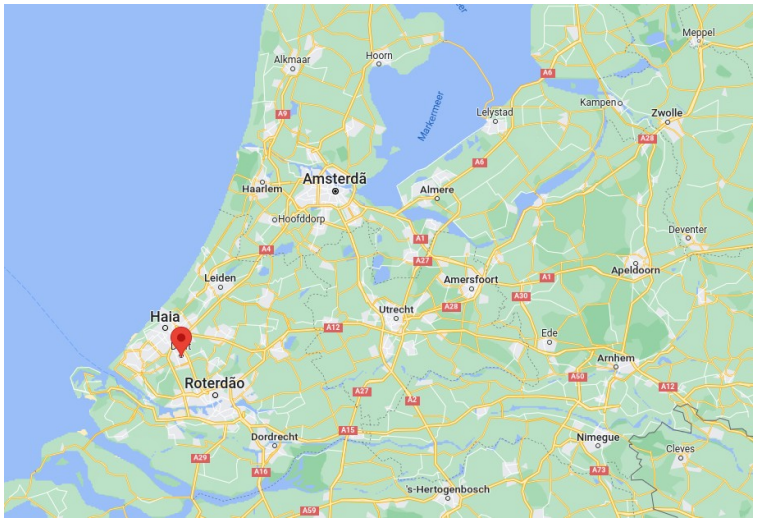
To pixel or not to pixel ...

Ricardo Marroquim

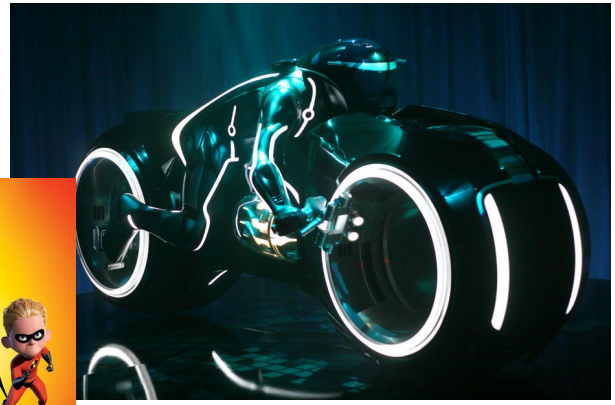
https://graphics.tudelft.nl/~marroquim/

28/04/2022

Delft


Meppel
Alkmaar
Hoorn
Markermeer
Lelystad
Kampen
Zwolle
Amsterdã
Haarlem
Almere
Hoofddorp
Deventer
Leiden
Amersfoort
Apeldoorn
Haia
Utrecht
Ede
Arnhem
Roterdão
Dordrecht
Nimegue
Cleves
's-Hertogenbosch

o que é CG?

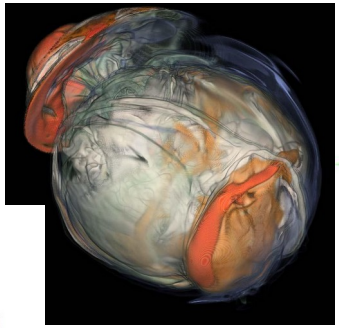
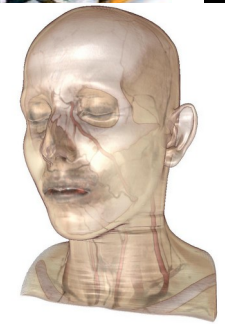
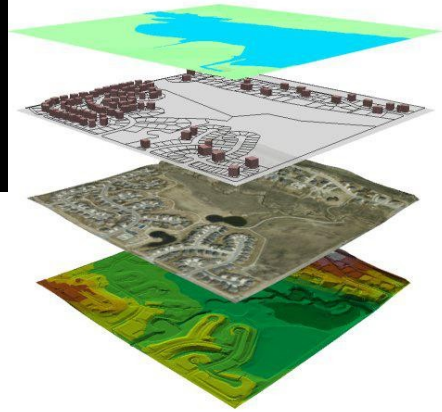


o que é CG?

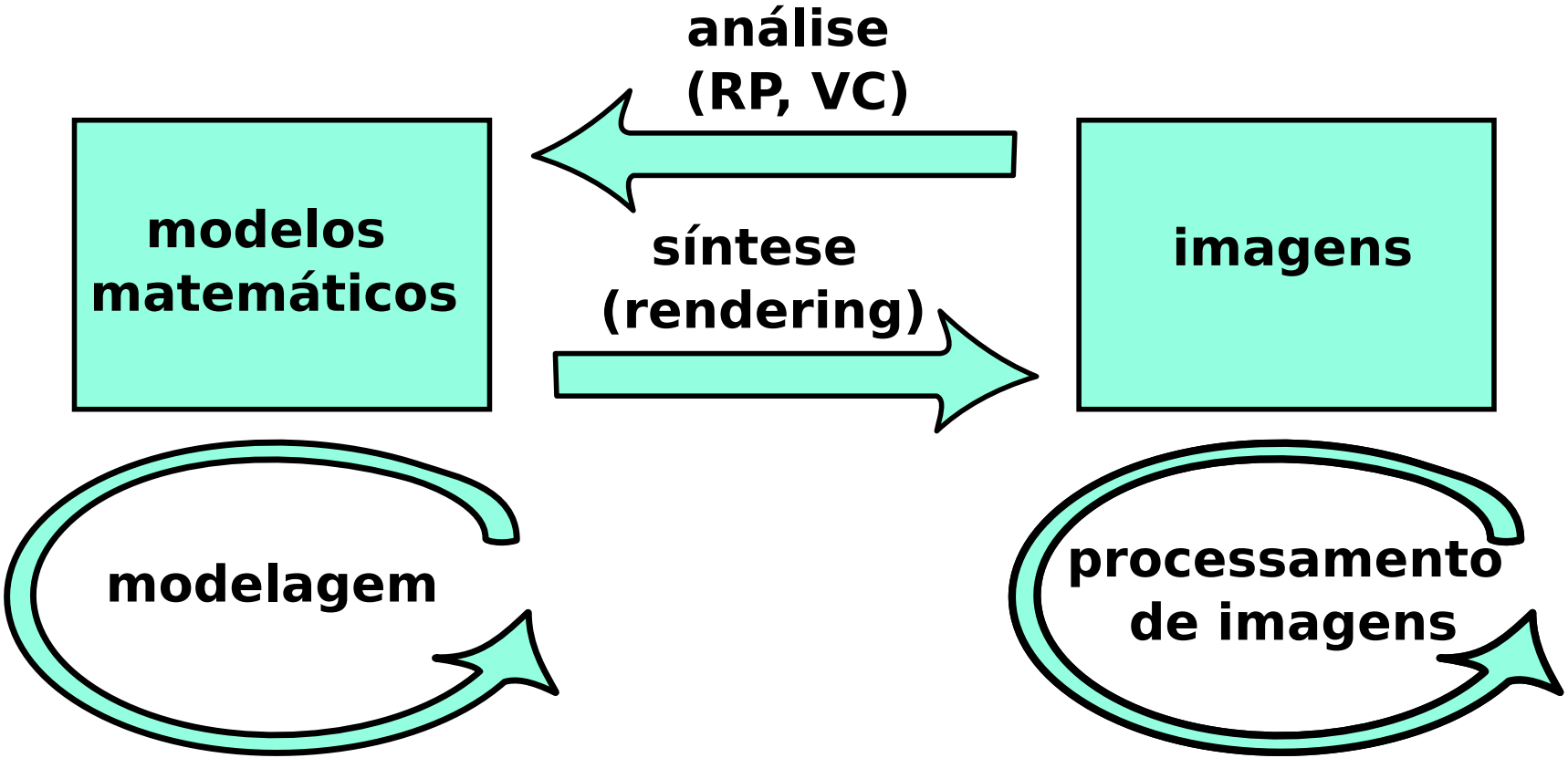
o que é CG?





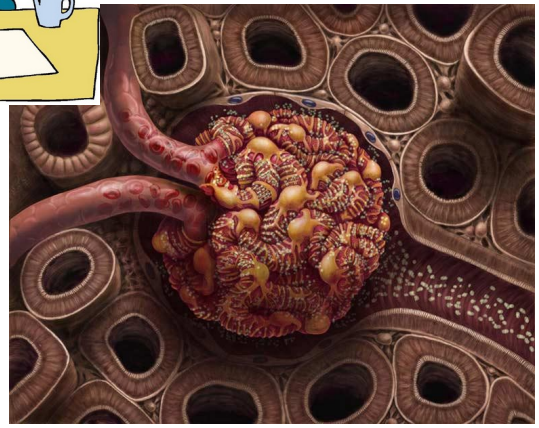




o que é CG?


análise
(RP, VC)
modelos
matemáticos
síntese
(rendering)
imagens
modelagem
processamento
de imagens

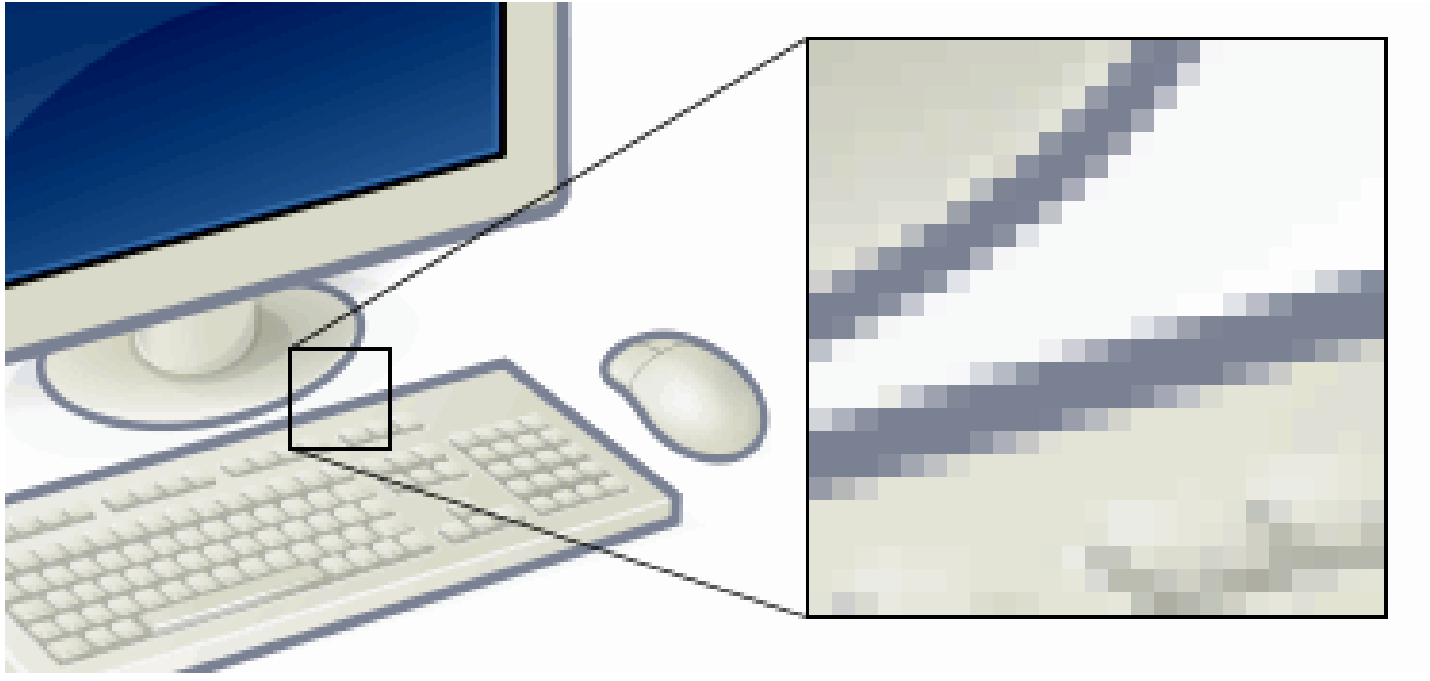
representar com imagens

- cenas
- ilustrações
- pensamentos
- ideias
- diagramas
- abstrações
- ...



porém, na sua essência...

- colorir pixels RGB [0, 255]



cores

- monitores
  - 3 canais (RGB)
  - 8 bits/canal
  - 24 bits total
  - 16.7M cores
- olho humano
  - ~10M cores

imagens no monitor

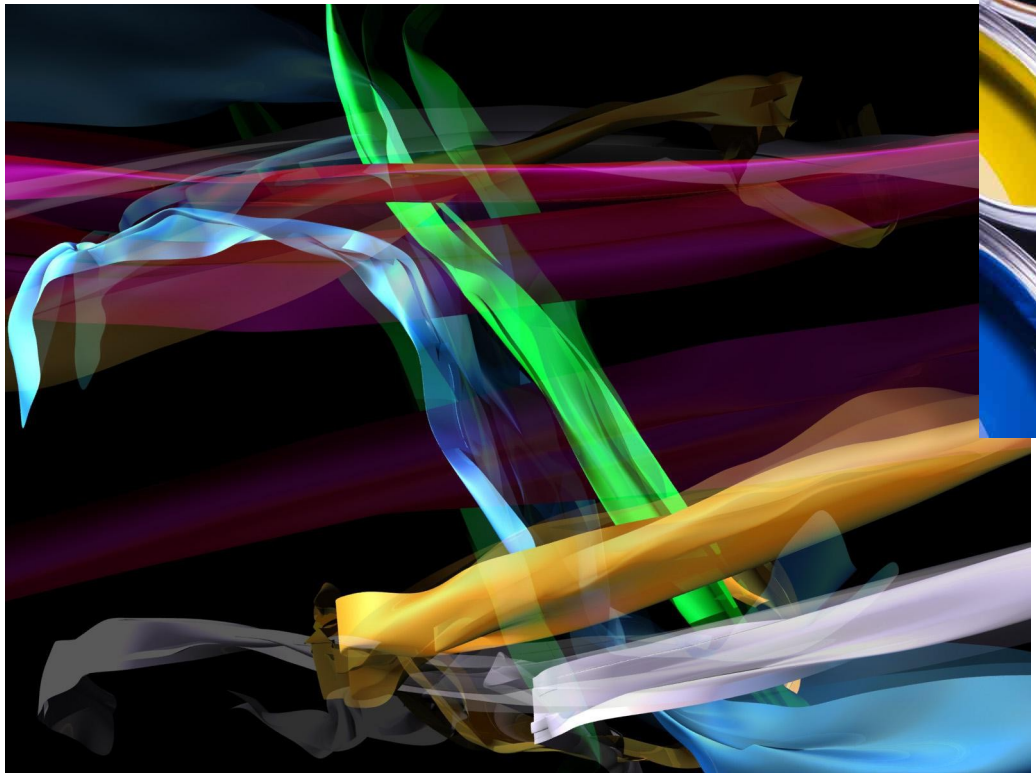
- LG W2252TQ
  - res: 1680x1050 = 1.763.000 pxs
  - 16.7M cores

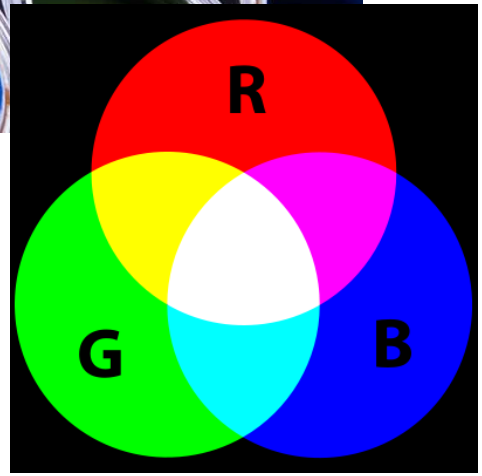
imagens no monitor

- LG W2252TQ
  - res: 1680x1050 = 1.763.000 pxs
  - 16.7M cores
- quantas imagens possíveis?
  - teorema do macaco infinito

cores

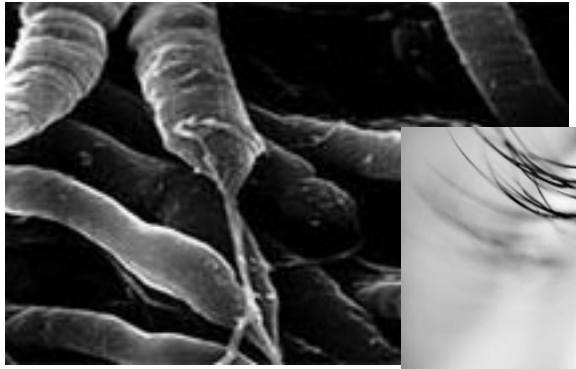
- percepção da interação luz-olho



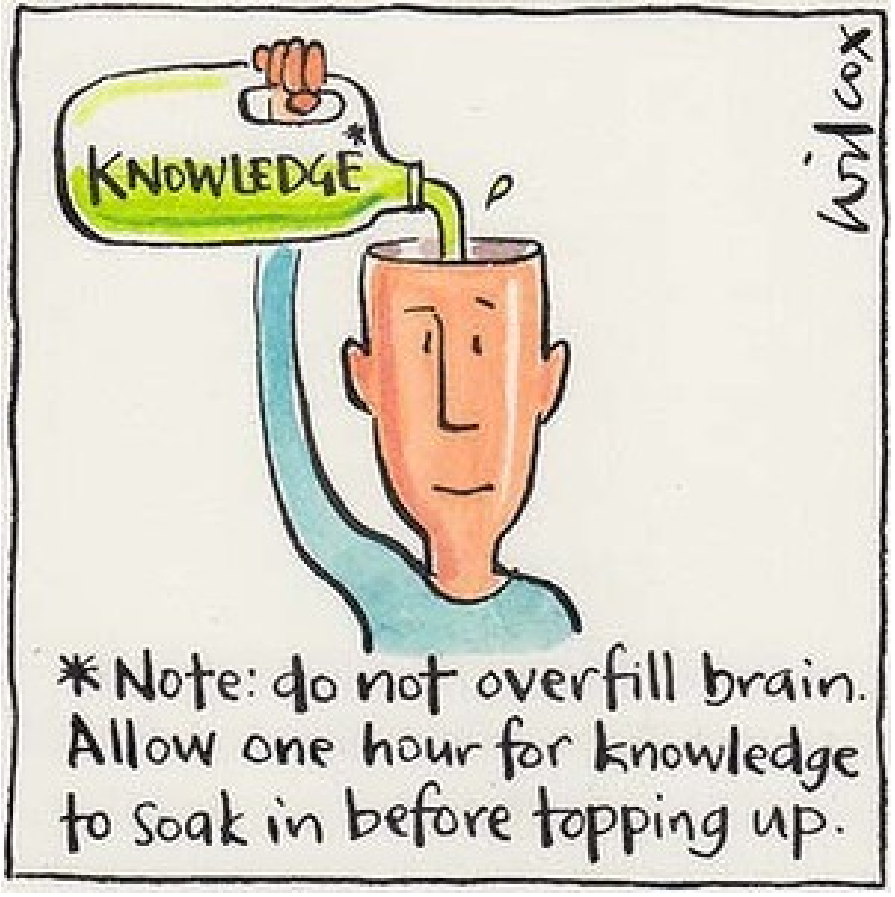


cores e olho

- anatomia
  - cone → cor
  - bastonete → intensidade



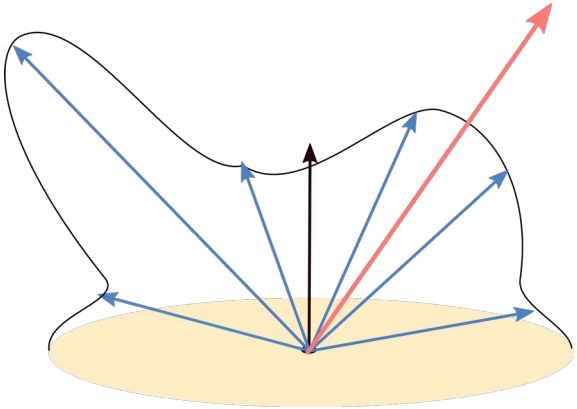
- quantidade de cones
  - cachorro/gato: 2
  - humano: 3
  - pombo: 4
  - tamarutaca: 12

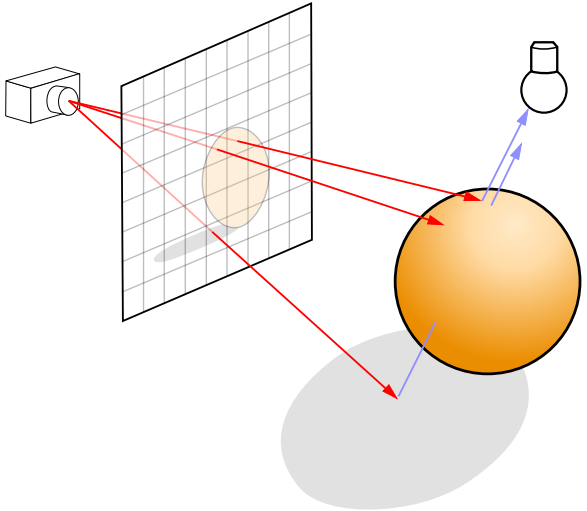

KNOWLEDGE*
wilcox
*Note: do not overfill brain.
Allow one hour for knowledge
to soak in before topping up.

como criar imagens?

ray-tracing

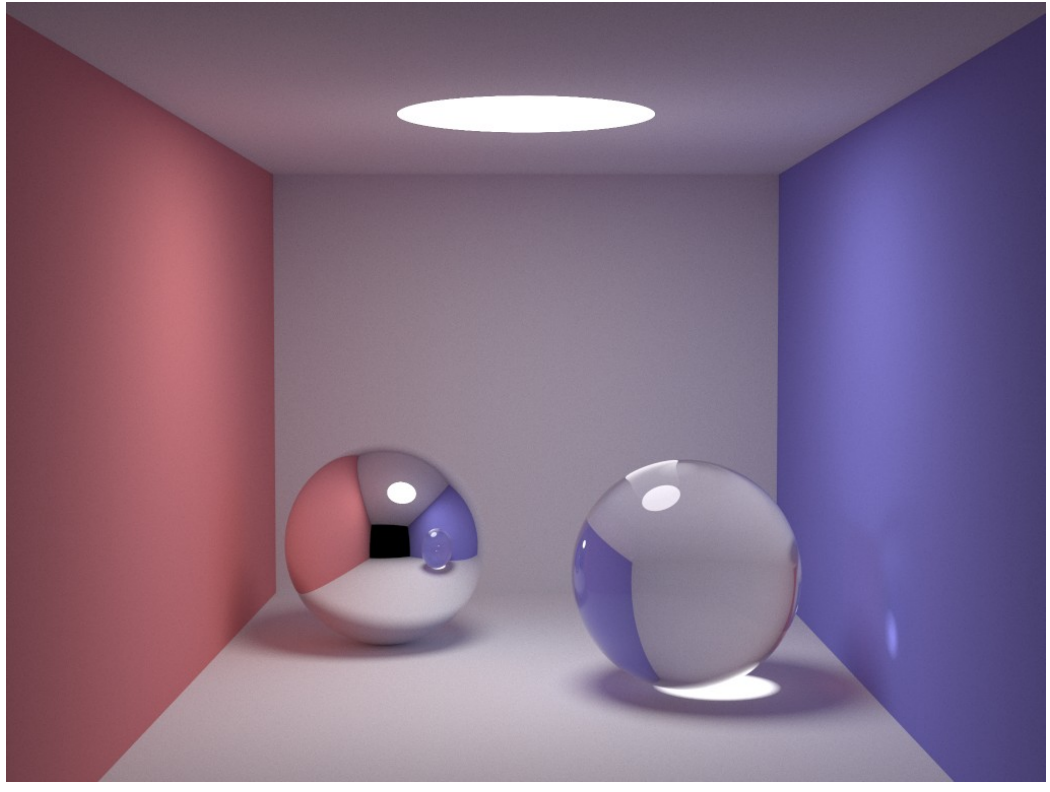
- simular interação luz-objetos
  - como luz interage com materiais?
  - seguir os raios até chegar no “olho” (ou na luz)





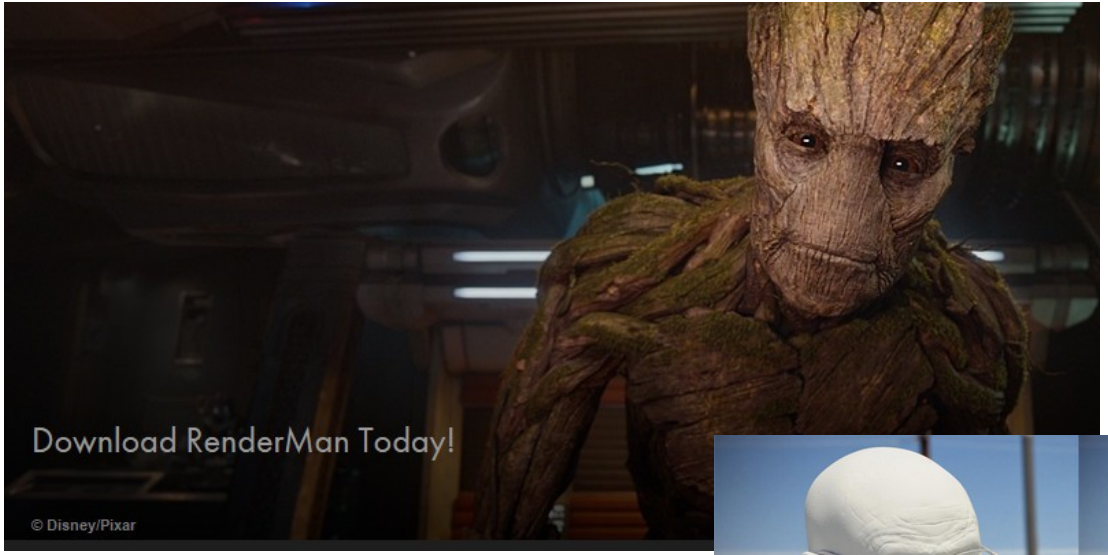
ray-tracing

- pode ser muito simples
  - smallpt : 99 linhas de código



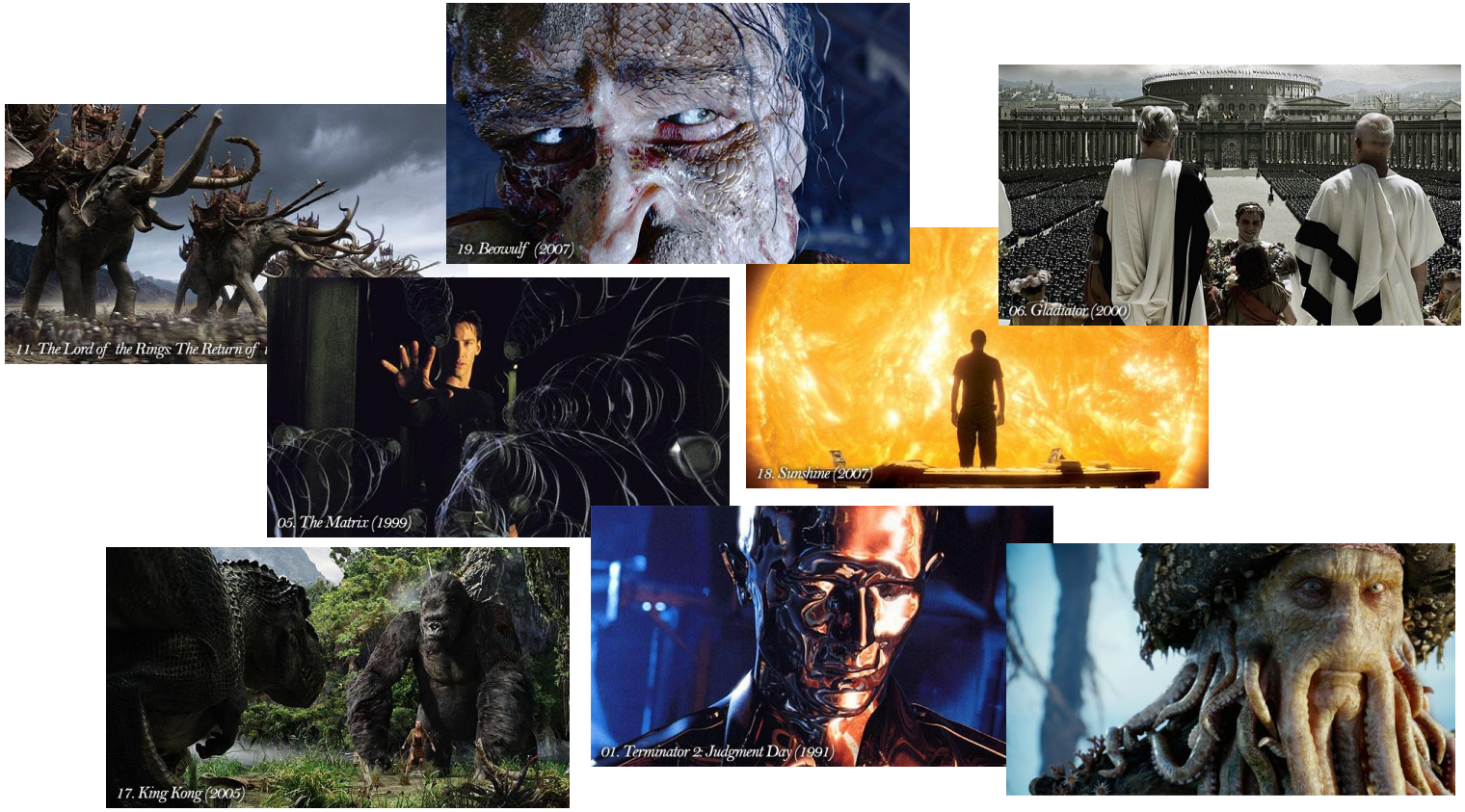
ray-tracing

- ou extremamente sofisticado



ray-tracing

- Pixar Renderman



ray-tracing

- quanto tempo demora?

ray-tracing

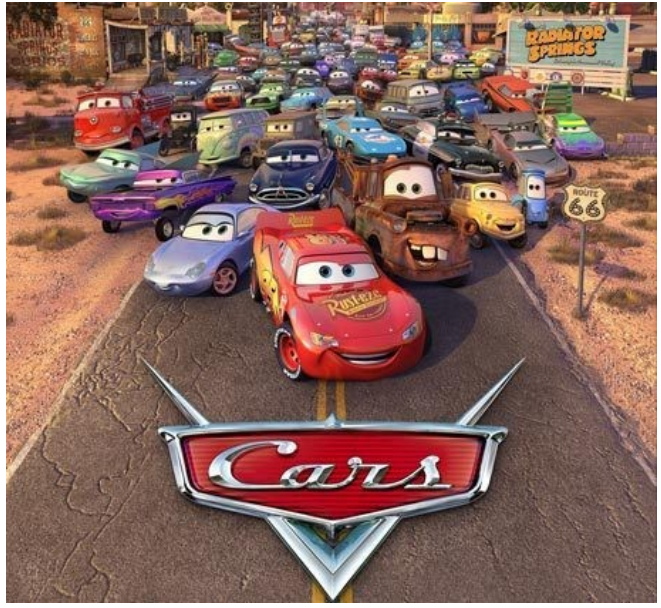
- quanto tempo demora?
- cena de abertura Pixar Cars
  - tempo máximo: 60h/quadro
  - após otimizações: 2.5h/quadro
  - média: 1h/quadro

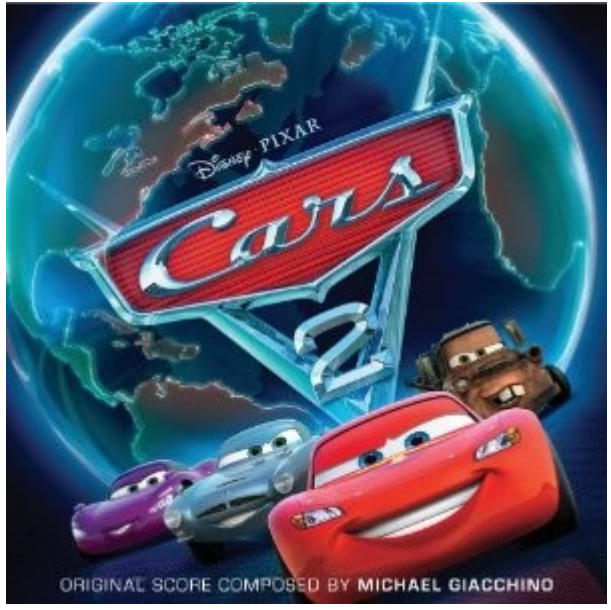
ray-tracing

- quanto tempo demora?
- cena de abertura Pixar Cars
  - tempo máximo: 60h/quadro
  - após otimizações: 2.5h/quadro
  - média: 1h/quadro
- filme inteiro
  - 1s ~ 30h ~ 1 dia
  - 1min ~ 75 dias
  - 117mins ~ 24 anos

ray-tracing

- 5 anos depois, Cars 2
  - mais tecnologia == mais rápido ??

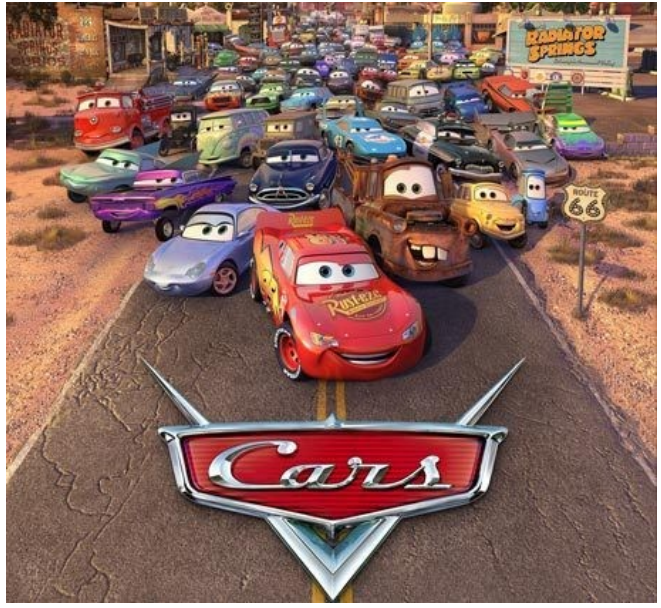




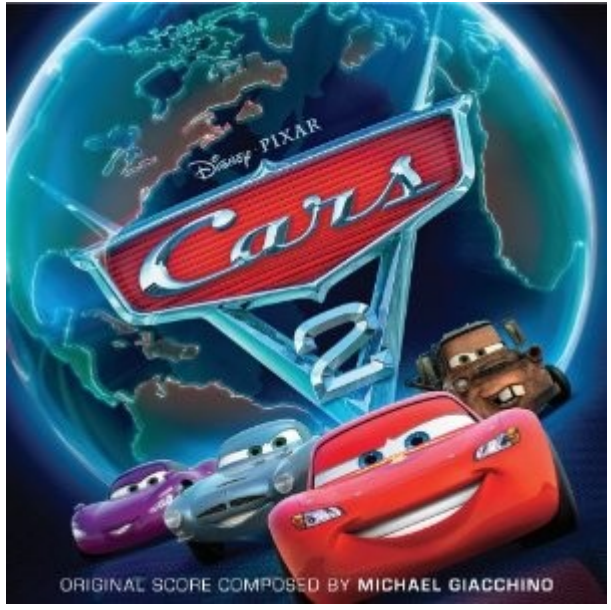
ray-tracing

- 5 anos depois, Cars 2
  - mais tecnologia == mais rápido ??

Cars 1, 2006 ~ 1h/quadro



Cars 2, 2011 ~ 11h/quadro



ray-tracing

Big Hero 6 (2014), > 1000 horas por quadro

ray-tracing

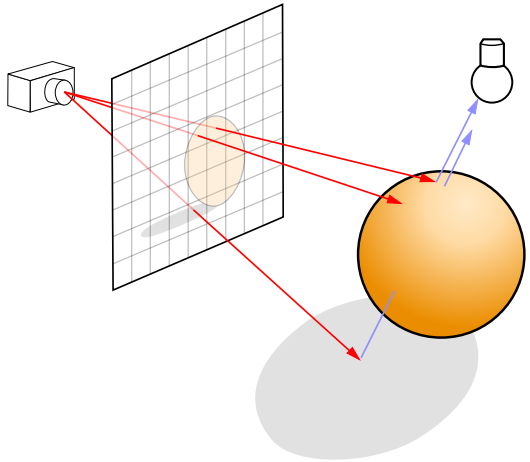
Pixar Renderfarm

ray-tracing

- não basta mais poder computacional
- precisa de ciência da computação!

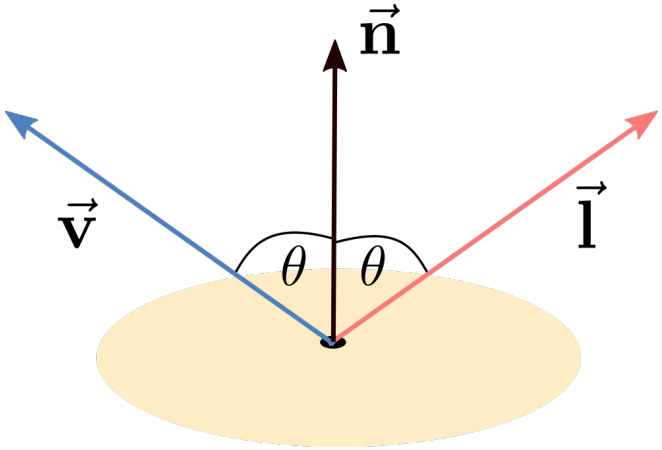
ray-tracing

- simular interação luz-objetos
  - como luz interage com materiais?
  - seguir os raios até chegar no “olho”



- resume em computar uma equação:

$$L_o(p,\omega_o)=L_e(p,\omega_o)+\int_{\Omega} f_r(p,\omega_i,\omega_o)L_o(r_c(p,\omega_i),-\omega_i)\cos\theta\, d\omega_i$$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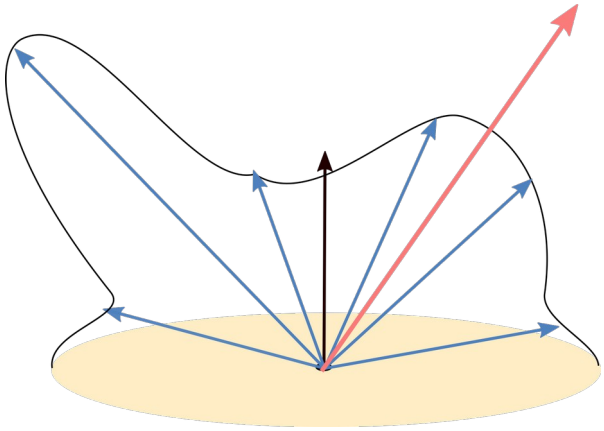
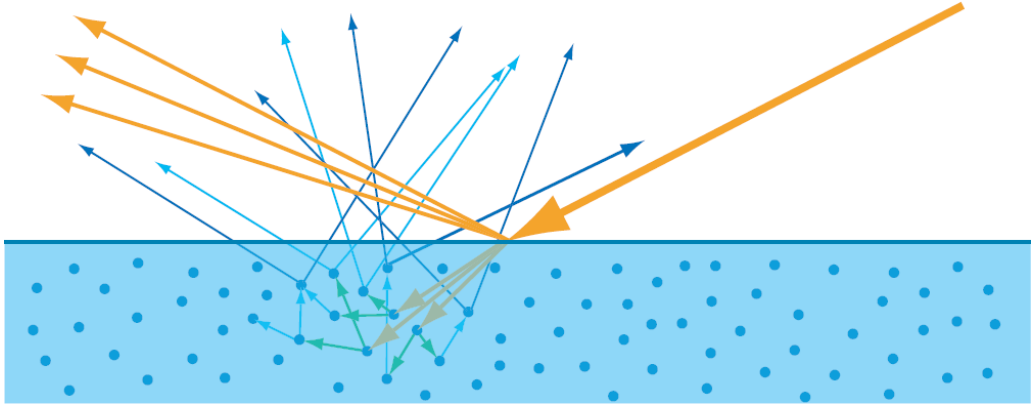
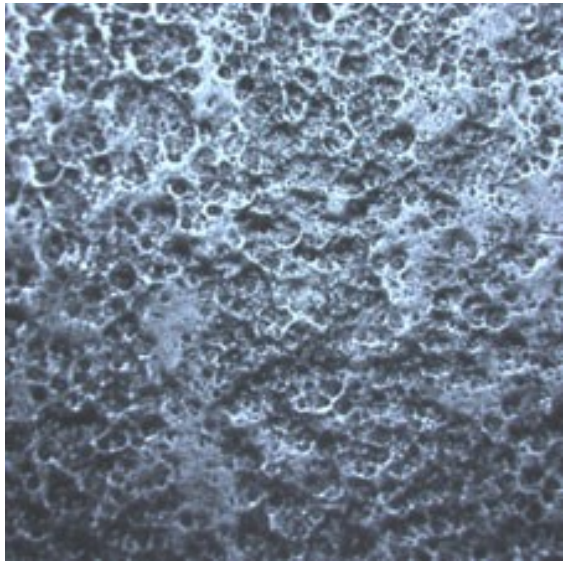
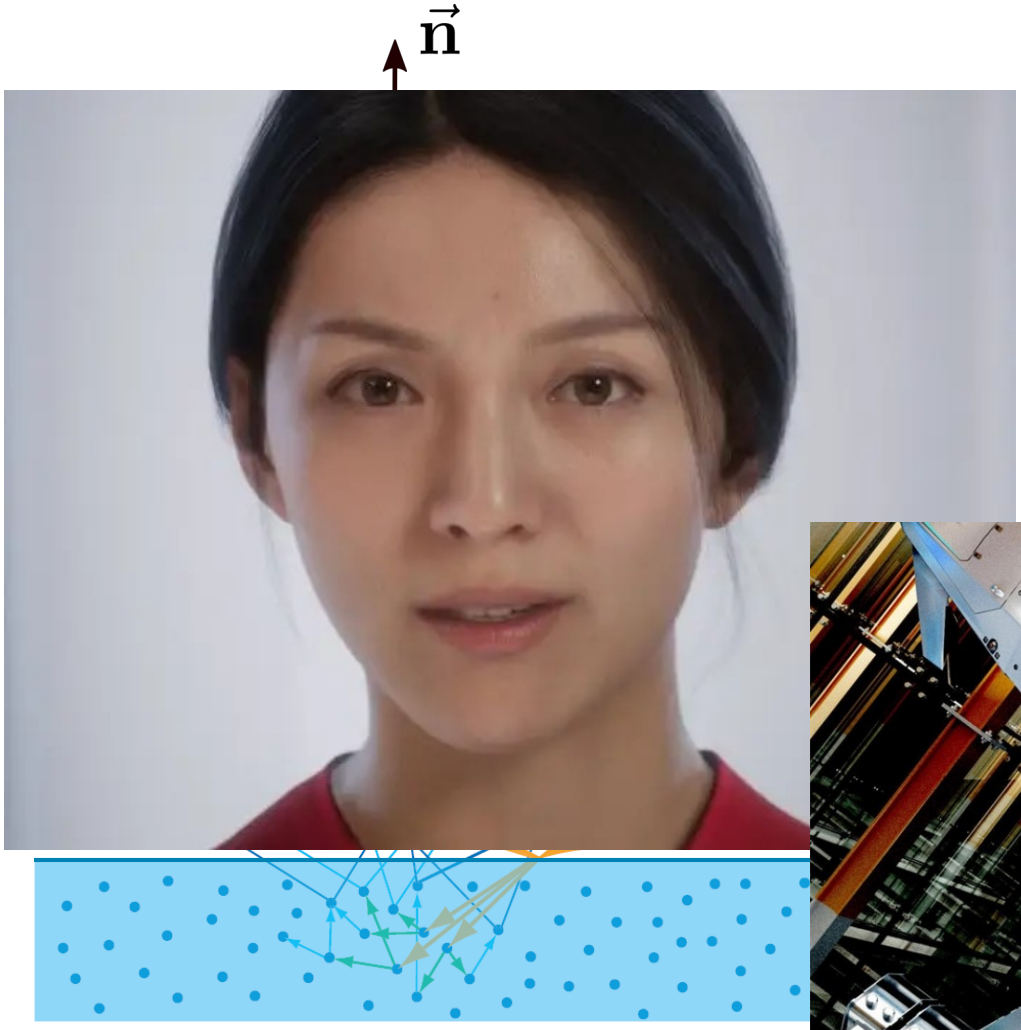
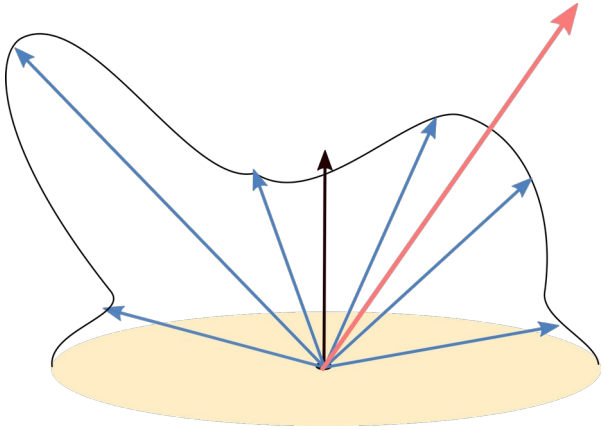







$\vec{\mathbf{n}}$




M50
ORION
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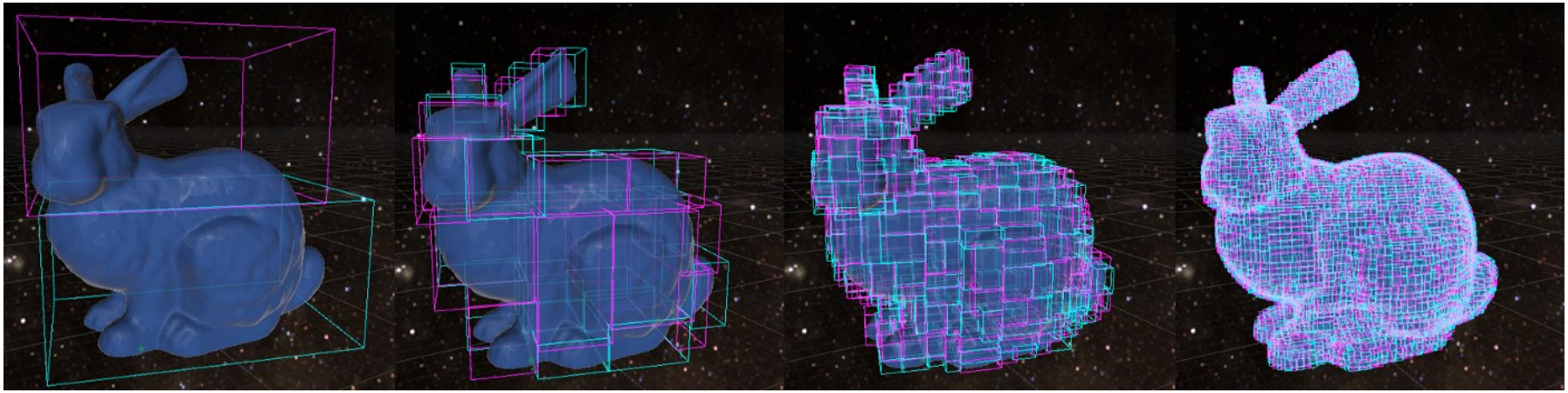
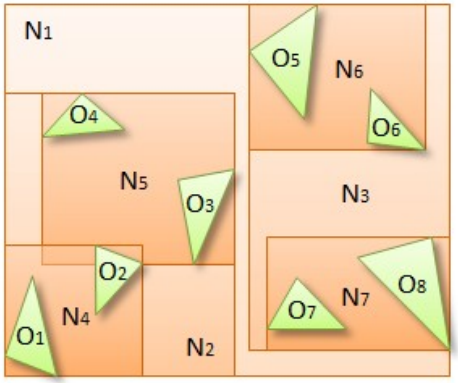
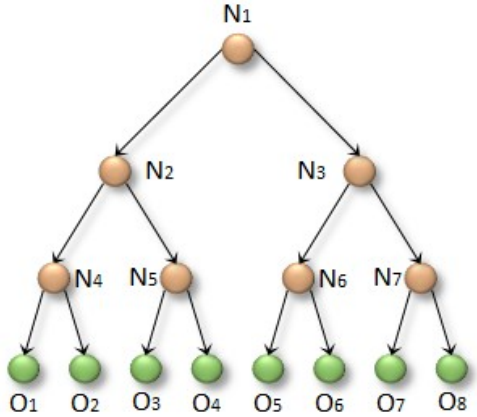
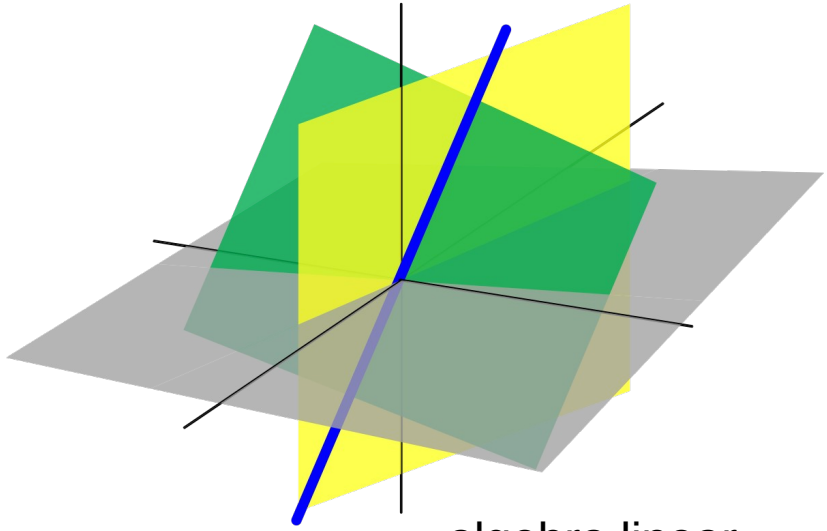


estrutura de dados





algoritmos



algebra linear

velocidade

estrutura de dados

algoritmos

computação de alto desempenho

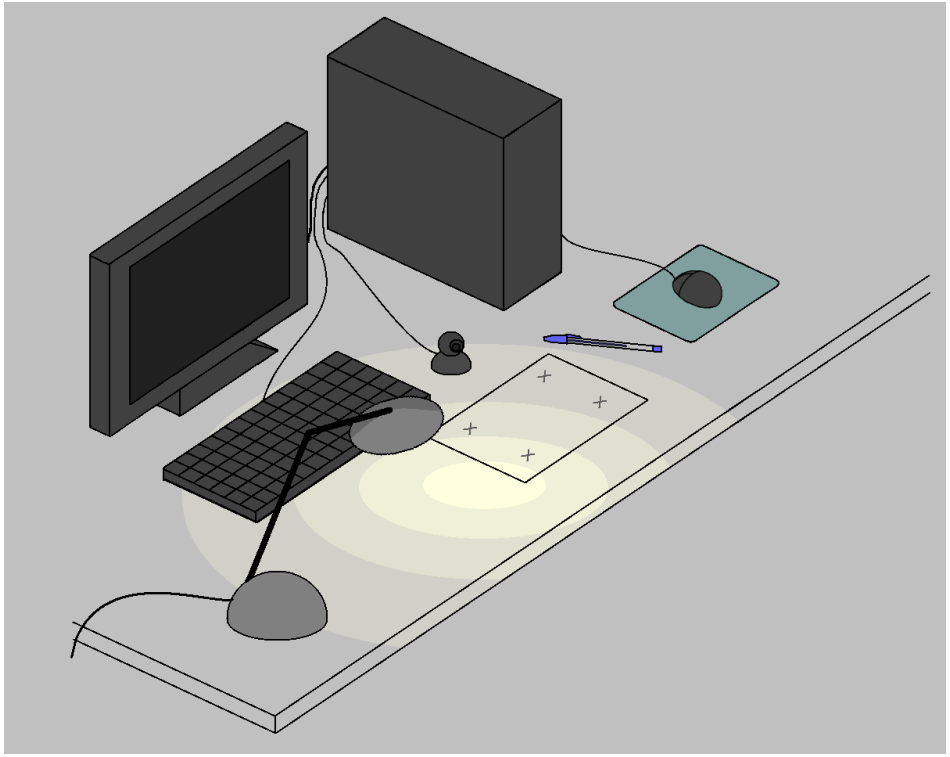
reaslismo

ótica (física)

matemática


PAUSE

WebcamPaperPen

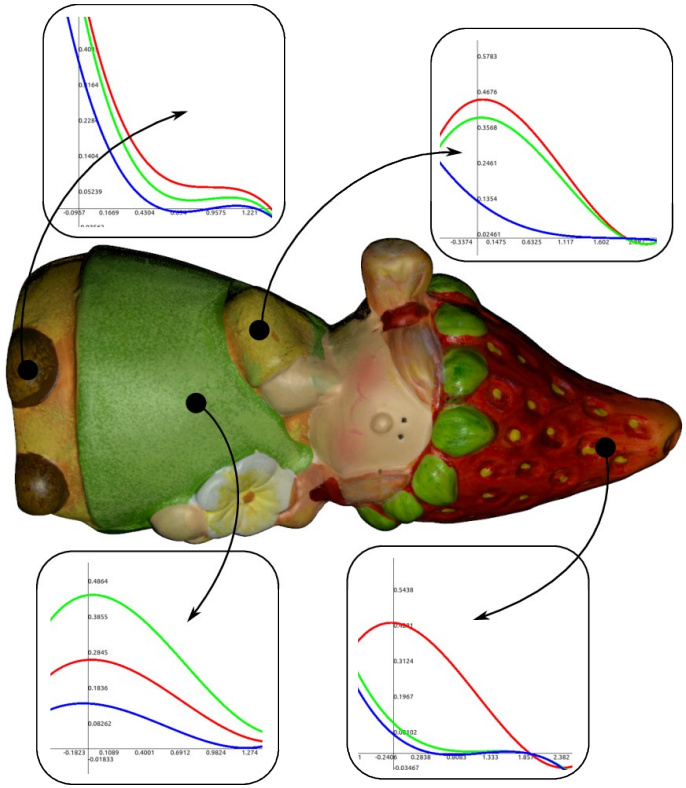


http://guthpf.github.io/

http://graphics.tudelft.nl/Publications-new/2014/PMO14

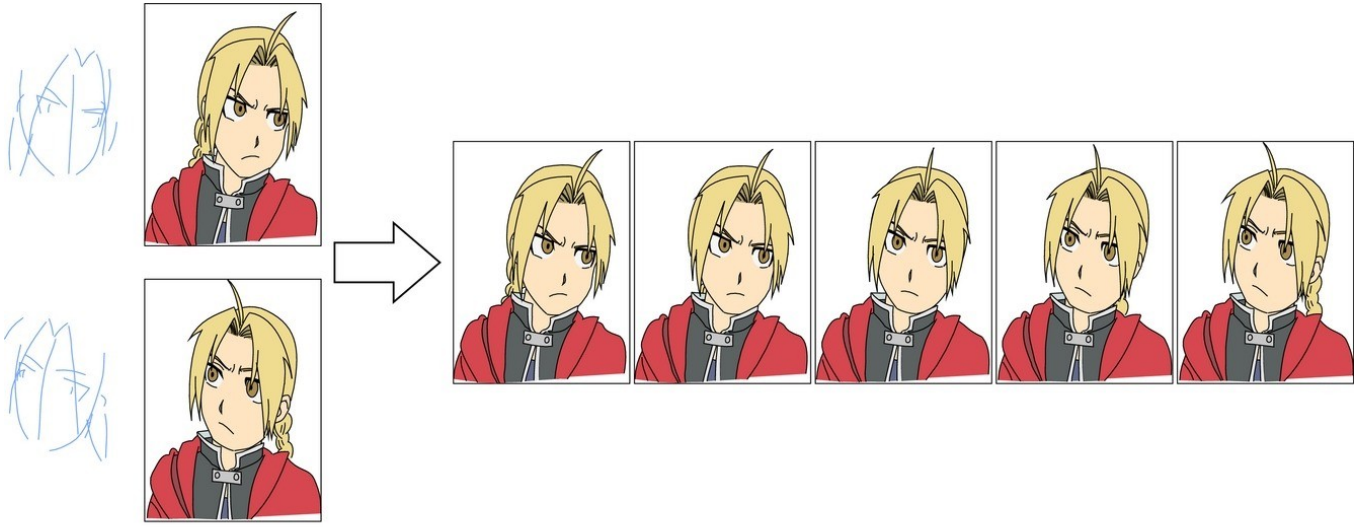
appearance acquisition

Laboratório de Computação Gráfica

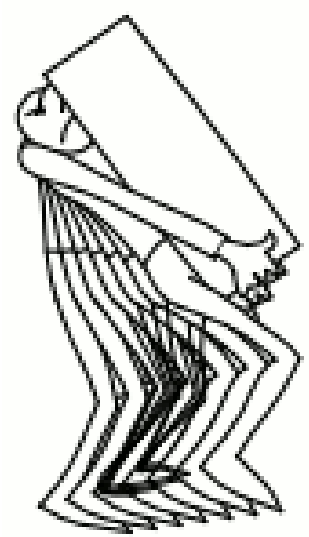


https://graphics.tudelft.nl/Publications-new/2017/CMDS17/

Automatic Inbetweening

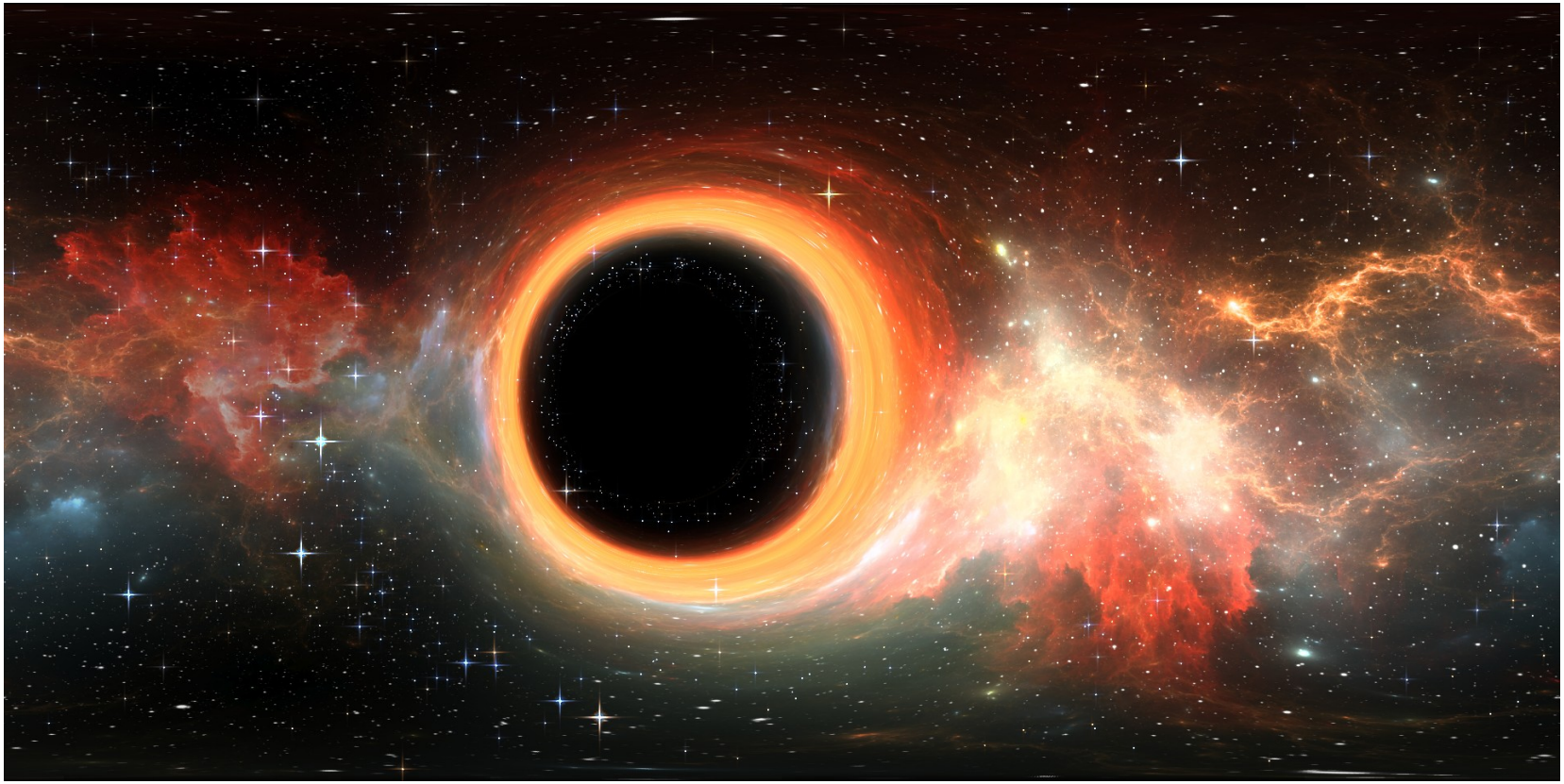


guidelines final art intermediate frames



https://graphics.tudelft.nl/Publications-new/2017/CMV17/

Interactive Black-Hole Visualization

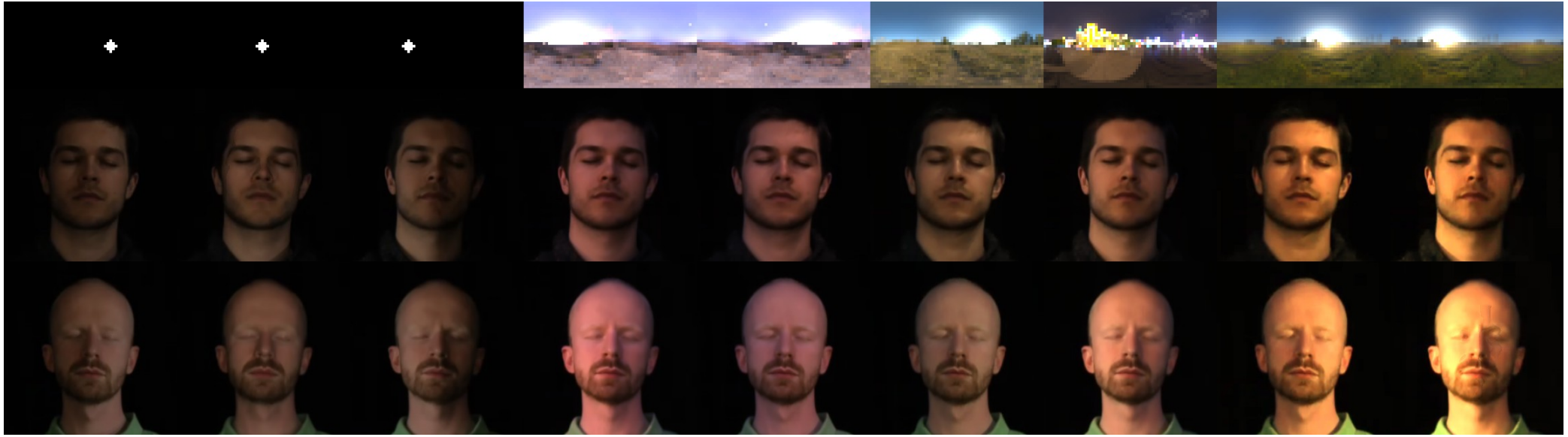


http://graphics.tudelft.nl/Publications-new/2020/VE20

Controllable Motion-Blur Effects in Still Images

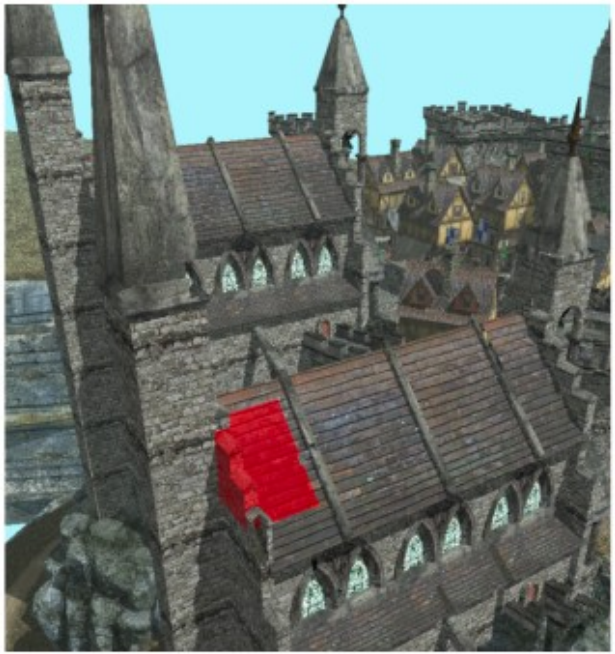
https://graphics.tudelft.nl/Publications-new/2020/LSE20/

Real-Time Relighting of Human Faces with a Low-Cost Setup



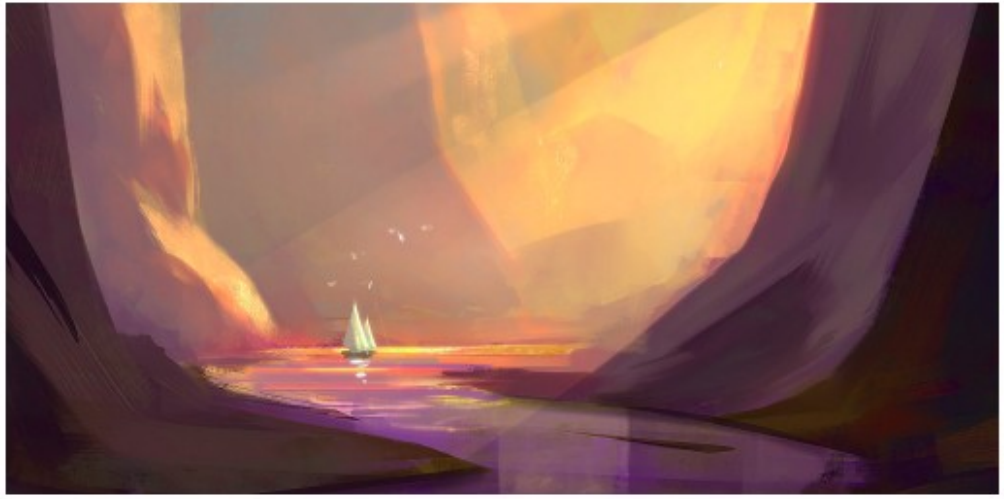
https://graphics.tudelft.nl/Publications-new/2022/MUEM22/

Interactively Modifying Compressed Sparse Voxel Representations



https://graphics.tudelft.nl/Publications-new/2020/CBE20/

Expressive Single Scattering for Light Shaft Stylization



https://graphics.tudelft.nl/Publications-new/2017/KKSE17/

Fig. 8 Sail shape variation due wind changing for clip "near_4k_08.mp4". **a** Frame 60. **b** Frame 210. **c** Frame 330

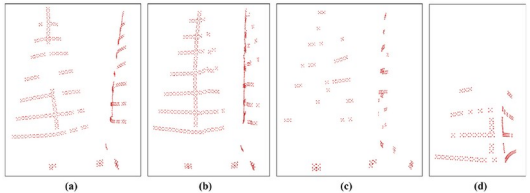
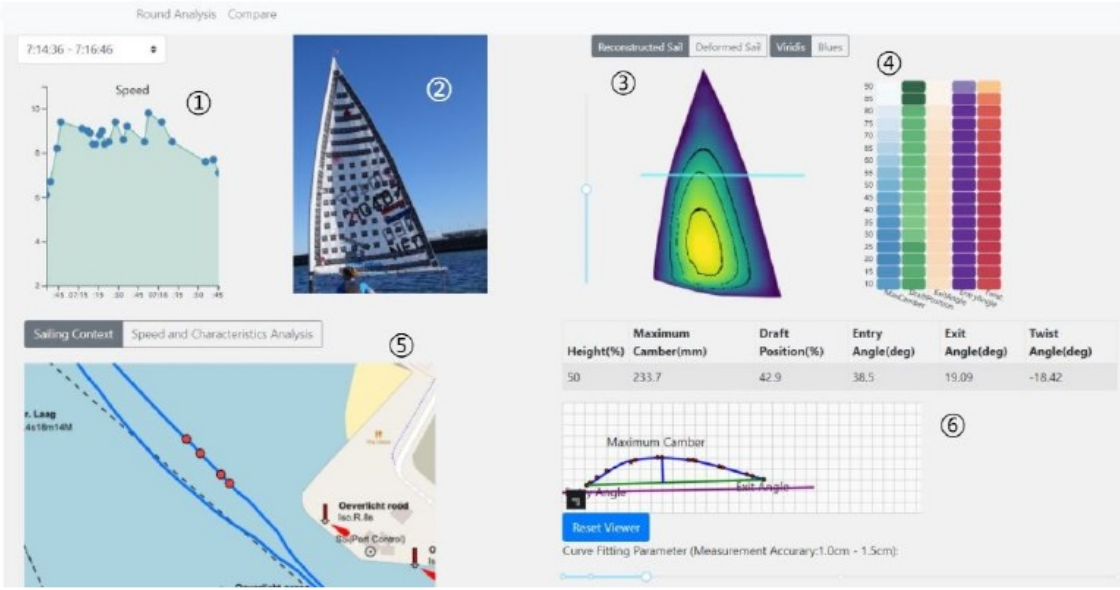
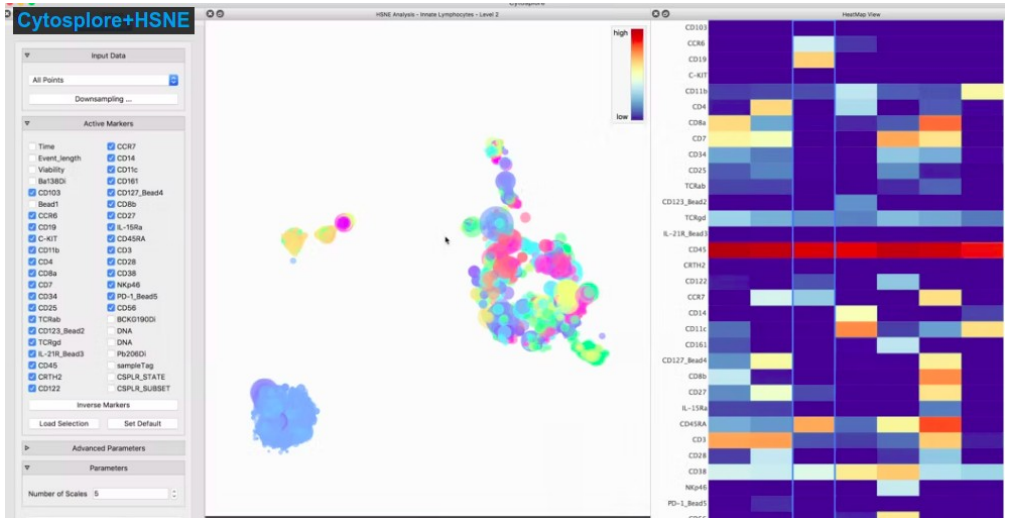
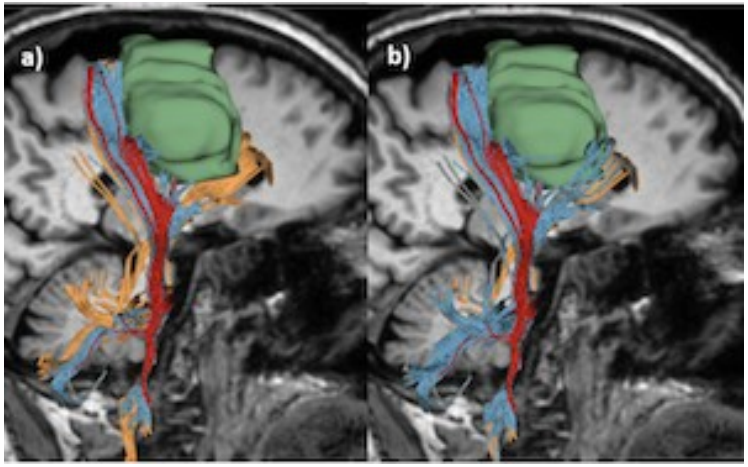
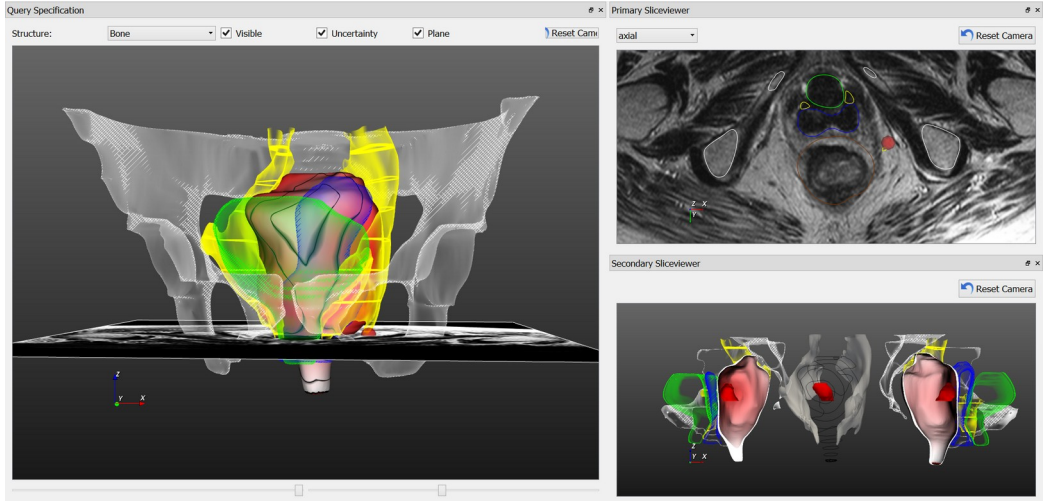


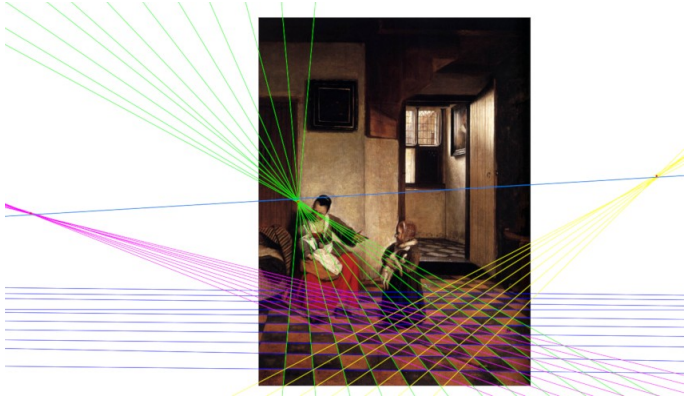
Fig. 9 Visualization of the reconstruction from two view points. **a** Frame 457 for clip "near_4k_17". **b** Frame 219 for clip "near_4k_08". **c** Frame 246 for clip "far_4k_14". **d** Frame 205 for clip "near_4k_07"

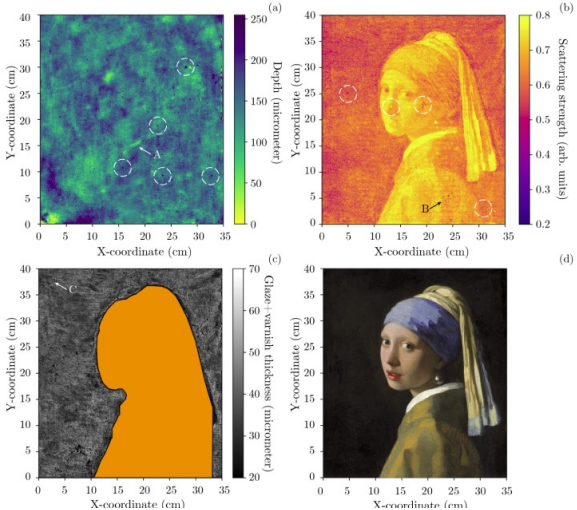


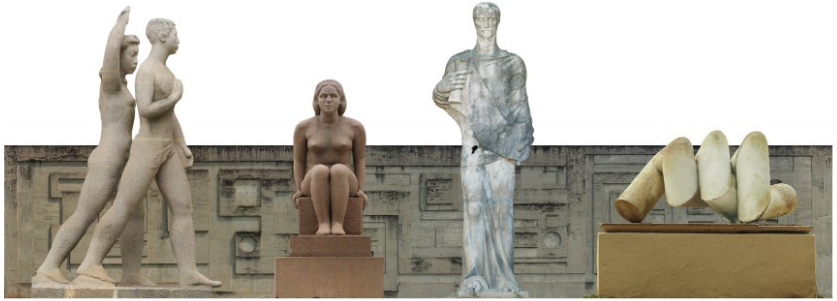

Cytosplore+HSNE
Input Data
All Points
Downsampling ...
Active Markers
Time
Event_length
Viability
Ba138Di
CD103
Bead1
CCR6
CD19
C-KIT
CD11b
CD4
CD8a
CD7
CD34
CD25
TCRab
CD123_Bead2
TCRgd
IL-21R_Bead3
CD45
CRTH2
CD122
CCR7
CD14
CD11c
CD161
CD127_Bead4
CD8b
CD27
IL-15Ra
CD45RA
CD3
CD28
CD38
NKp46
PD-1_Bead5
CD56
IBCKG190Di
DNA
DNA
Pb206Di
sampleTag
CSPLR_STATE
CSPLR_SUBSET
Inverse Markers
Load Selection
Set Default
Advanced Parameters
Parameters
Number of Scales 5
HSNE Analysis - Innate Lymphocytes - Level 2
high
low
HeatMap View


a)
b)


Query Specification
Structure:
Bone
Visible
Uncertainty
Plane
Reset Camera
Primary Sliceviewer
axial
Reset Camera
Secondary Sliceviewer
Reset Camera







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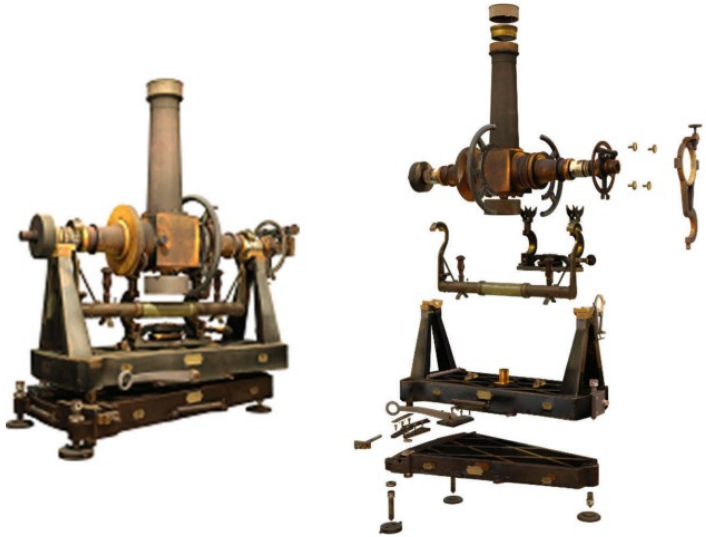

https://www.lcg.ufrj.br/bamberg/

velocidade

estrutura de dados

algoritmos

computação de alto desempenho

reaslismo

ótica (física)

matemática

obrigado

Ricardo Marroquim

https://graphics.tudelft.nl/~marroquim/