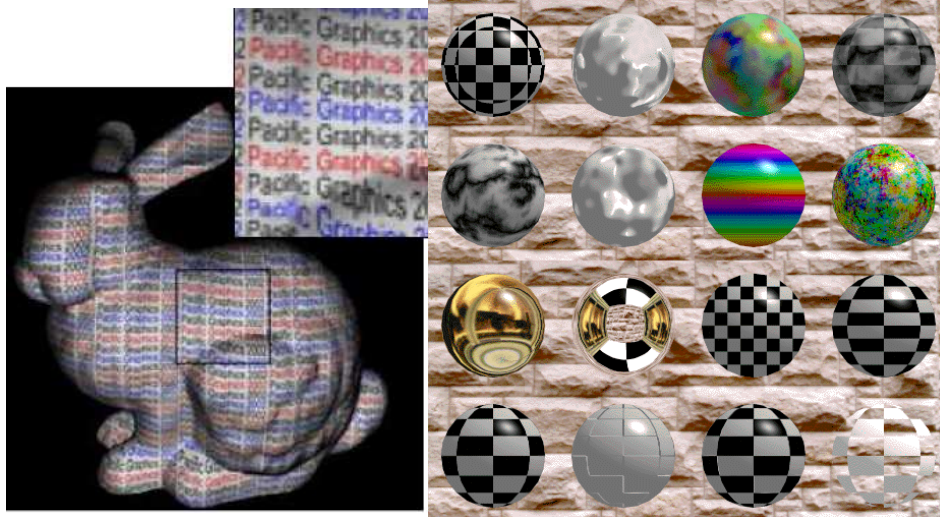
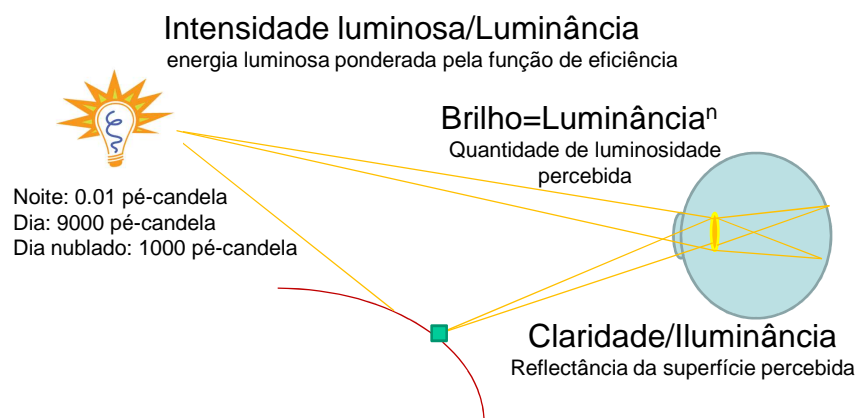


Fundamentos de Imagens



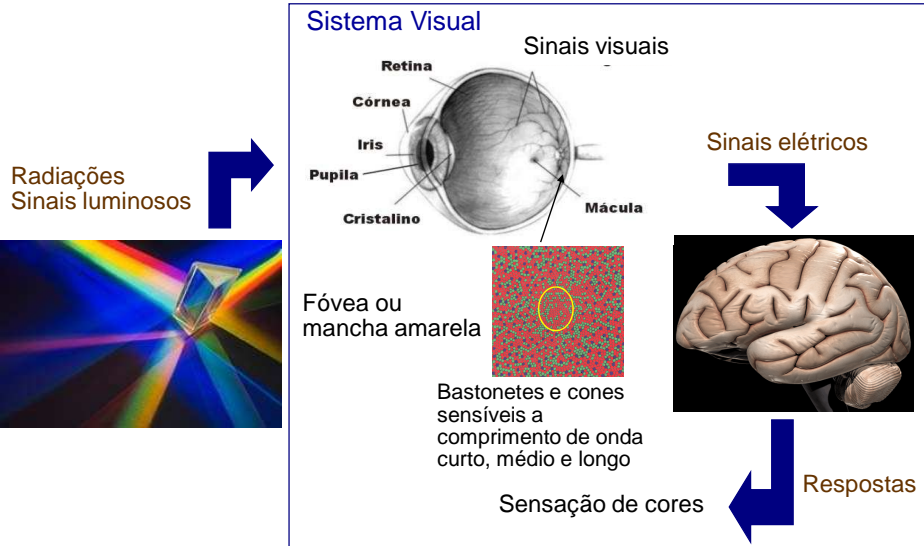
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Percepção de Imagens Óptica Geométrica



EA978 – 2s2008 - Ting

Sistema Visual



EA978 - 2s2008 - Ting

Olho

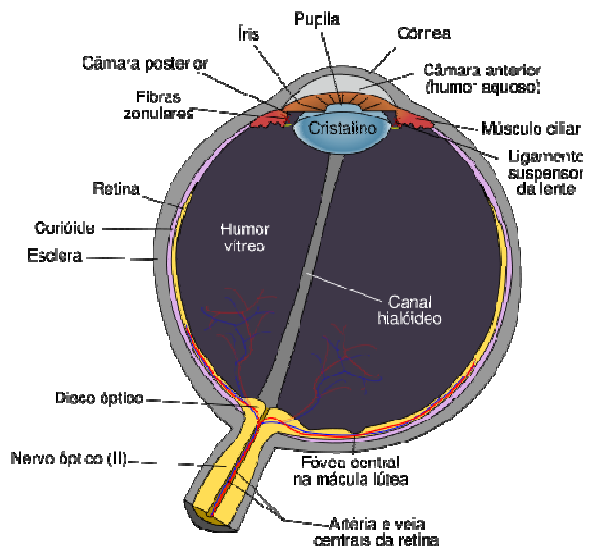
Analogia à câmara

Pupila: diafragma

Cristalino: lente

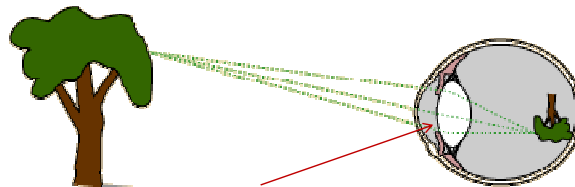
Retina: arranjo óptico

Nervo Óptico: comunicação com cérebro

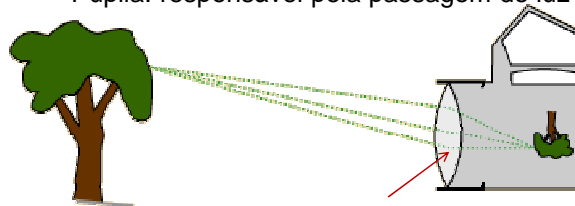


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Pupila



Pupila: responsável pela passagem de luz do meio exterior



Diafragma

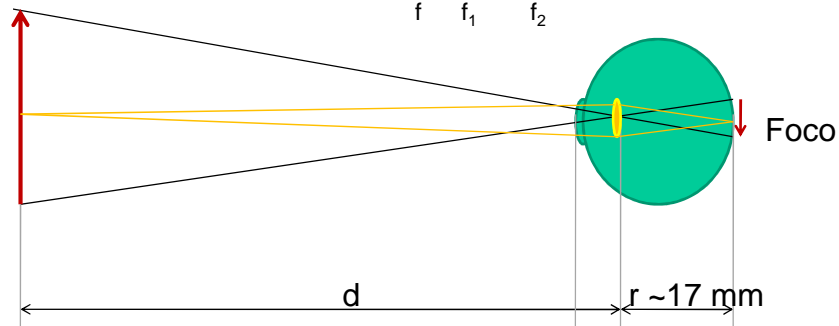
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Lente

Córnea (f_1) e Cristalino (f_2)

Vergência de uma lente $\frac{1}{f} = \frac{1}{d} + \frac{1}{r}$ (em dioptria -di)

Vergência da lente humana $\frac{1}{f} = \frac{1}{f_1} \pm \frac{1}{f_2} = \sim 40 \text{ di} \pm \text{acomodação}$



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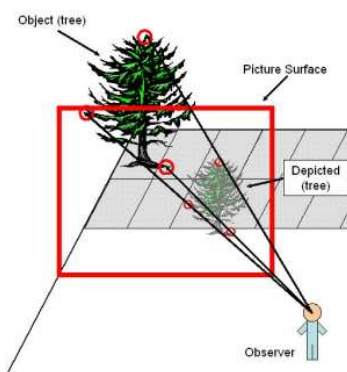
Ângulo Visual

Visual Angles Associated with Common Objects and Distances	
Character on a computer screen at 50 cm	17' (0.28 degrees)
Diameter of the sun and moon as seen from Earth	30' (0.50 degrees)
Quarter held at arm's length	2.5 degrees
Thumbnail at arm's length (basis for the expression "rule of thumb")	2 degrees
Quarter at 100 meters	0.85' (0.014 degrees)
Quarter at 5 km	1" (0.00028 degrees)
Diameter of the fovea	1 degree
Diameter of a foveal cone	30" (0.5')
Dimensions of the blind spot	7.5 degrees (vertical); 5 degrees (horizontal)

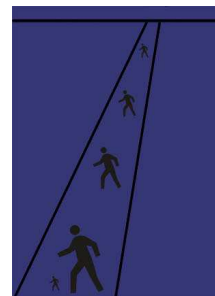
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Perspectiva

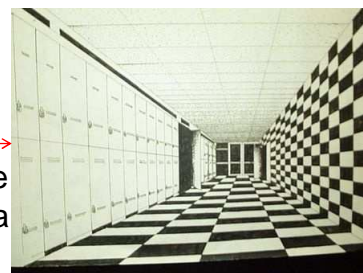
• Projeções perspectivas



• Gradiente de tamanho

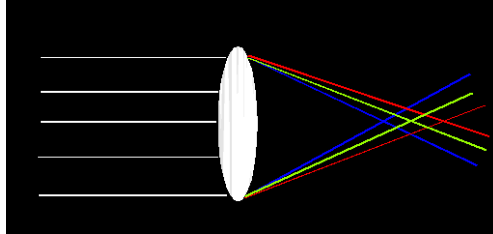


• Gradiente de textura



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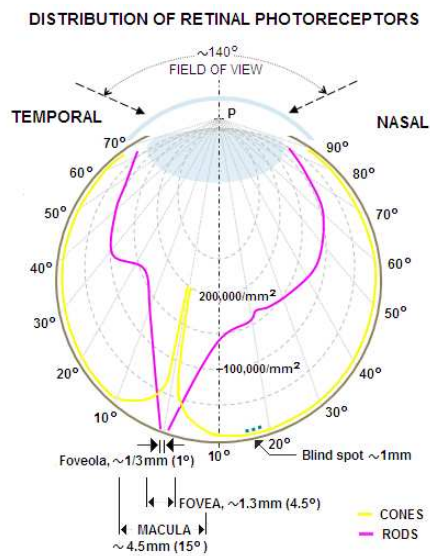
Aberrações Cromáticas



Muitas pessoas vêem o vermelho
mais próximo do que o azul
Mas para algumas
o efeito é contrário

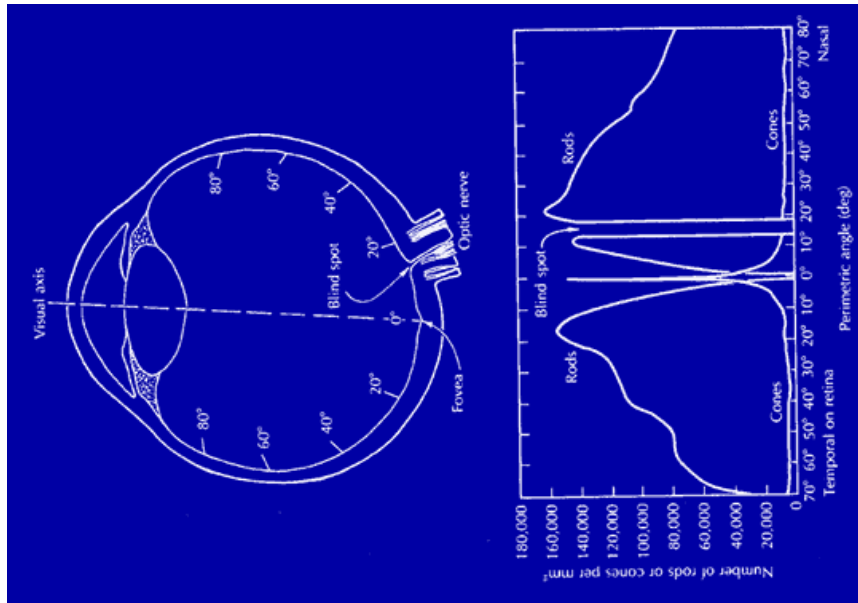
EA978 – 2s2008 - Ting

Retina



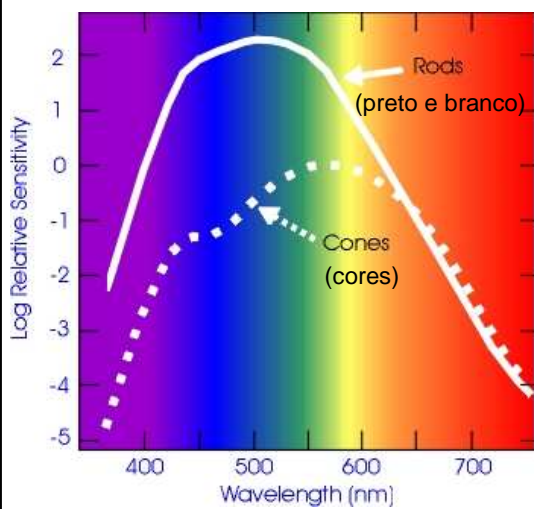
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Retina



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Fotoreceptoras



Visão fotópica (diurna) : visão adaptada a altos níveis de luminância. Visão colorida.

Visão mesópica: visão adaptada a regiões de níveis intermediários.

Visão escotópica (noturna): visão adaptada a baixos níveis de luminância. Os bastonetes respondem melhor.

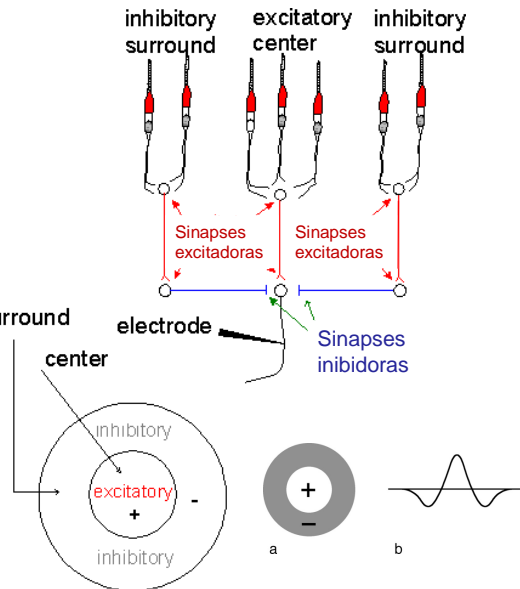
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Campos Receptivos de Neurônios

Modelo de
Diferença de
Gaussianas

$$f(x) = \alpha_1 e^{-\left(\frac{x}{w_1}\right)^2} - \alpha_2 e^{-\left(\frac{x}{w_2}\right)^2}$$

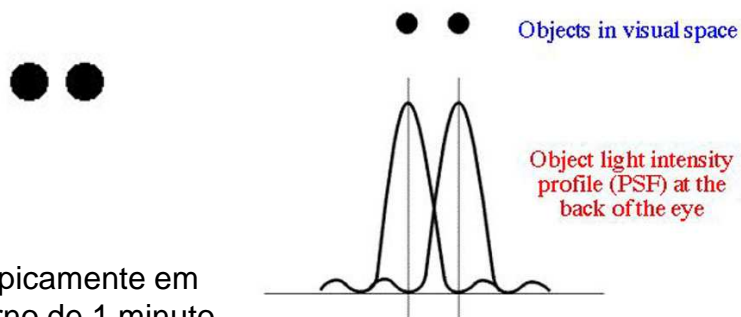
Função de espalhamento pontual



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Acuidade Espacial

Habilidade em distinguir separabilidade

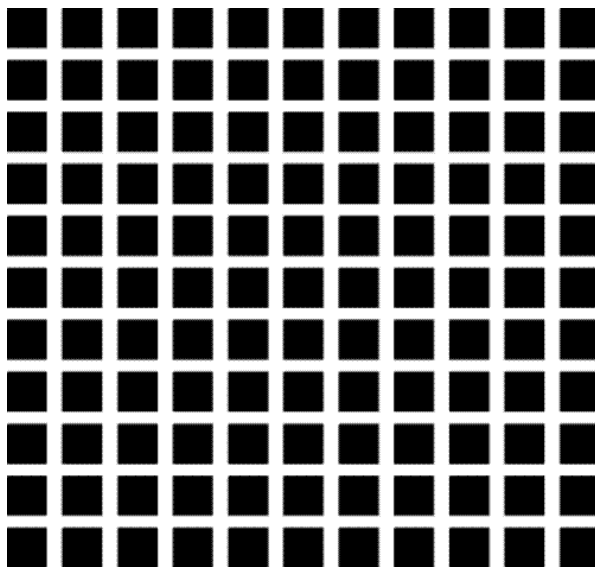


tipicamente em
torno de 1 minuto
de arco.

Função de espalhamento pontual

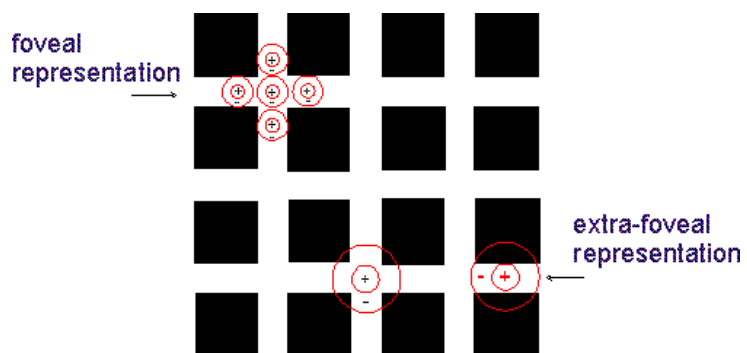
EA978 - 2s2008 - Ting

Ilusão de Grade de Hermann



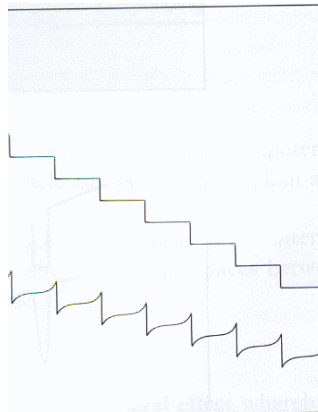
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Ilusão de Grade de Hermann



EA978 – 2s2008 - Ting

Ilusão de Chevreul



EA978 – 2s2008 - Ting

Ilusão de Chevreul



EA978 – 2s2008 - Ting

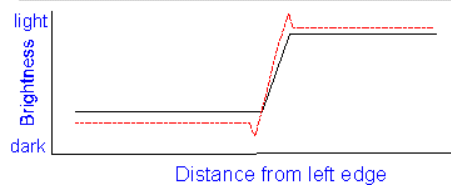
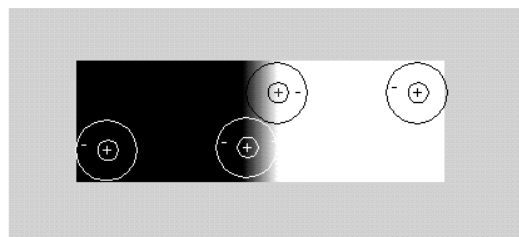
Ilusão de Banda de Mach



Ilusão de duas “bandas”

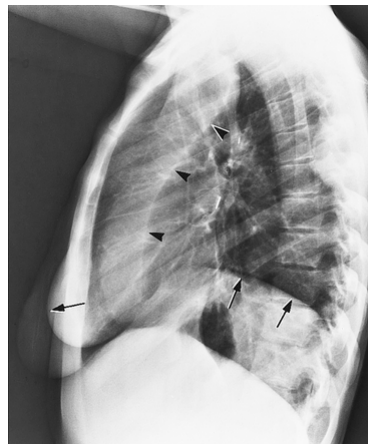
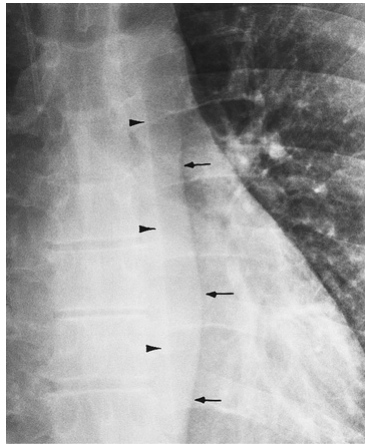
EA978 – 2s2008 - Ting

Ilusão de Banda de Mach



EA978 – 2s2008 - Ting

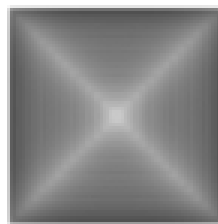
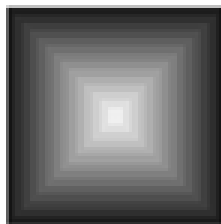
Análise de Imagens Radiográficas



<http://radiology.rsna.org/cgi/content/full/219/3/596>

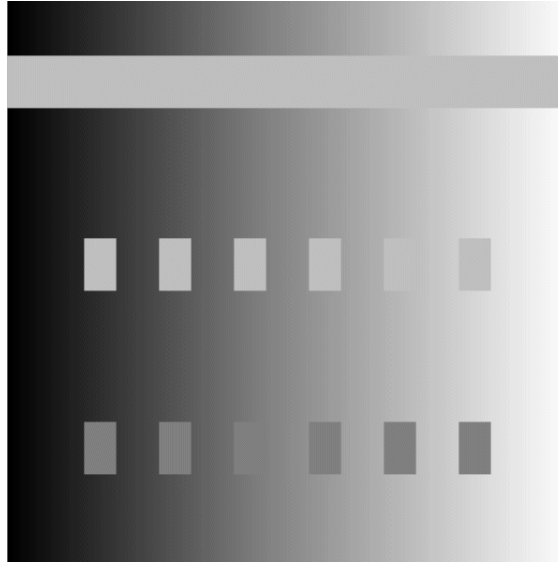
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Ilusão de Vasarely



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Contraste de Brilhos Simultâneos



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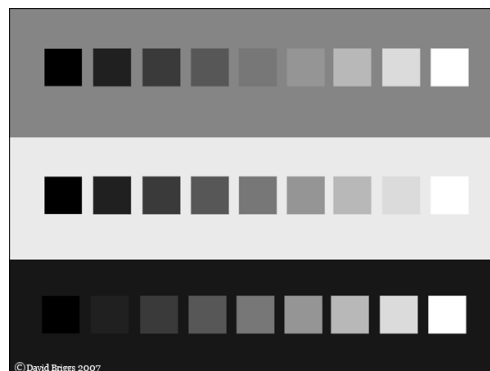
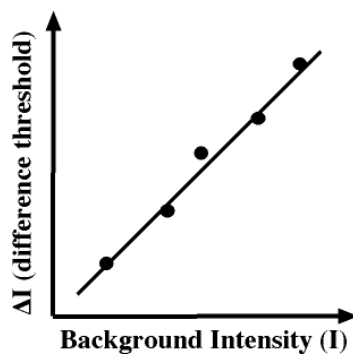
Discriminação de Intensidade

Razão de Weber

Para $L \pm \Delta L \sim L$, esta razão é em torno de 0.005 e independente da luminância

$$\frac{\Delta I}{I} = K$$

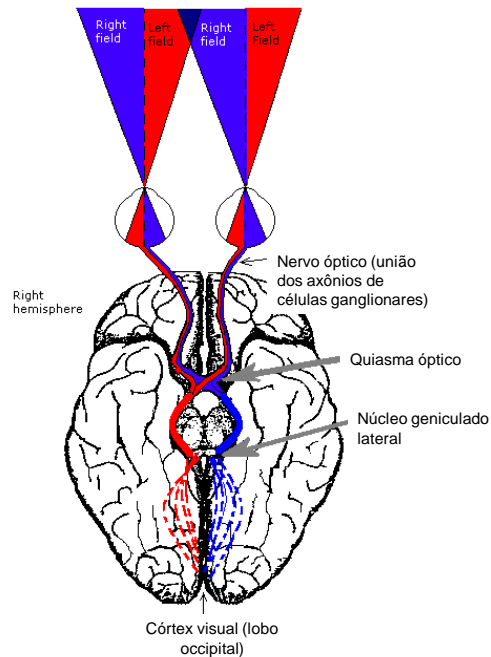
The Weber fraction



© David Briggs 2007

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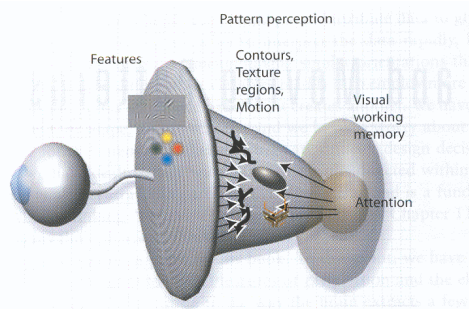
Visão Binocular



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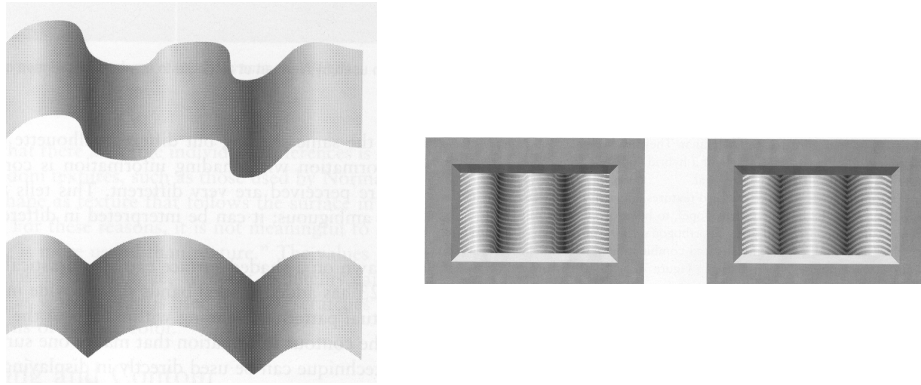
Modelo de Percepção

- Constituído de 3 fases
 - Análise de características primitivas, como forma, movimento, cor e profundidade estereoscópica
 - Percepção de padrões, identificando contornos, regiões, textura e padrões de movimento;
 - Processamento atencional orientado a tarefas, onde objetos e padrões relevantes são focalizados.



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Interação de vários fatores Borda e Sombreamento



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Interação de vários fatores Efeito cinético + Rigidez

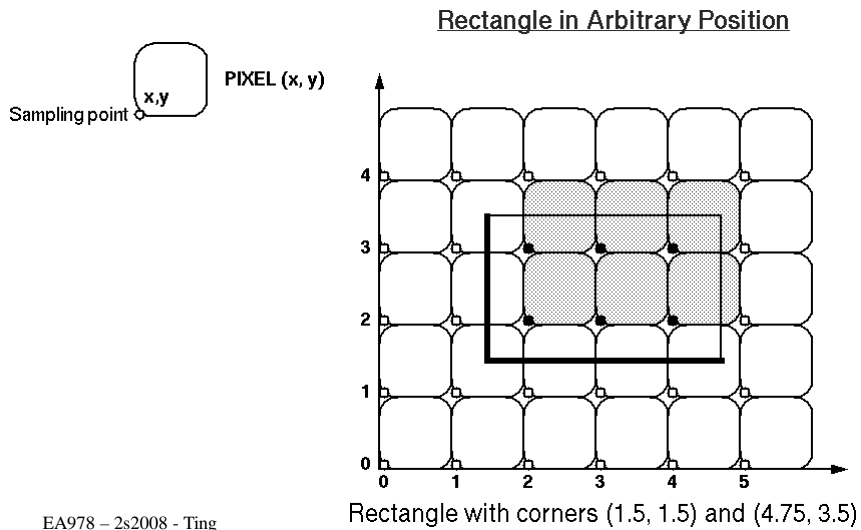


©2003 Bach

http://www.michaelbach.de/ot/mot_ske/

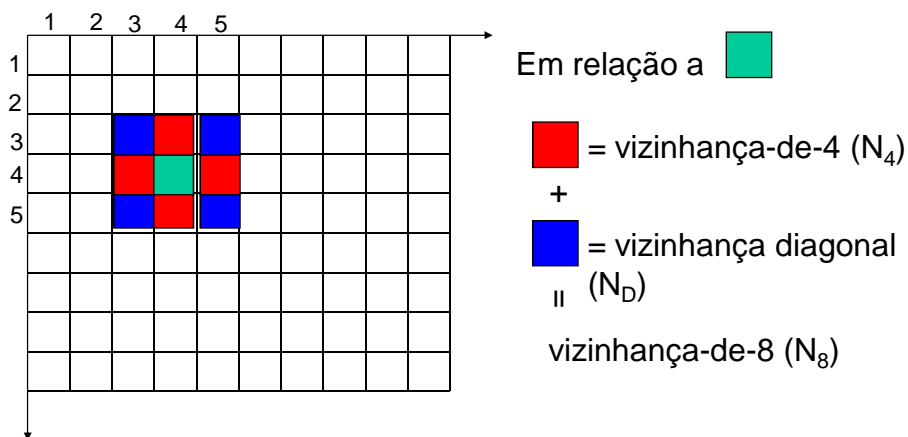
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Endereçamento de Pixels



Matemática de Raster

Vizinhança

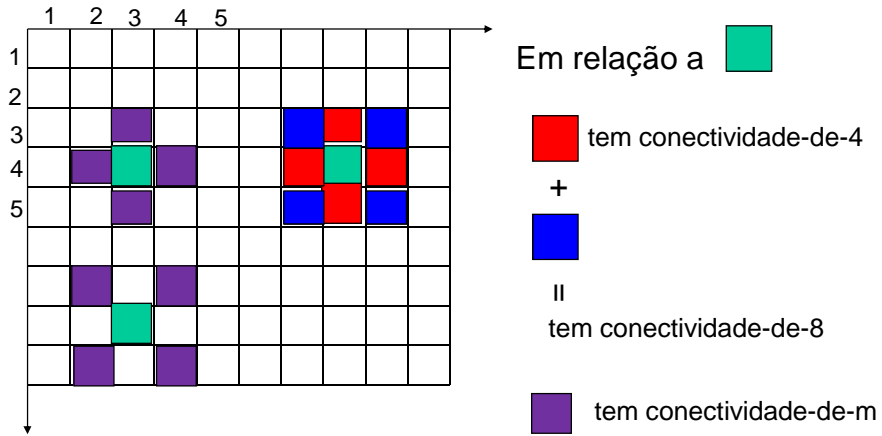


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Matemática de Raster

Conectividade

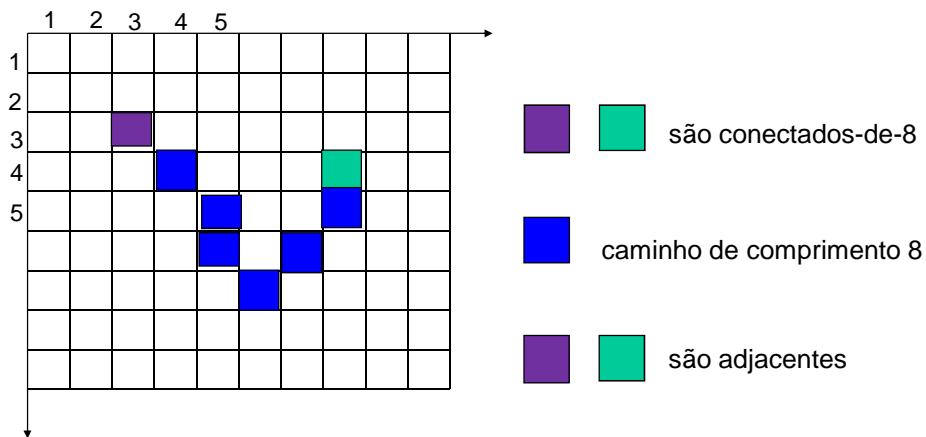
Os pixels coloridos satisfazem o mesmo critério de similaridade



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Matemática de Raster

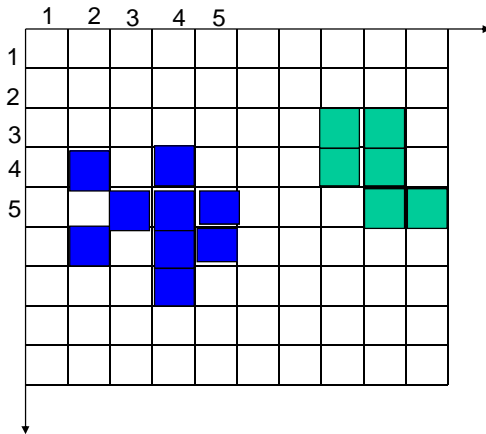
Adjacência



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Matemática de Raster

Componentes Conexos

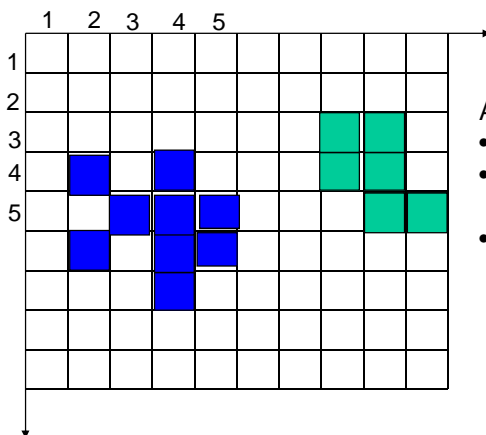


- Componente conexo(-de-4)
- Componente conexo(-de-8)

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Matemática de Raster

Relação de Equivalência

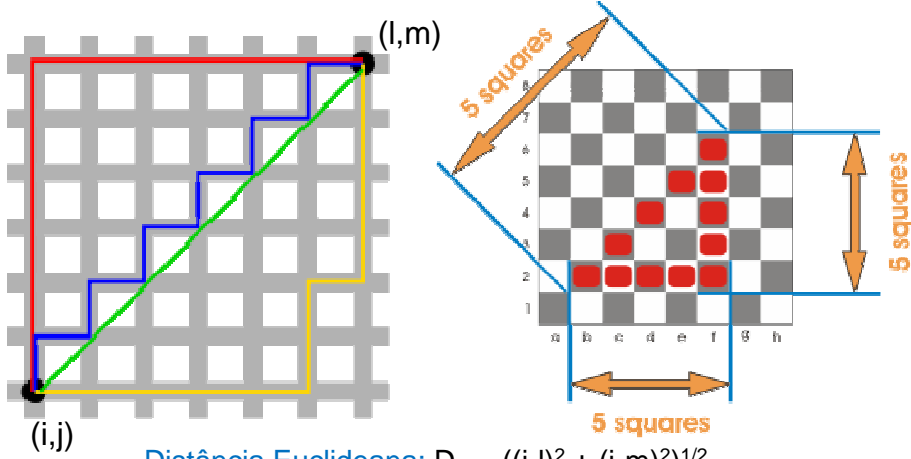


- A relação R entre *pixels* é
- reflexiva: se para cada *pixel* p , pRp
 - simétrica, se para cada *pixel* p e q , pRq implica qRp
 - transitiva, se para cada *pixel* p , q e r , pRq e qRr implica pRr

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Matemática de Raster

Métricas



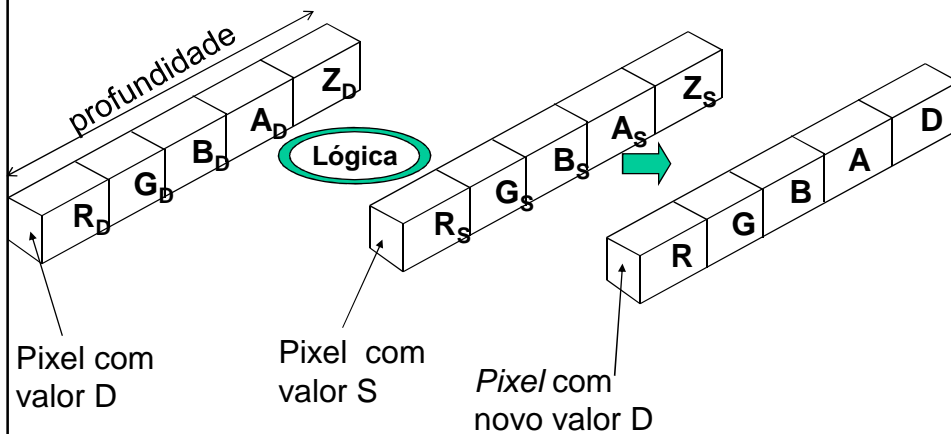
Distância Euclideana: $D_E = ((i-l)^2 + (j-m)^2)^{1/2}$

Distância de Quarteirão: $D_4 = |i-l| + |j-m|$

Distância de Xadrez: $D_8 = \max(|i-l|, |j-m|)$

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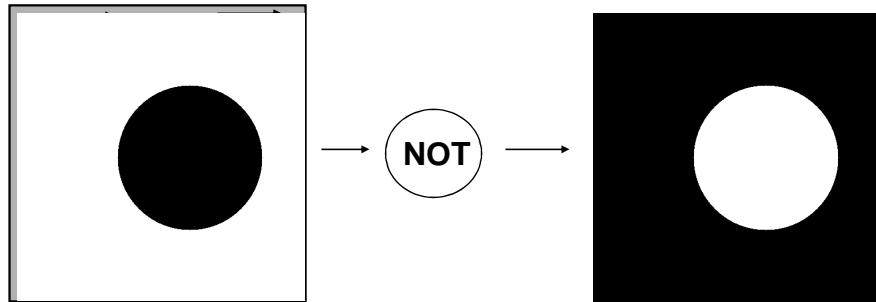
Operações Lógicas: Unárias e Binárias



Operações lógicas (AND, NAND, OR, NOT, etc) bit a bit

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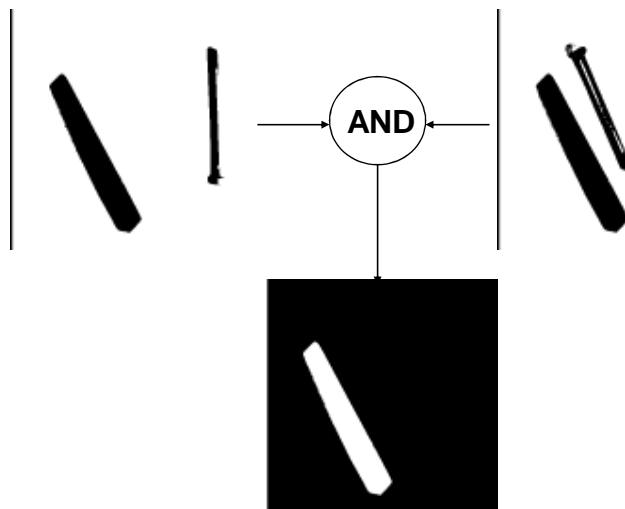
NOT



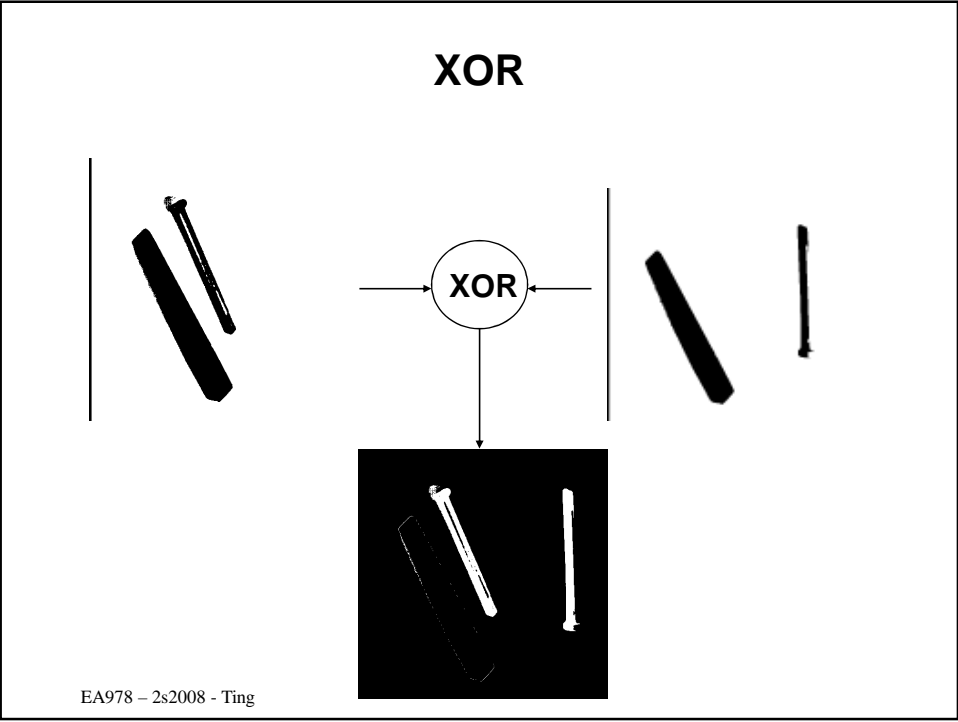
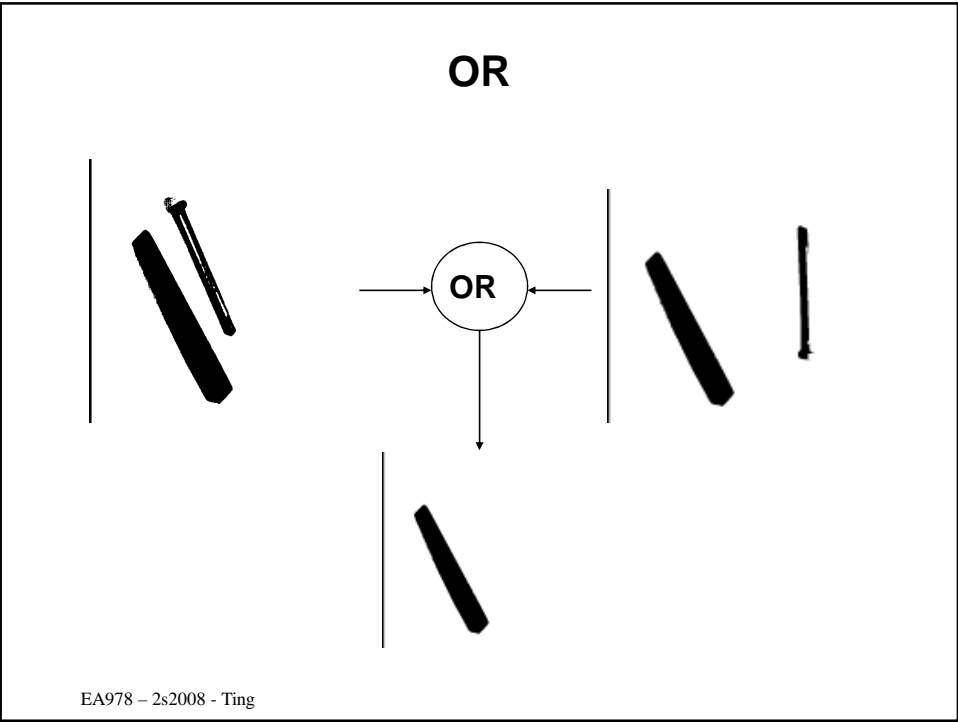
<http://homepages.inf.ed.ac.uk/rbf/HIPR2/index.htm>

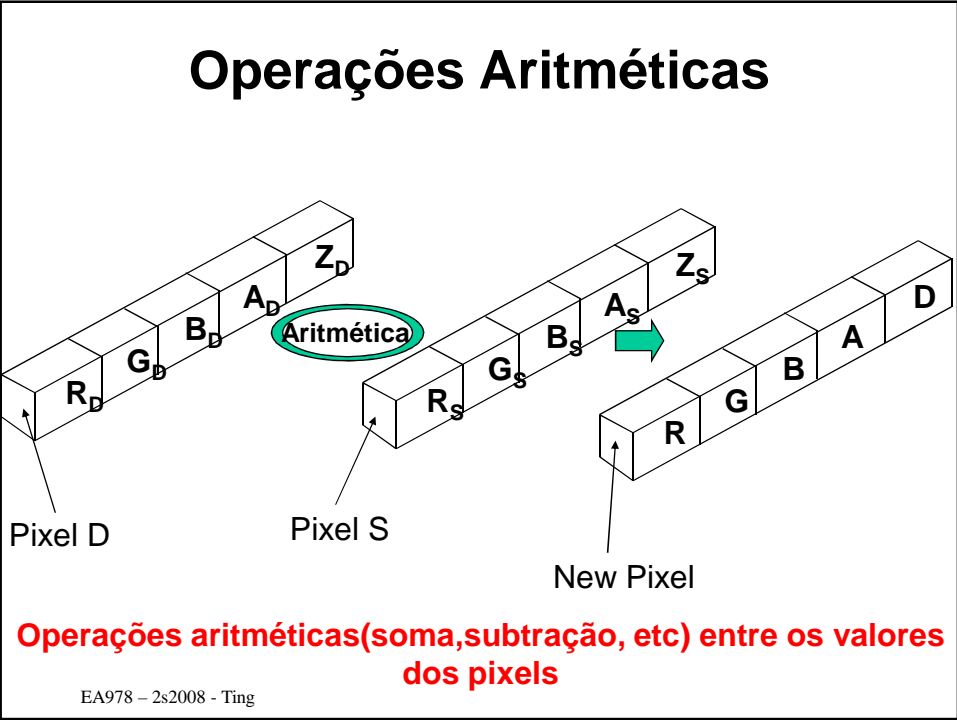
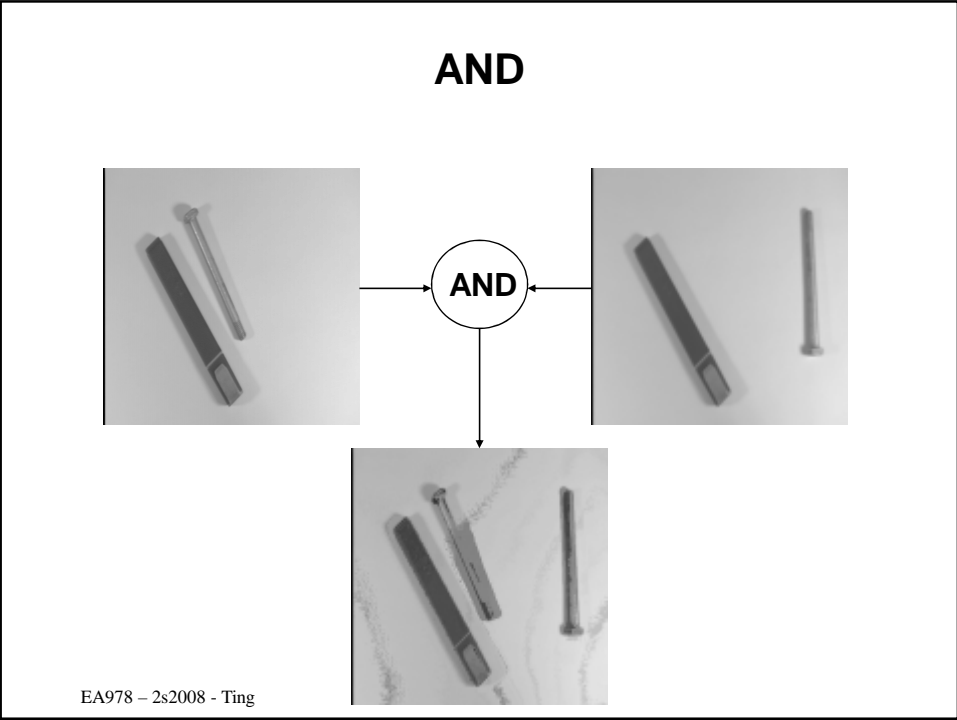
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AND

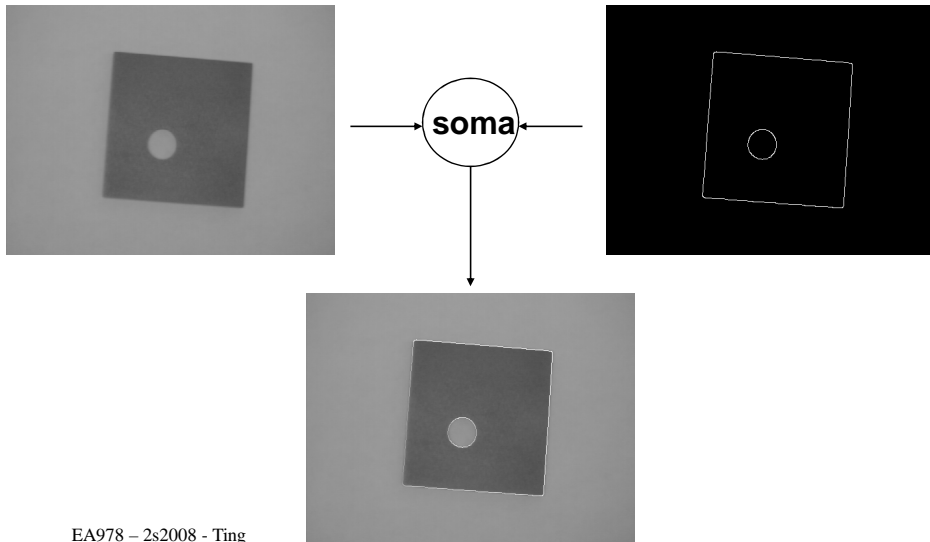


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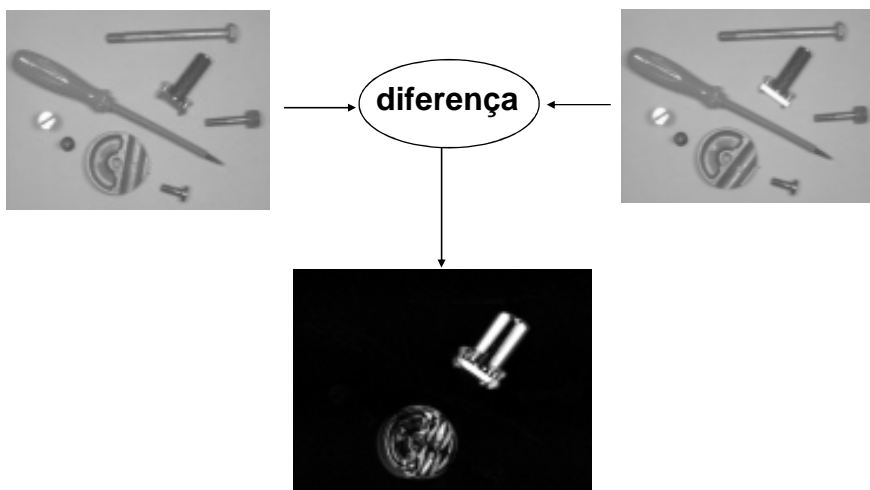




Soma



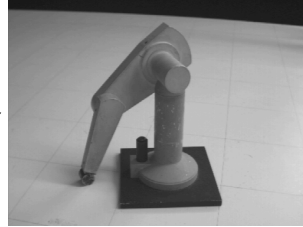
Diferença



Multiplicação



multiplica

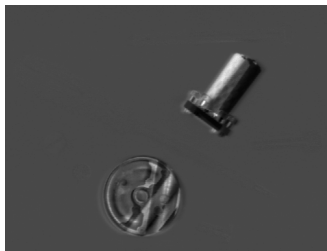


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Divisão

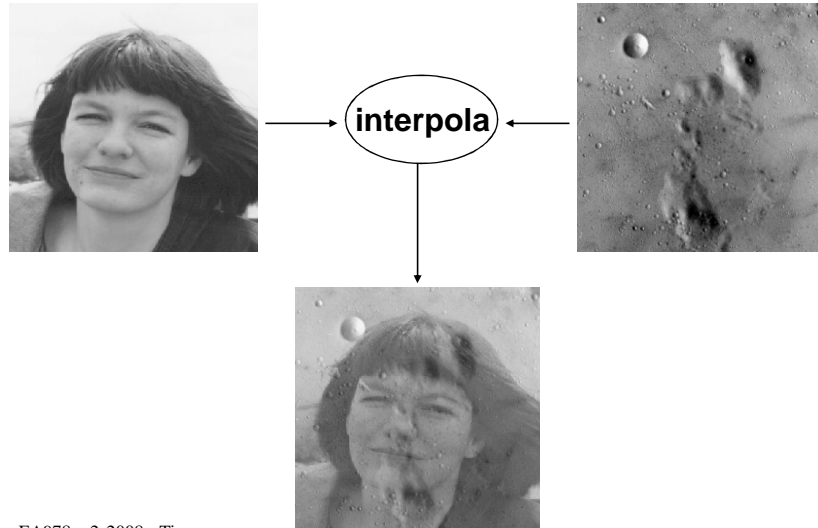


divide



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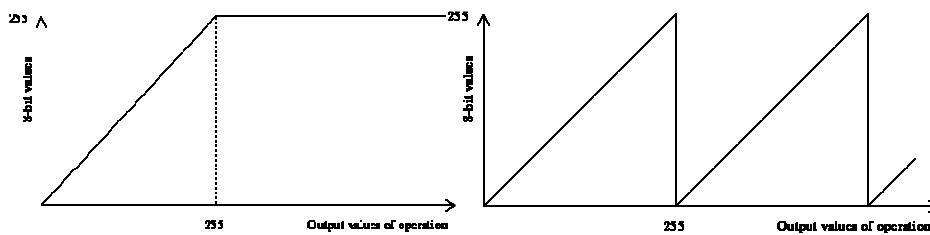
Interpolação



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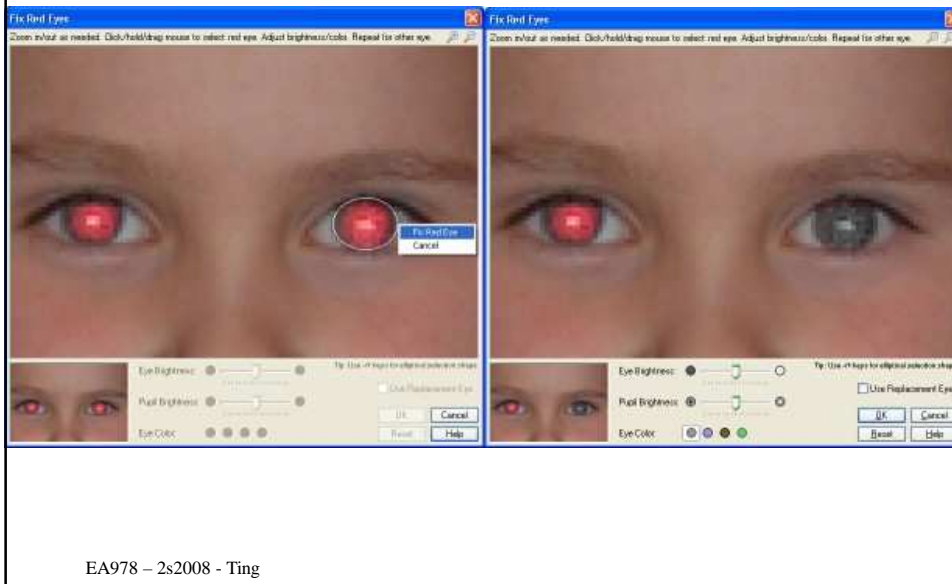
Domínio de Valores de *Pixels*

- Valores resultantes fora da faixa representável:
 1. **Saturação** em valores extremos
 2. **Módulo** em relação ao valor máximo



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Operações por *pixels* Exemplo



Operações por *pixels* Exemplo



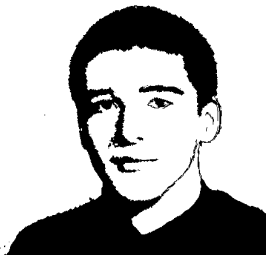
Operações por *pixels*

Exemplo

RGB

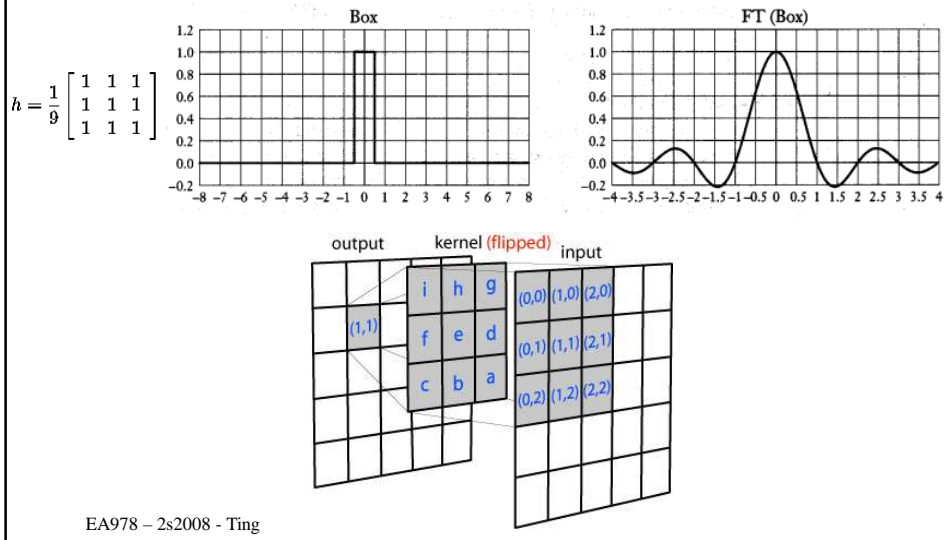


RGB



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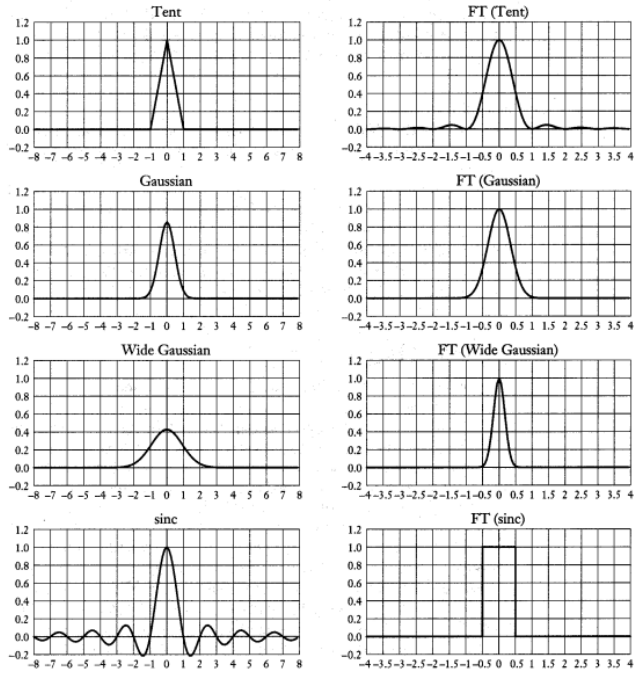
Máscara de Convolução



$$\frac{1}{115}$$

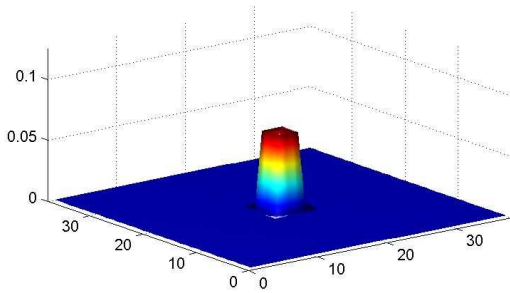
2	4	5	4	2
4	9	12	9	4
5	12	15	12	5
4	9	12	9	4
2	4	5	4	2

Figure 3 Discrete approximation to Gaussian function with $\sigma=1.4$



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Operações de Imagens: por *pixels* Filtro da Média = *Box filter*



$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$

Ruídos podem afetar os valores dos *pixels* de forma nociva.

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Operações de Imagens: por *pixels*

Filtro da Mediana

123	125	126	130	140
122	124	126	127	135
118	120	150	125	134
119	115	119	123	133
111	116	110	120	130

Neighbourhood values:

115, 119, 120, 123, 124,
125, 126, 127, 150

Median value: 124

Muito eficiente para remover ruídos do tipo “sal e pimenta”.

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Operações de Imagens: por *pixels*

Filtro da Mediana



Imagem original

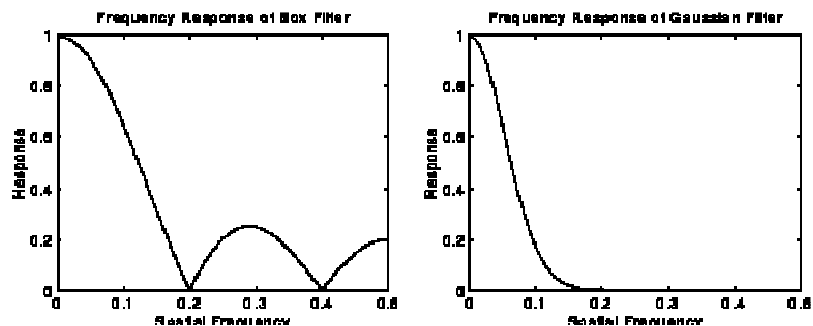
Imagem + ruído gaussiano

(Imagem + ruído
gaussiano) filtrada

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Operações de Imagens: por *pixels*

Filtro Gaussiano

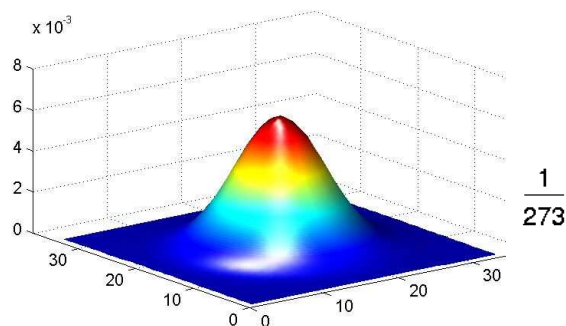


Controle da faixa de frequências contida na imagem

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Operações de Imagens: por *pixels*

Filtro Gaussiano



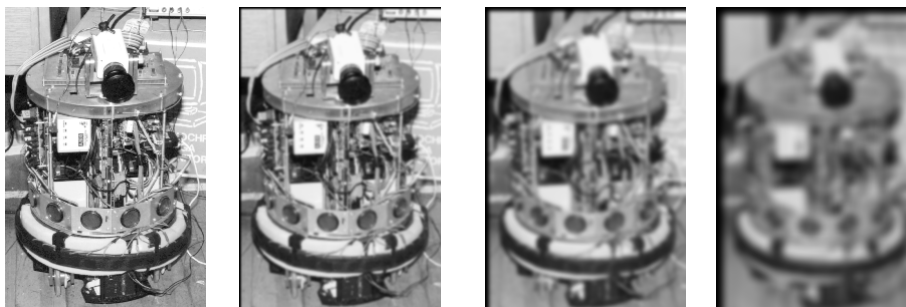
1	4	7	4	1
4	16	26	16	4
7	26	41	26	7
4	16	26	16	4
1	4	7	4	1

$$G(x, y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

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Operações de Imagens: por *pixels*

Filtro Gaussiano

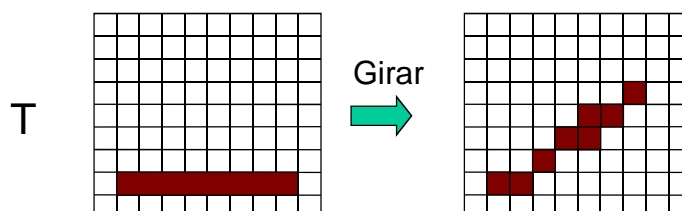


Eficiente para atenuar efeitos de borda serrilhada ou criar efeitos de borramento

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Transformações Geométricas

$$T = \begin{pmatrix} a & b & c \\ d & e & f \\ 0 & 0 & 1 \end{pmatrix}$$



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Transformações Geométricas



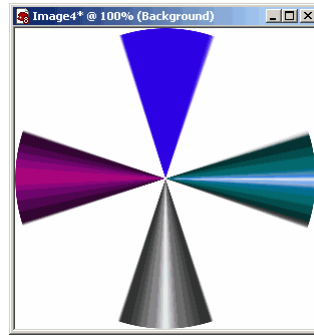
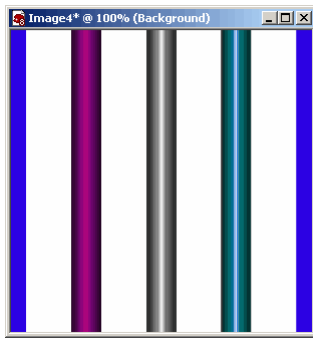
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Wrapping



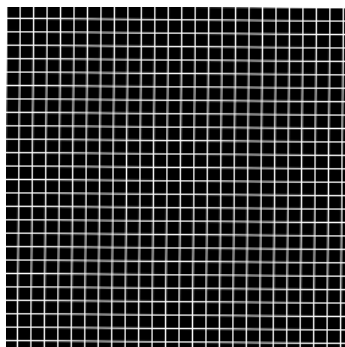
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Wrapping

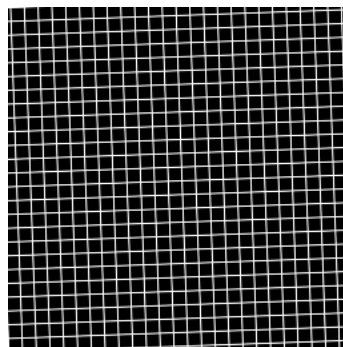


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Transformações Geométricas Subamostragem



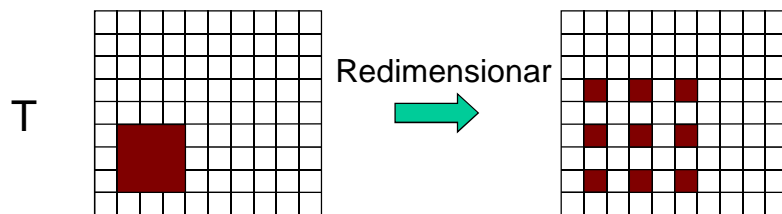
Girar 2°
anti-horário
→



Como atenuar serrilhados na nova imagem?

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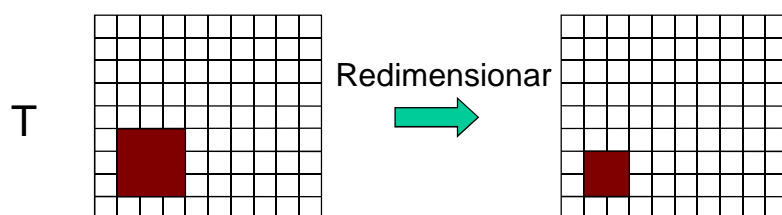
Transformações Geométricas Subamostragem



Como preencher os “vazios” na nova imagem?

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Transformações Geométricas Superamostragem



Como tratar os valores dos *pixels* sobrepostos na nova imagem?

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