28)	= 2.80	= 3
2			
3			
4			
5			
6	-		

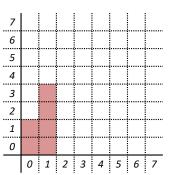
Imagem processada:

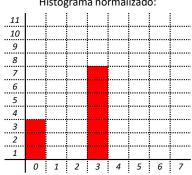


Histograma normalizado:

Histograma normalizado:







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Equalização de histograma

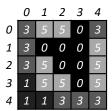
Imagem original:

	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

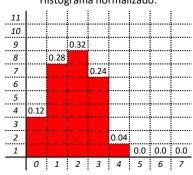
5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7] $s_k = T(r_k) = L - 1 \sum_{j=0}^k p_r(r_j)$

k		p'	$s_k = T(r_k)$
0	7 × (0.12)	= 0.84	= 1
1	7 × (0.12 + 0.28)	= 2.80	= 3
2	7 × (0.12 + 0.28 + 0.32)	= 5.04	= 5
3			
4			
5			
6			
7	_		

Imagem processada:



Histograma normalizado:



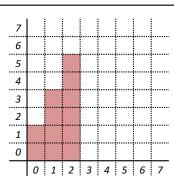


Imagem original:

	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

$s_k =$	$T(r_k) =$	$L-1\sum_{i=0}^{k}p_{r}(r_{j})$)
		i=0	

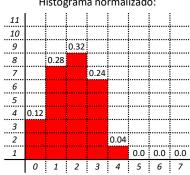
k		p'	$s_k = T(r_k)$
0	7 × (0.12)	= 0.84	= 1
1	7 × (0.12 + 0.28)	= 2.80	= 3
2	7 × (0.12 + 0.28 + 0.32)	= 5.04	= 5
3	7 × (0.12 + 0.28 + 0.32 + 0.24)	= 6.72	= 7
4			
5			
6			
7			

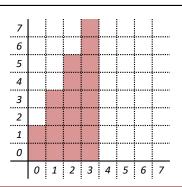
Imagem processada:

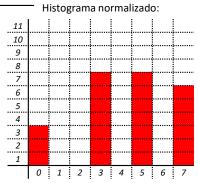
	0	1	2	3	
)	3	5	5	7	

0	3	5	5	7	3
1	3	7	7	0	5
2	3	5	7	7	5
3	1	5	5	7	5

Histograma normalizado:







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Equalização de histograma

Imagem original:

	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

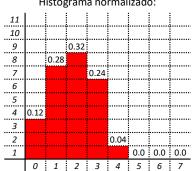
5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7] $s_k = T(r_k) = L - 1 \sum_{j=0}^k p_r(r_j)$

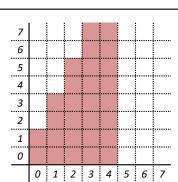
k		p'	$s_k = T(r_k)$
0	7 × (0.12)	= 0.84	= 1
1	7 × (0.12 + 0.28)	= 2.80	= 3
2	7 × (0.12 + 0.28 + 0.32)	= 5.04	= 5
3	7 × (0.12 + 0.28 + 0.32 + 0.24)	= 6.72	= 7
4	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04)	= 7.00	= 7
5			
6			
_			

Imagem processada:

	0	1	2	3	4
0	3	5	5	7	3
1	3	7	7	7	5
2	3	5	7	7	5
3	1	5	5	7	5
4	1	1	3	3	3

Histograma normalizado:





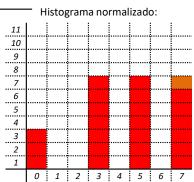


Imagem original:

	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

$s_k =$	$T(r_k) =$	$L-1\sum_{i=0}^{k}p_{r}(r_{j})$)
		i=0	

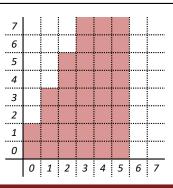
k		p'	$s_k = T(r_k)$
0	7 × (0.12)	= 0.84	= 1
1	7 × (0.12 + 0.28)	= 2.80	= 3
2	7 × (0.12 + 0.28 + 0.32)	= 5.04	= 5
3	7 × (0.12 + 0.28 + 0.32 + 0.24)	= 6.72	= 7
4	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04)	= 7.00	= 7
5	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04 + 0)	= 7.00	= 7
6			
7			

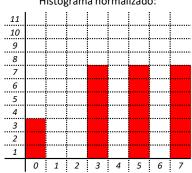
Imagem processada:

	0	1	2	3	4
0	3	5	5	7	3
1	3	7	7	7	5
2	3	5	7	7	5
3	1	5	5	7	5

Histograma normalizado:

	Histograma normalizado:									
	11									
•	10									
•	9			0.32						
•	8		0.28							
	7				0.24					
	6									
	5									
	4	0.12								
	3									
	2					0.04				
	1						0.0	0.0	0.0	
		0	1	2	3	4	5	6	7	





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Equalização de histograma

Imagem original:

	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

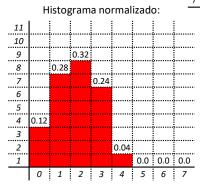
5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

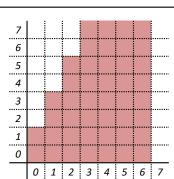
	k
$s_k = T(r_k) = L -$	$1\sum_{i=0}p_r(r_j)$

k		p'	$s_k = T(r_k)$
0	7 × (0.12)	= 0.84	= 1
1	7 × (0.12 + 0.28)	= 2.80	= 3
2	7 × (0.12 + 0.28 + 0.32)	= 5.04	= 5
3	7 × (0.12 + 0.28 + 0.32 + 0.24)	= 6.72	= 7
4	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04)	= 7.00	= 7
5	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04 + 0)	= 7.00	= 7
6	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04 + 0 + 0)	= 7.00	= 7
7			

Imagem processada:

	0	1	2	3	4
0	3	5	5	7	3
1	3	7	7	7	5
2	3	5	7	7	5
3	1	5	5	7	5
4	1	1	3	3	3





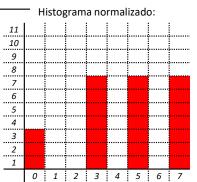


Imagem original:

	0	1	2	3	4
0	1		2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

$s_k = T(r_i)$	$_{k})=L-1\sum^{k}p_{r}(r_{j})$
	$\frac{2}{i=0}$

k		p'	$s_k = T(r_k)$
0	7 × (0.12)	= 0.84	= 1
1	7 × (0.12 + 0.28)	= 2.80	= 3
2	7 × (0.12 + 0.28 + 0.32)	= 5.04	= 5
3	7 × (0.12 + 0.28 + 0.32 + 0.24)	= 6.72	= 7
4	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04)	= 7.00	= 7
5	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04 + 0)	= 7.00	= 7
6	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04 + 0 + 0)	= 7.00	= 7
7	$7 \times (0.12 + 0.28 + 0.32 + 0.24 + 0.04 + 0 + 0)$	= 7.00	= 7

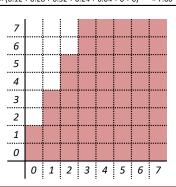
Imagem processada:

	0	1	2	3	4
0	3	5	5	7	3
1	3	7	7	7	5
2	3	5	7	7	5
3	1	5	5	7	5

4 1 1 3 3 3

Histograma normalizado:

	mistograma normanzado.							
11								
10								
9			0.32					
8		0.28						
7				0.24				
6								
5								
4	0.12							
3								
2					0.04			
1						0.0	0.0	0.0
	0	1	2	3	4	5	6	7



Histograma normalizado: 10 0 1 2 3 4 5 6 7

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Equalização de histograma

Imagem original:

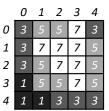
	0	1	2	3	4
0	1	2	2	3	1
1	1	3	3	4	2
2	1	2	3	3	2
3	0	2	2	3	2
4	0	0	1	1	1

5 x 5 pixels = 25 pixels 3 bits ou 2³ = 8 níveis de cinza (L). Intervalo de níveis de cinza: [0, 7]

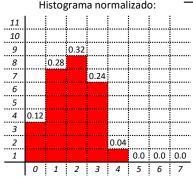
m() 1	$\sum_{k=1}^{k}$
$s_k = T(r_k) = L -$	$1 \sum_{j=0}^{\infty} p_r(r_j)$

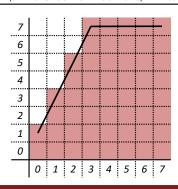
k		p'	$s_k = T(r_k)$
0	7 × (0.12)	= 0.84	= 1
1	7 × (0.12 + 0.28)	= 2.80	= 3
2	7 × (0.12 + 0.28 + 0.32)	= 5.04	= 5
3	7 × (0.12 + 0.28 + 0.32 + 0.24)	= 6.72	= 7
4	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04)	= 7.00	= 7
5	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04 + 0)	= 7.00	= 7
6	7 × (0.12 + 0.28 + 0.32 + 0.24 + 0.04 + 0 + 0)	= 7.00	= 7
7	7 × (0 12 + 0 28 + 0 32 + 0 24 + 0 04 + 0 + 0)	= 7.00	= 7

Imagem processada:



Histograma normalizado:





Histograma normalizado: 10 9 8 7 6 5 4 3 2 0.28 0.28 0.28 2 3 4 5 6 7

Bibliografia

MARQUES FILHO, O.; VIEIRA NETO, H. Processamento digital de imagens. Brasport, 1999.

Disponível para download no site do autor (Exclusivo para uso pessoal)

http://dainf.ct.utfpr.edu.br/~hvieir/pub.html

Seções 3.3

GONZALEZ, R.C.; WOODS, R.E.; **Processamento Digital de Imagens.** 3º edição. Editora Pearson, 2009.

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J. E. R. Queiroz, H. M. Gomes. Introdução ao Processamento Digital de Imagens. RITA. v. 13, 2006.

http://www.dsc.ufcg.edu.br/~hmg/disciplinas/graduacao/vc-2016.2/Rita-Tutorial-PDI.pdf Seção 3.2

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FIM