

Computer Graphics -Applications

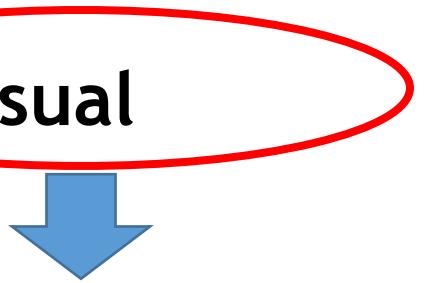
Junjie Cao @ DLUT

Spring 2019

<http://jjcao.github.io/ComputerGraphics/>

What is computer graphics?

- The use of computers to synthesize and manipulate visual information.



- The u
infor



(sound)

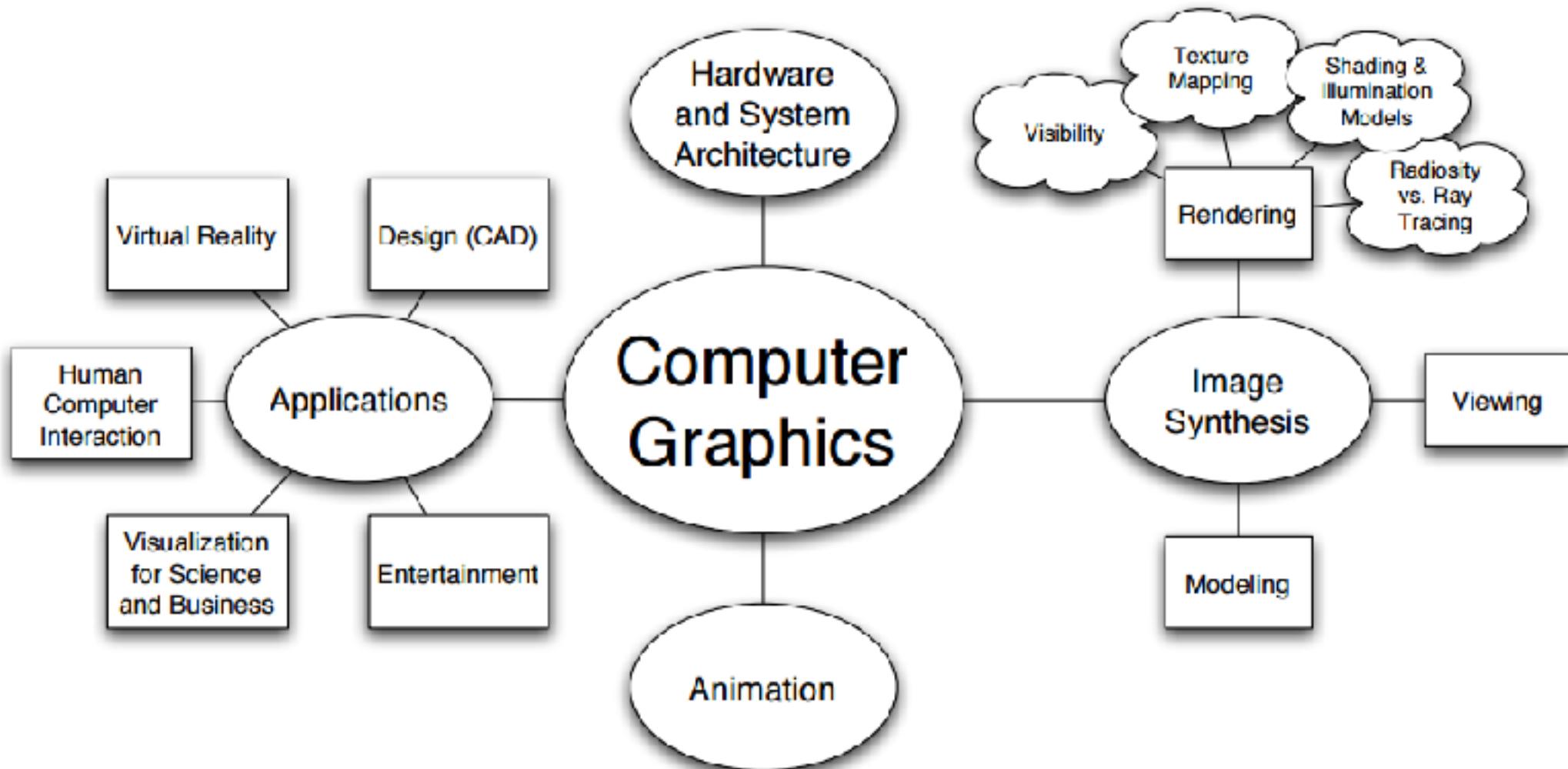


(touch)

Topics in graphics

- **Imaging 成像**
 - 2D: photography, image processing, compositing
 - 3D: texture mapping, volume imaging
- **Modeling 建模**
 - 2D: page description (e.g. PDF), typography, user interfaces
 - 3D: objects, characters, scenes
- **Rendering 渲染**
 - 2D: drawing shapes, motion blur, simulating art materials
 - 3D: realistic rendering; non-photorealistic rendering
- **Animation 动画**
 - 2D: user interfaces, titles, 2D animated films, 2D games
 - 3D: technical illustration, animation, visual effects, games

What Is Computer Graphics?

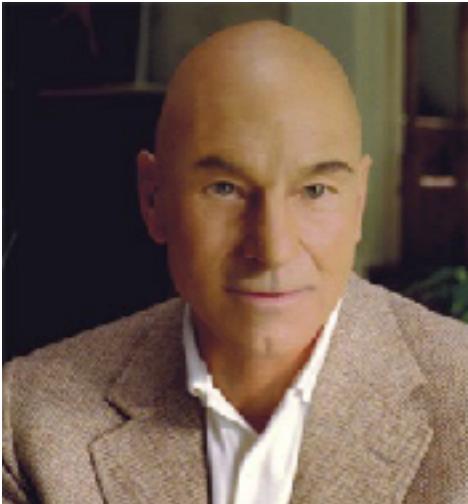
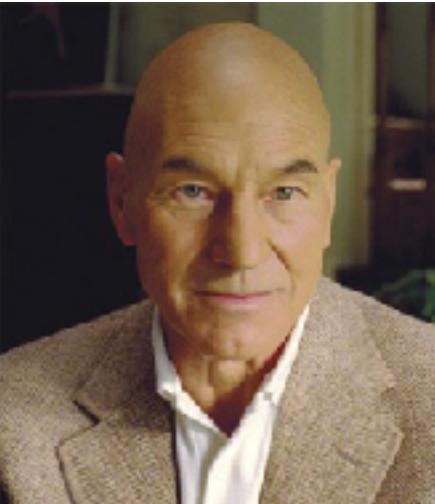


2D imaging

Do I need a wide angle lens? Panorama



Image synthesis, editing, recoloring, matting



2D modeling

Font by spline curves

Pollard's father was a prominent professor of microbiology who often took his family with him to scientific conferences. At least a dozen Nobel Prize winners attended young Pollard's fourth birthday party, which was celebrated in Sweden where his father was attending a conference. At Stanford University Pollard was known as a teller of tall tales, but was so well informed and articulate that he "made what might otherwise have been an outlandish series of claims quite convincing". Pollard's Stanford senior yearbook photo listed him as "Colonel" Pollard and he reportedly convinced almost everyone that secret intelligence was paying his fees.

At one point, Pollard received permission to establish a back-channel contact with South African intelligence through a South African friend.

Alveole 75 pt

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**THE NUMBERS
READ:**

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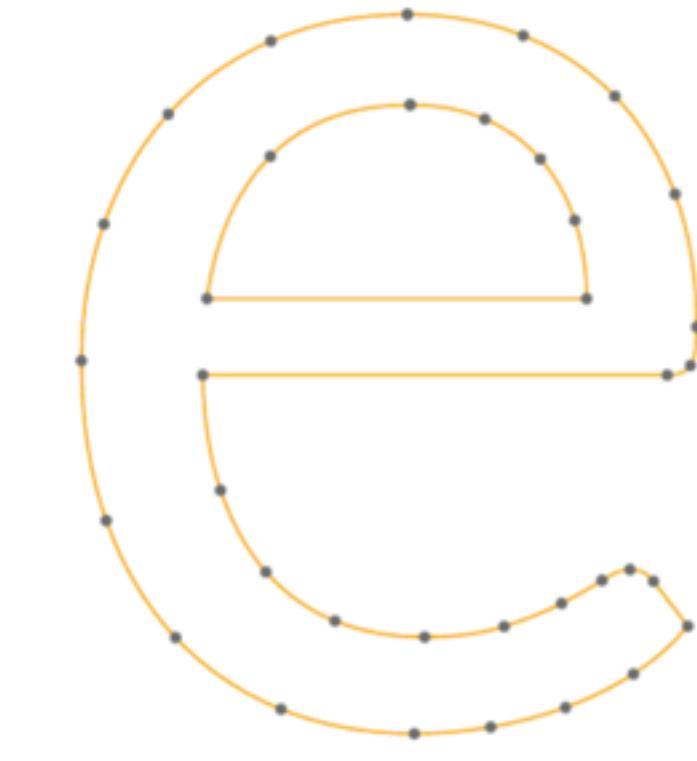
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KGB/FSB/GRU
[Die 00000-Familie]

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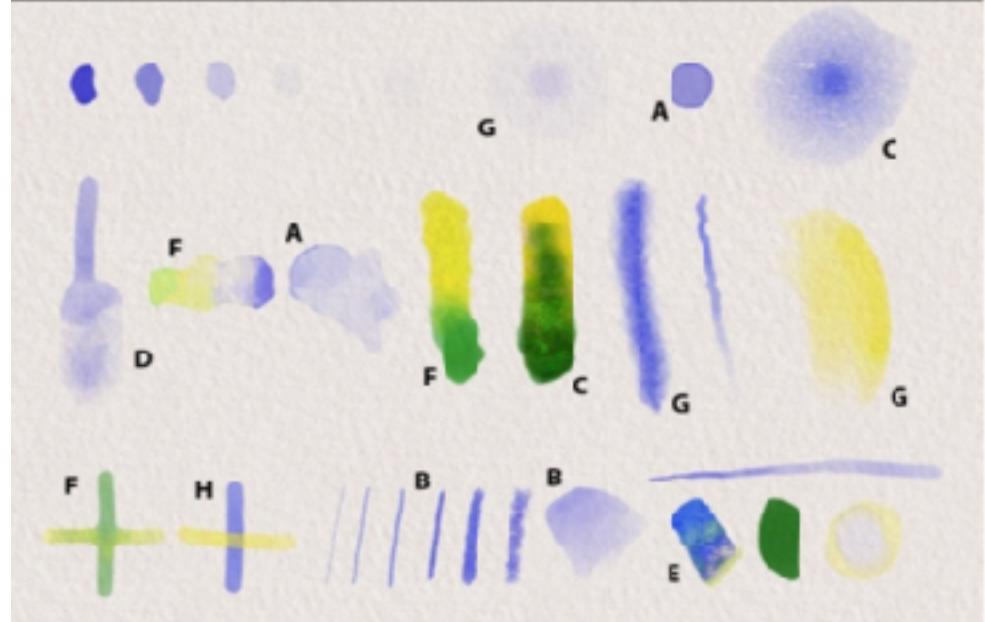
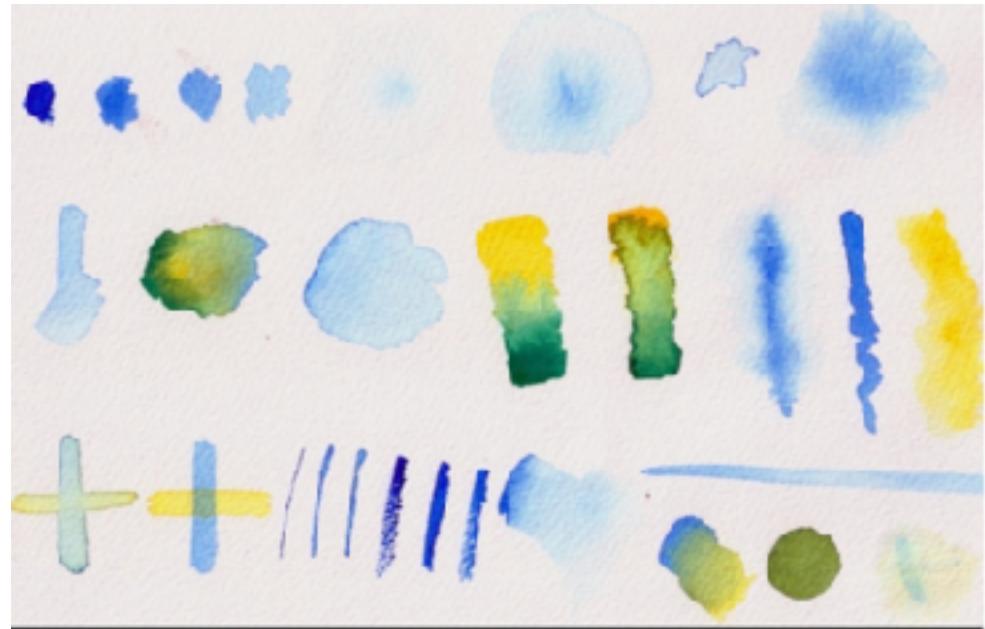
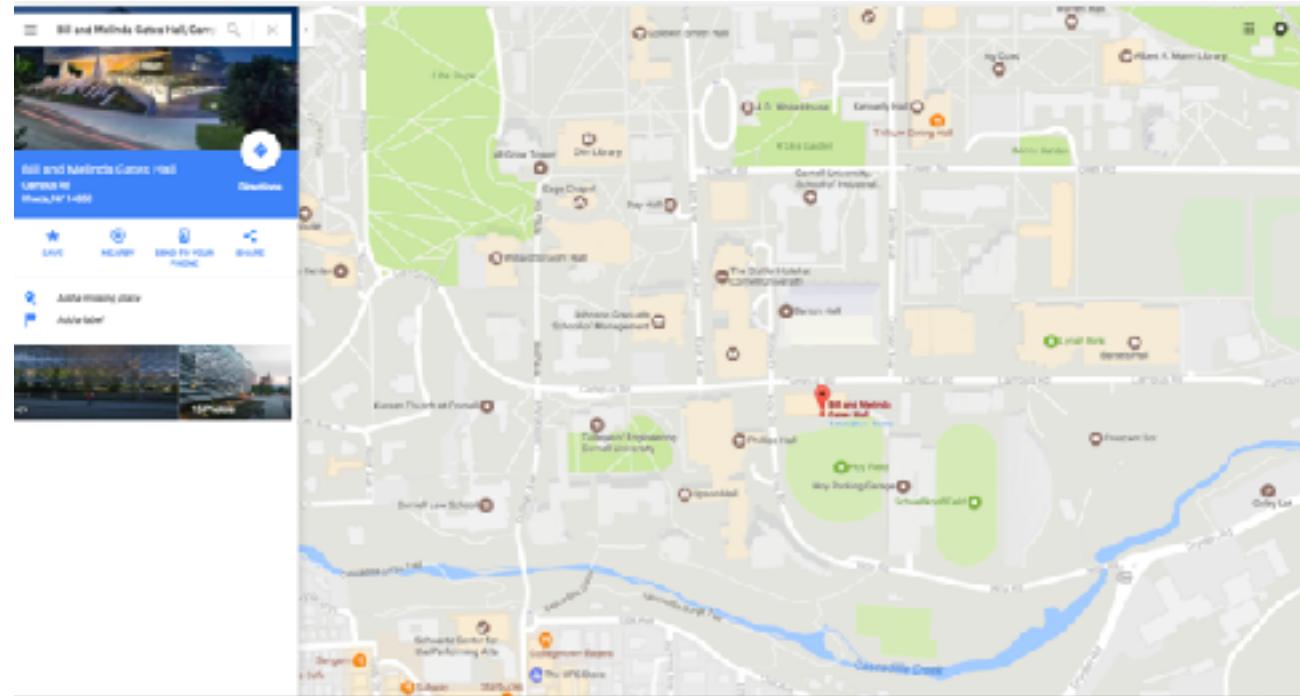
Pavithra Solai, kint.io

Art and design



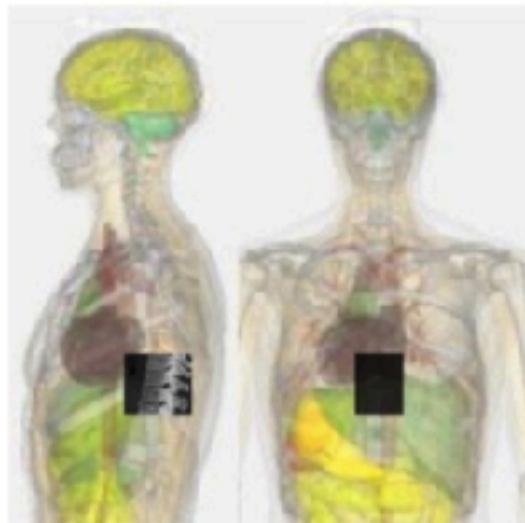
Legible compact calligrams, Siggraph 16

2D rendering



CT scan presentations

3D imaging



Average intensity projection



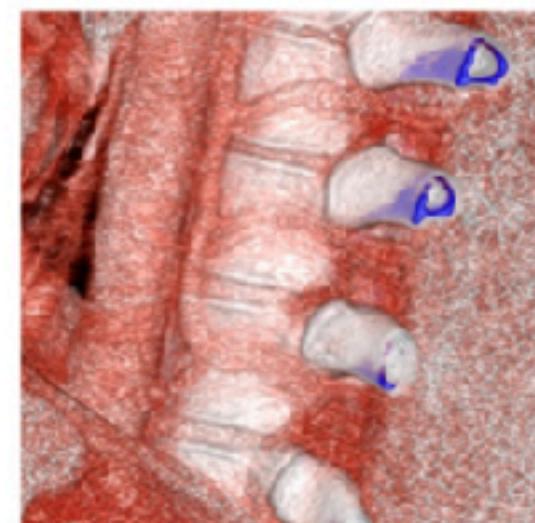
Maximum intensity projection



Thin slice



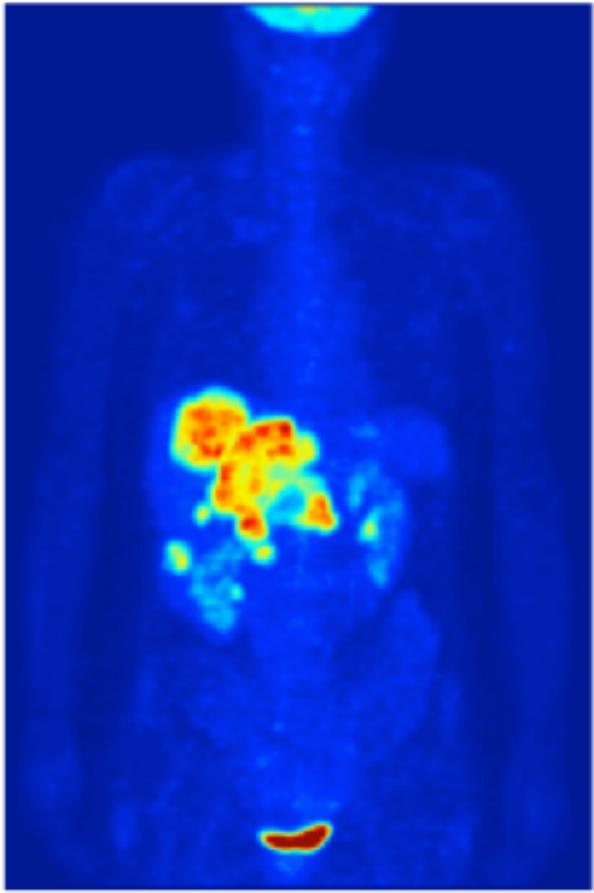
Volume rendering:
High threshold



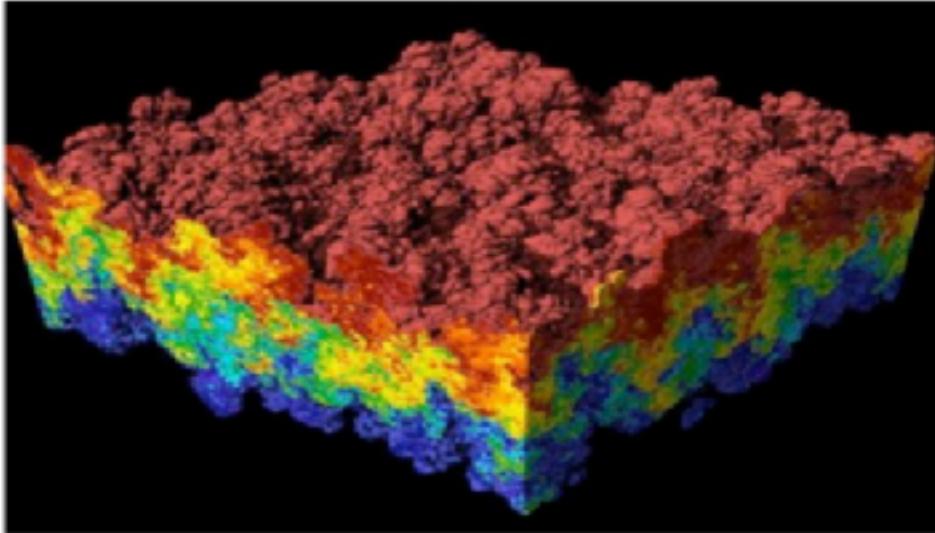
Volume rendering:
Low threshold

Scientific/mathematical visualization

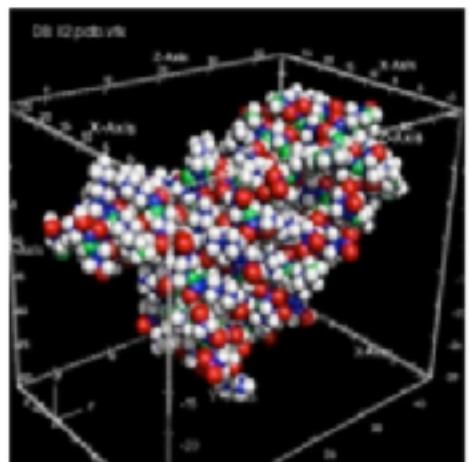
Medical/anatomical visualization



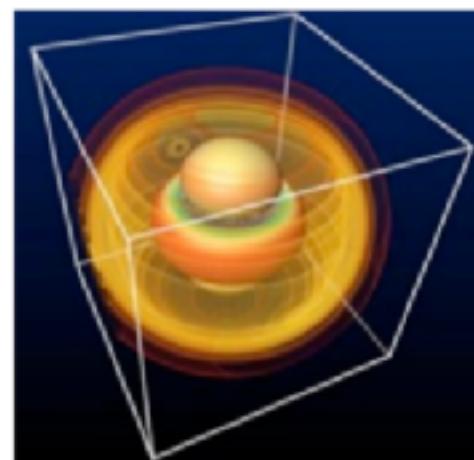
Wikipedia - PET scan



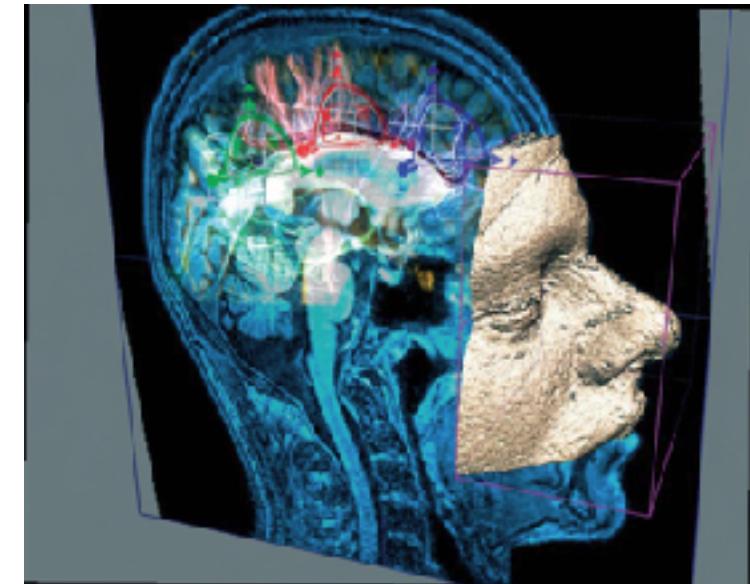
Wikipedia - mixing fluids



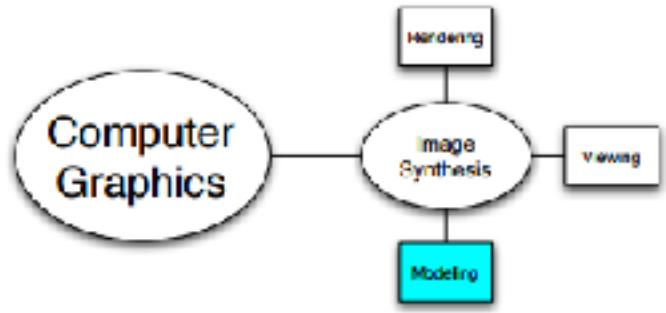
Wikipedia - protein rendering



Wikipedia - gravity waves



3D Modeling

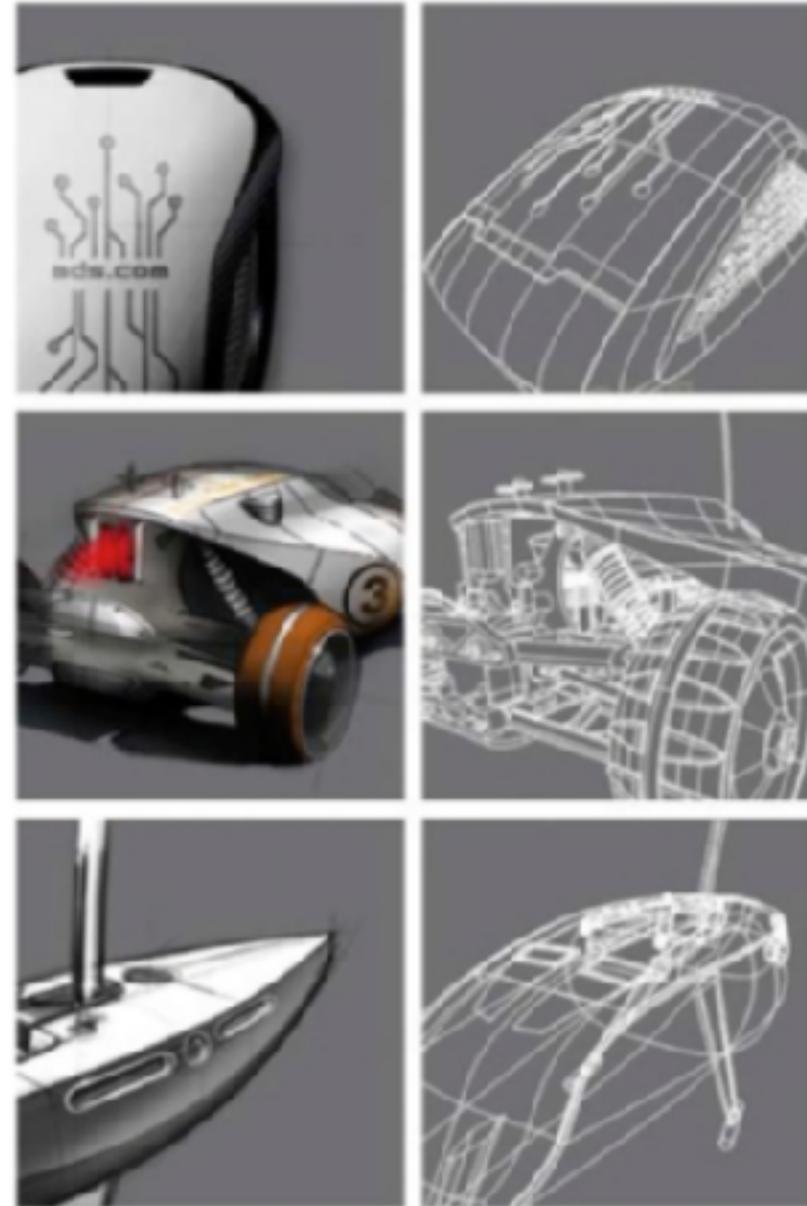


- How to represent real environments
 - Geometry: curves, surfaces, volumes
 - Photometry: light, color, reflectance
- How to build these representations
 - Interactive: sculpt it
 - Algorithmic: let it grow (fractals, extraction)
 - Scanning: via 3D sensing

Interactive modeling in Industrial design

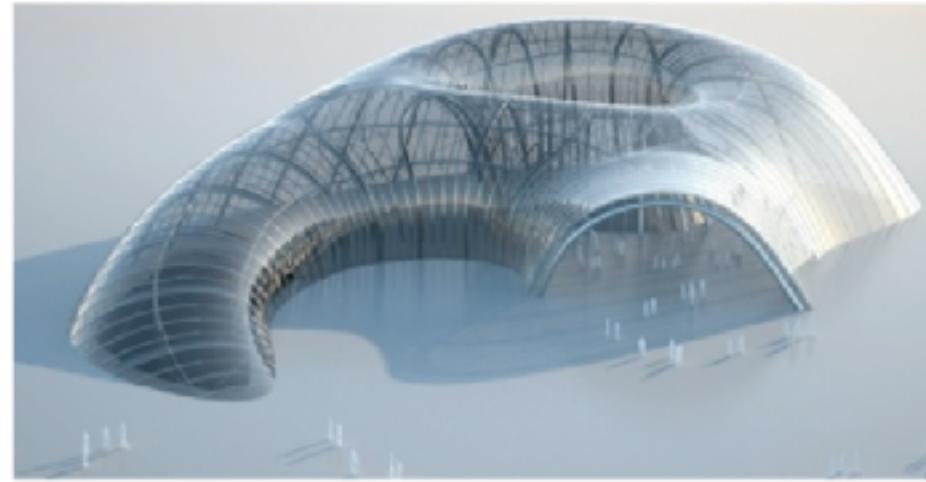
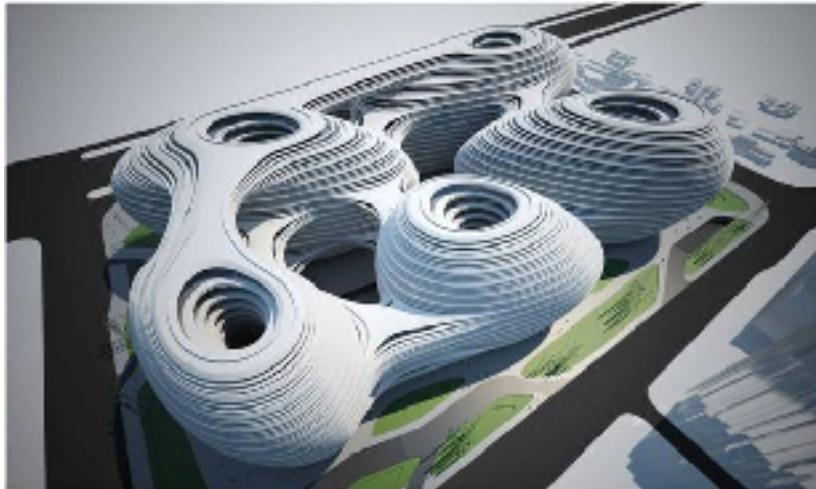


cyberswift - mechanical design



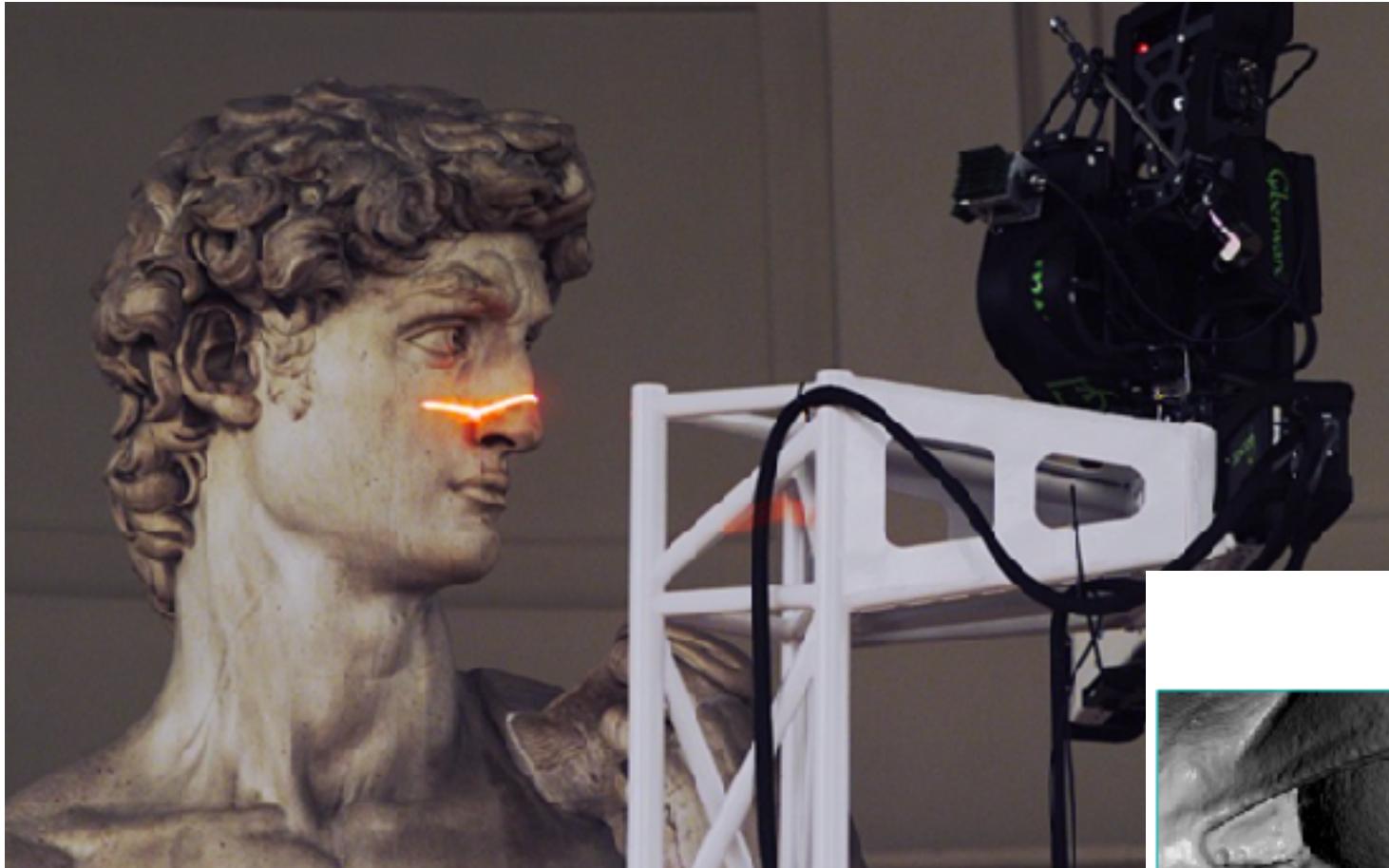
catia - product design

Architecture

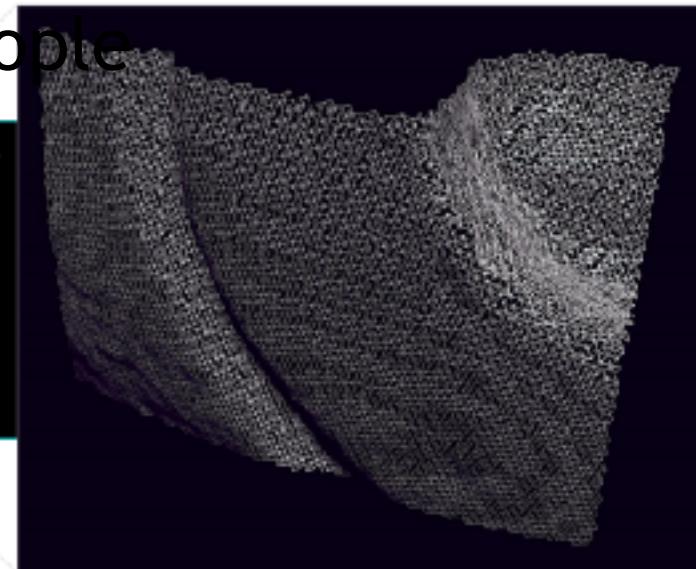
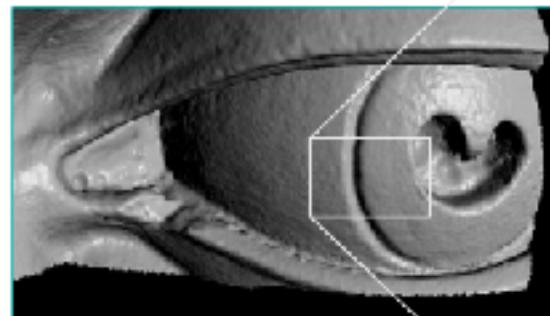


“从拓扑和几何的角度而言，扎哈在如下几个方面颠覆了传统：**拓扑的颠覆、曲率的颠覆、稳定性的颠覆、叶状结构的突破**，等等。从扎哈的作品中，我们看到了复杂拓扑、凸体几何、双曲几何、黎曼面理论等现代数学的精髓。” - 顾险峰

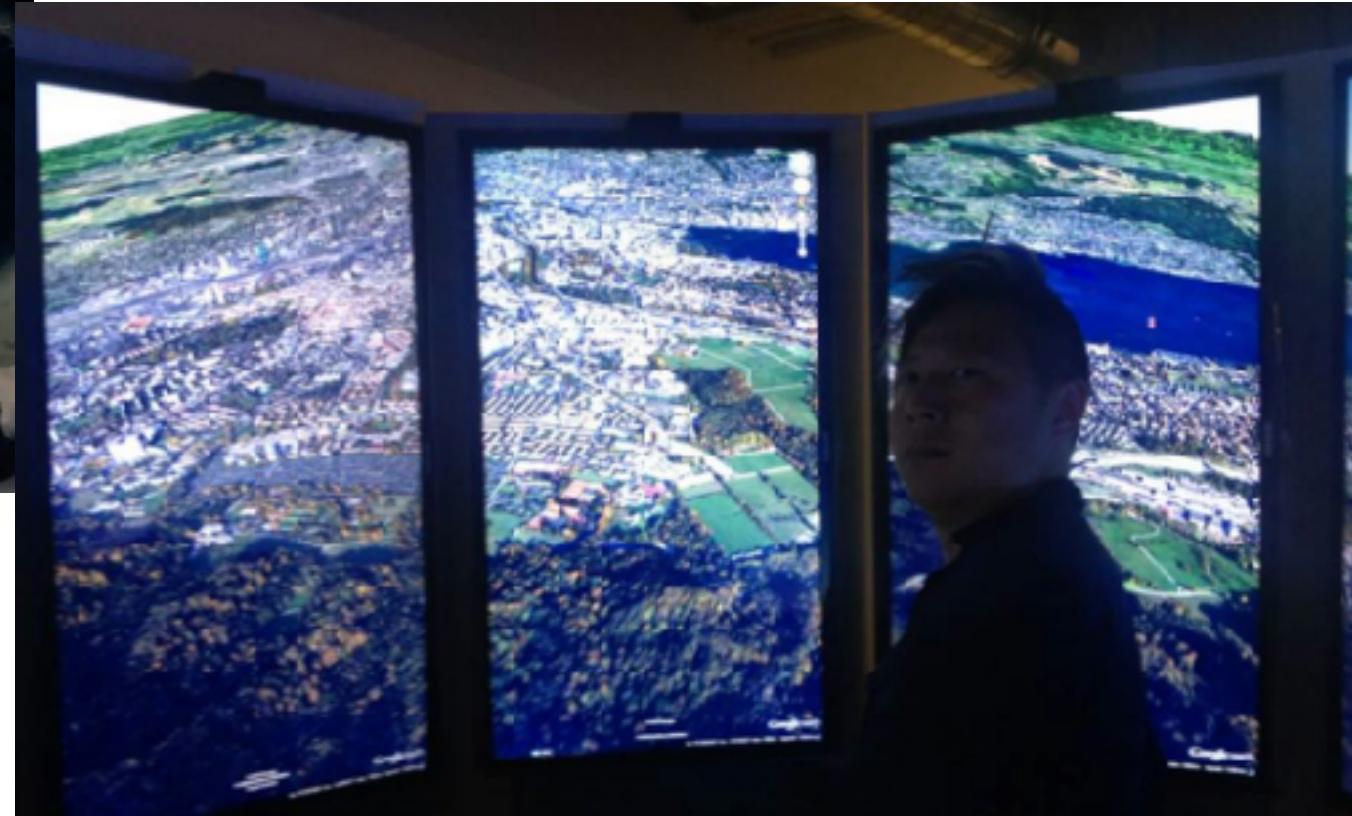
Digital Michelangelo Project -- Marc Levoy, Stanford



- 480 individually aimed scans
- 2 billion polygons
- 7,000 color images
- 32 gigabytes
- 30 nights of scanning
- 22 people

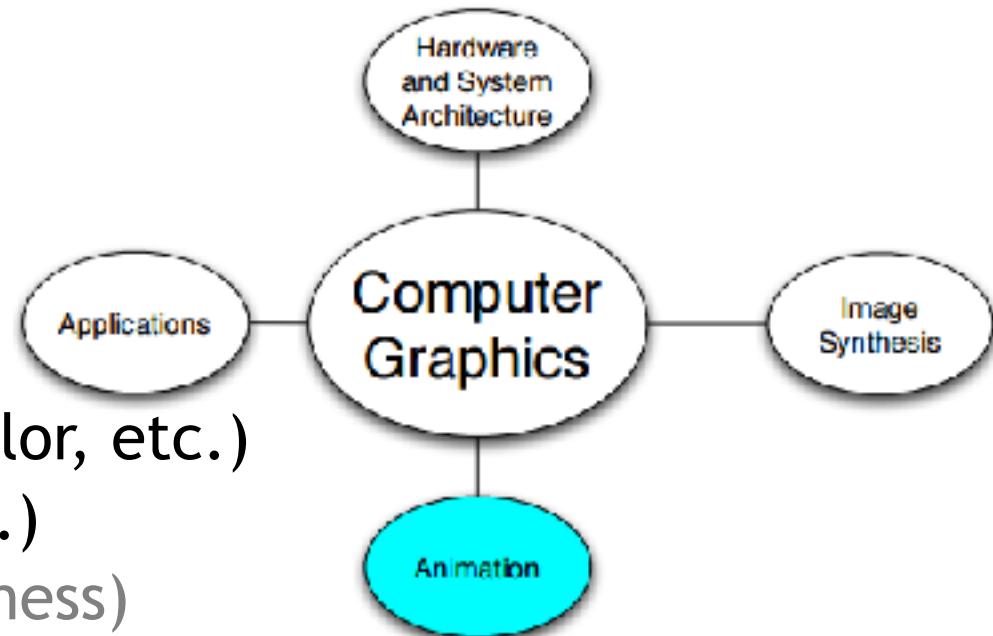


3D Cities & Google Earth

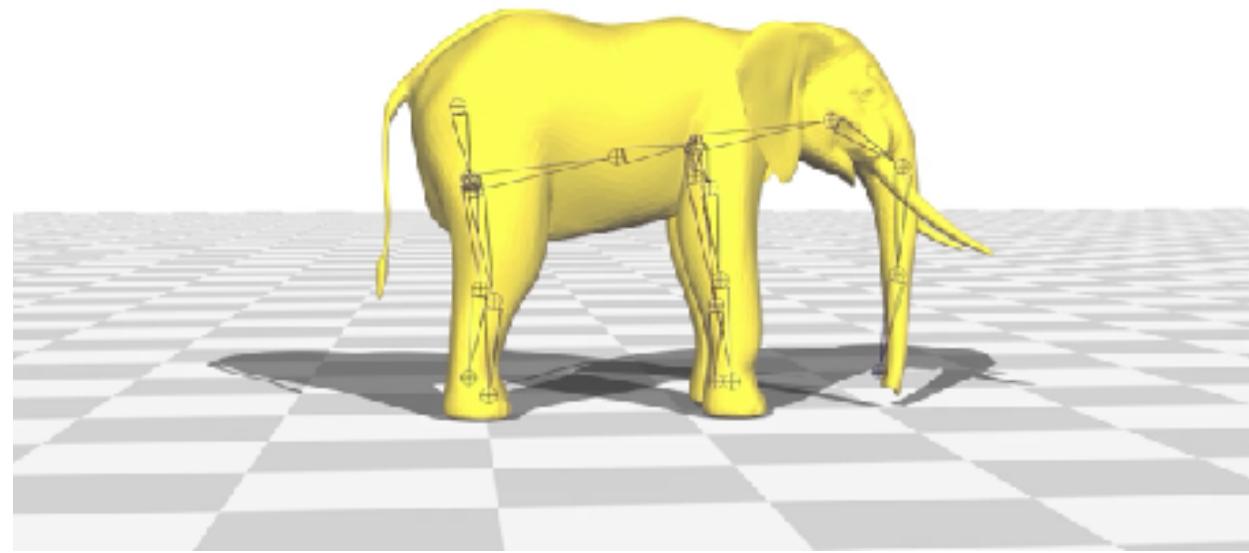


Animation

- Model how things move
- Temporal change of
 - Objects (position, orientation, size, shape, color, etc.)
 - Camera (position, direction, angle, focus, etc.)
 - Illumination (position, direction, color, brightness)
- Represent motion
 - Sequence of stills
 - Parameter curves

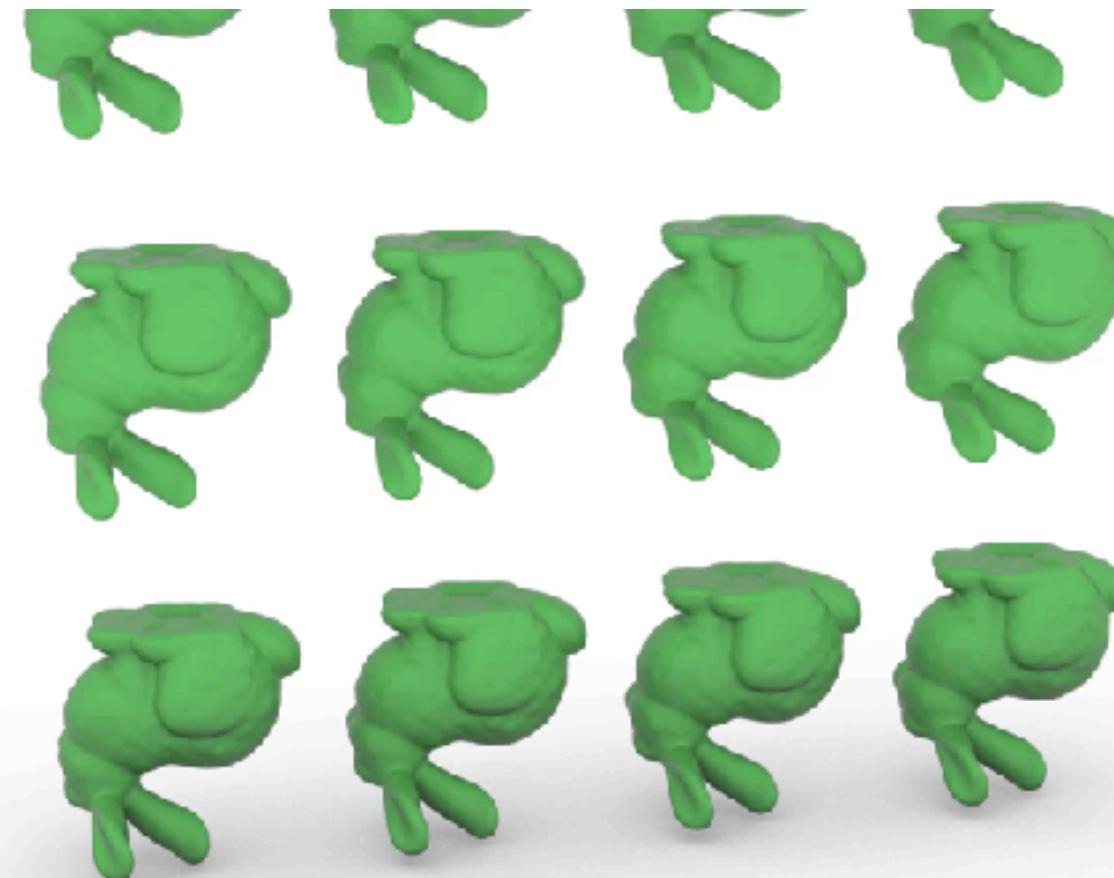


3D animation



Panzo & Jacobson, libigl tutorial (libigl.github.io/libigl)

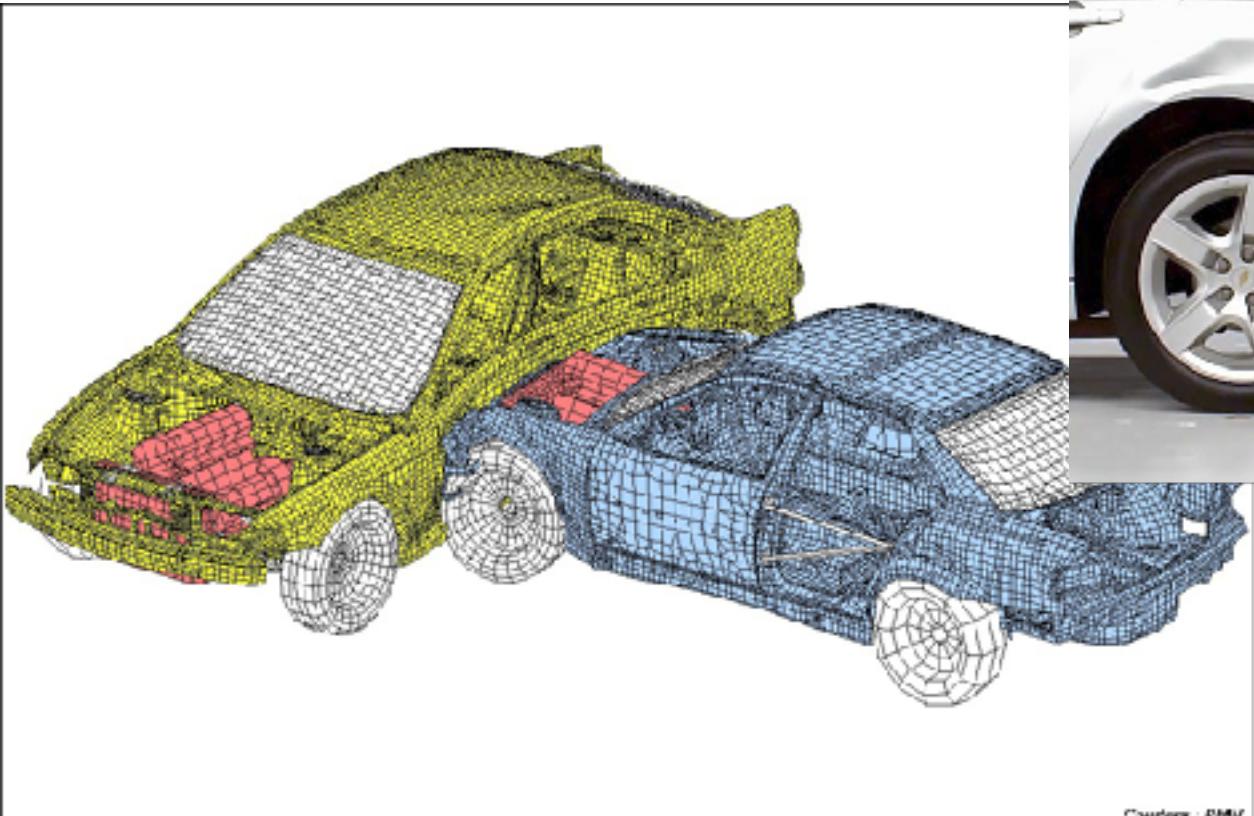
Physically-based simulation of motion

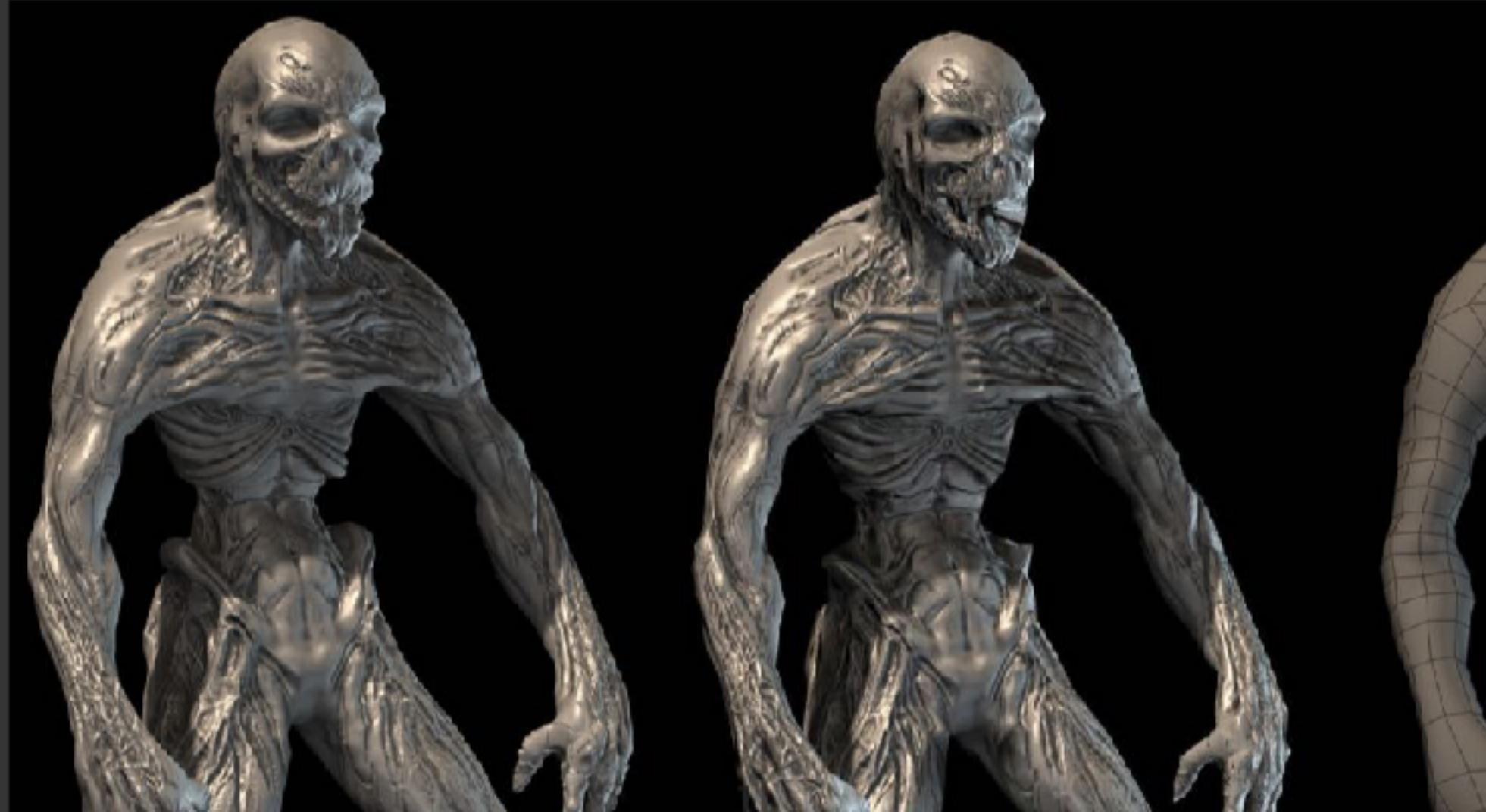


Physics + Computational Geometry + Animation + Ray Tracing

Barbic, James, SIGGRAPH 2010

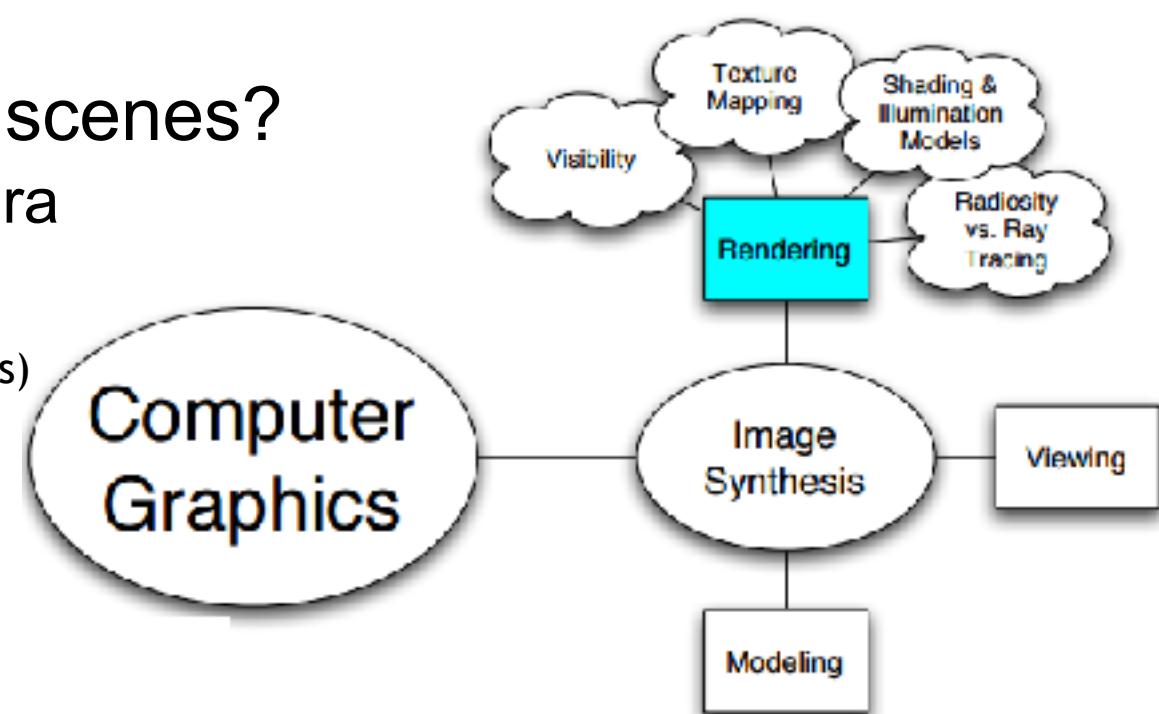
Simulation





3D Rendering

- What is an image?
 - Distribution of light energy on 2D “film”
- How do we represent and store images?
 - Sampled array of “pixels”: $p[x,y]$
- How do we generate images from scenes?
 - Input: 3D description of scene, camera
 - Project to camera’s viewpoint
 - Illumination (position, direction, color, brightness)





The Hobbit: An Unexpected Journey (New Line Cinema, 2012)—visual effects by Weta Digital

Autodesk 360 Cloud Render



Computing Illustrations



A. Herzmann, D. Zorin
SIGGRAPH 2000

Non-Photorealistic Rendering (NPR)

Pixar

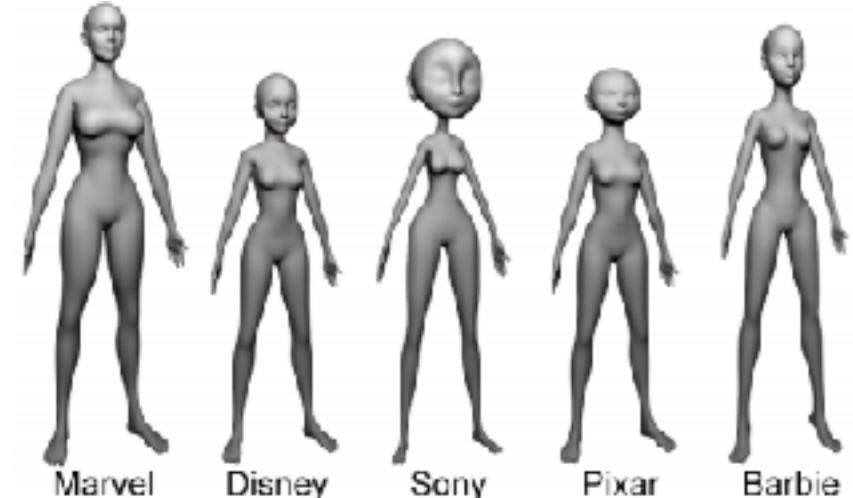
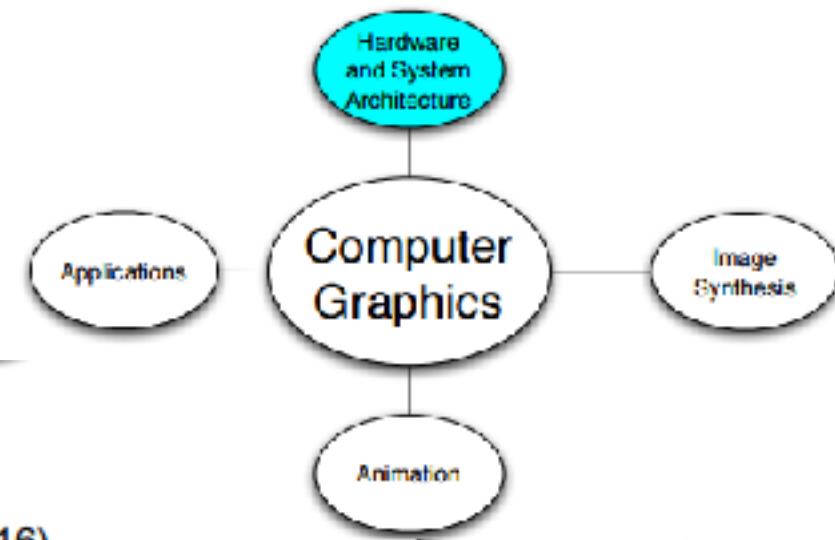
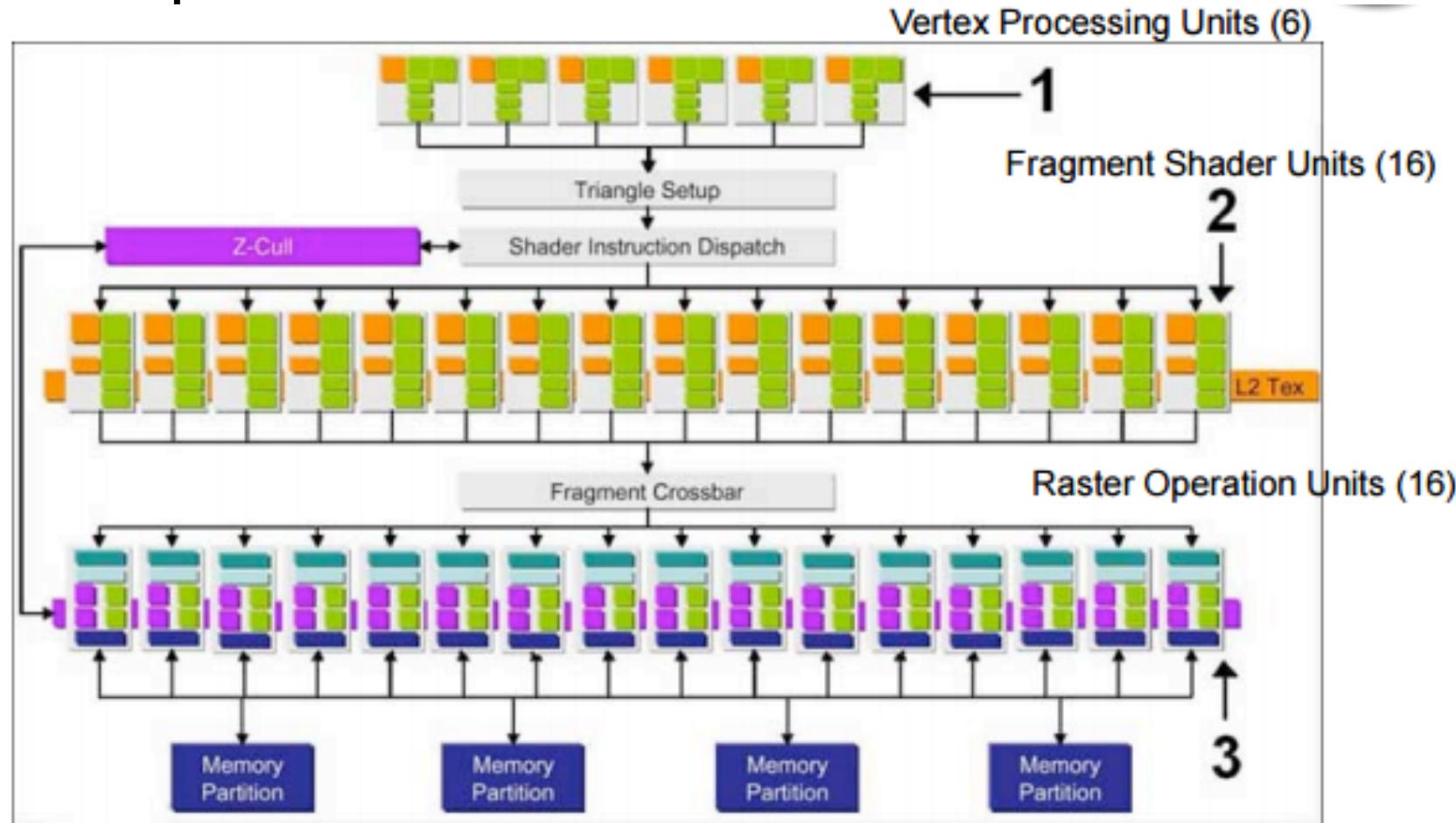


Figure 2: Style templates created from character reference.

Appealing female avatars from 3D body scans:
Perceptual effects of stylization, 2016

Hardware

- Example: NVIDIA GeForce 6800



Game => High performance computing => Deep learning
A watched flower never blooms, but an untended willow grows.

VR/AR

Virtual / mixed / augmented reality



Oculus Rift
VR headset



HoloLens
AR/MR headset



Pokémon Go
Phone based AR game



IKEA Place | iOS app

Training / Simulation; Human Computer Interfaces



VR/AR & Human Computer Interfaces

- 微软增强现实眼镜(硬盘播放) -- 全息传输
- 裸眼
 - **Sig07_Rendering for an Interactive 360° Light Field Display**
 - Bleen--世界上第一个真正的空间3D全息投影设备!