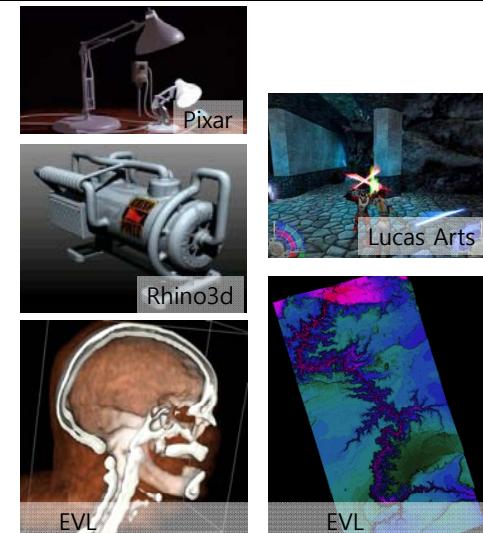


Introduction to Computer Graphics

321190
2014년 봄학기
3/6/2014
단국대학교 멀티미디어공학 박경신

Computer Graphics Applications

- Computer Animation
- CAD/CAM
- Games
- Virtual Reality
- Medical Imaging
- Scientific Visualization



Computer Graphics Main Theme

- 이미지 (Imaging)
 - 2차원 이미지를 효과적으로 표현
- 모델링 (Modeling)
 - 실물이나 가상의 3차원 물체를 컴퓨터가 이해할 수 있는 형태의 3차원 입체로 형상화
- 렌더링 (Rendering)
 - 3차원 모델(기하모델, 볼륨, 영상)에서 2차원 이미지로 화면에 형상화
- 애니메이션 (Animation)
 - 인간 또는 의인화된 동식물, 로봇 등 사물의 시간에 따른 움직임을 자연스럽게 표현

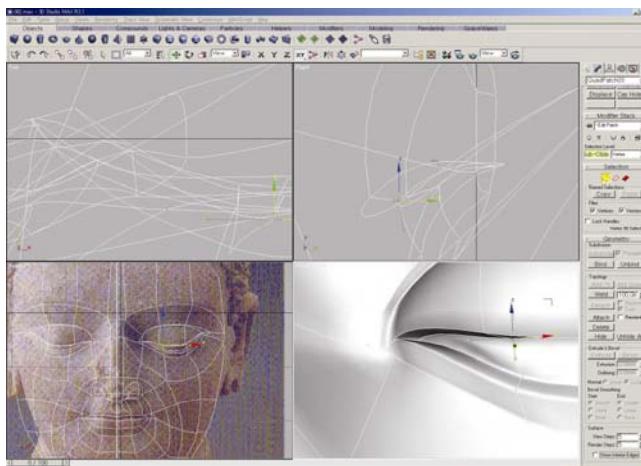
Modeling

- Geometric Modeling
 - Maya, 3D Max Studio 등의 그래픽 도구를 이용하여 3차원 모델 생성
 - Physically Based Modeling 물, 연기, 불, 폭발과 같은 자연계의 물리 현상을 컴퓨터 그래픽스를 통해 사실적으로 재현하는 기술
- 3D Scanning
 - 레이저 또는 특정한 패턴을 피사체에 투사하고 이를 촬영한 영상으로부터 3차원 형상 복원
- Image-based Modeling
 - 다수의 사진으로부터 3차원 모델 생성

Rendering

- Physically Based Rendering
 - 빛과 물체의 물리적 상호작용을 기반으로 CG물체를 실제와 같이 사실감 있게 표현
 - Ray Tracing, Radiosity
- Volume Rendering
 - 대용량의 볼륨 데이터를 3차원으로 표현
- Image-based Rendering
 - 한 시점에서 생성된 영상(또는 촬영된 사진)을 다른 시점에서 보여지는 영상으로 재생성
- Non-Photorealistic Rendering
 - 사실적 렌더링과 반대로 사람이 그린듯한 형태로 표현
 - Cartoon, 연필화, 수채화, 유화, 모자이크, 수묵화 기법
- Real-Time Rendering
 - 대화식(Interactive) 그래픽스 응용 소프트웨어 제작에 필요한 실시간 렌더링

Geometric Modeling



3D Studio Max

Animation

- Keyframe Animation
 - 대상체의 움직임 중 중요한 장면(Keyframe)을 숙련된 키프레임 애니메이터가 설정하고 키프레임 사이를 부드럽게 연결
 - 셀 애니메이션에서는 수작업으로 현재 컴퓨터 애니메이션에서는 자동 계산
- Motion Capture
 - 광학식 카메라, 자기식 센서, 기계식 센서 등을 이용하여 관절의 움직임을 직접 캡처
 - 가장 사실적인 동작 생성이 가능하여 영화에 널리 적용되고 있으나, 캡처 동작 편집이 어려움
- Physically Based Animation
 - 물리적 법칙에 근거한 시뮬레이션을 통해 사실적인 상호 작용 및 애니메이션 생성
- AI-based Behavior Animation
 - 캐릭터에 지능과 행동 양식을 부여하여 실제 인간과 같은 자연스런 행동을 자동 생성

Physically Based Modeling and Animation



Cloth simulation

David Baraff and Andrew Witkin

<http://www.cs.cmu.edu/~baraff/sigcourse/index.html>



Fire simulation

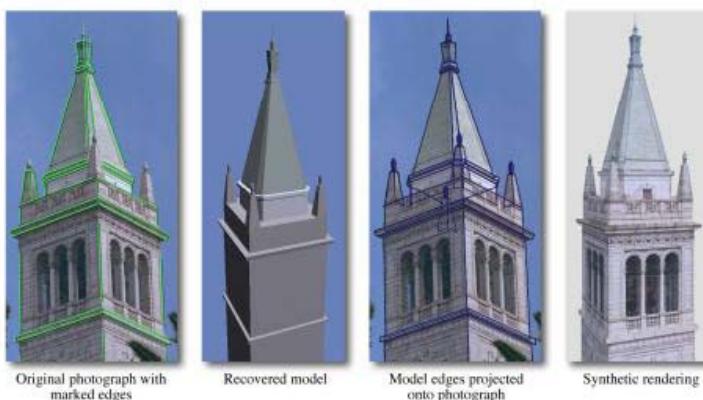
Duc Quang Nguyen

Ronald Fedkiw

Henrik Wann Jensen

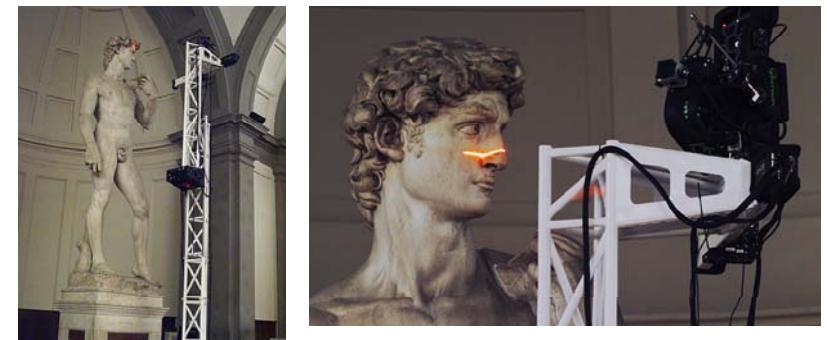
<http://graphics.ucsd.edu/~henrik/papers/fire>

Image Based Modeling and Rendering



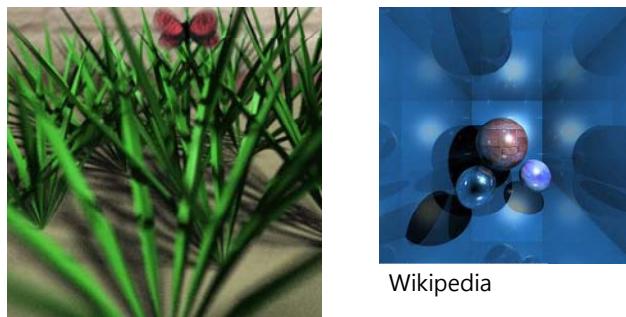
Façade
<http://www.debevec.org/Research/>

3D Scanning



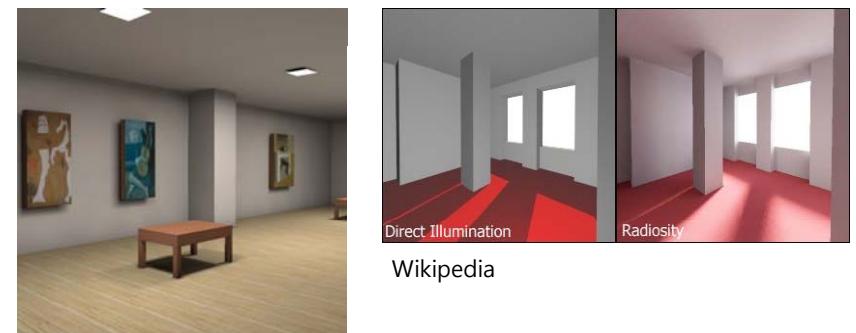
Digital Michelangelo Project
Marc Levoy
Paul Debevec
<http://graphics.stanford.edu/projects/mich/more-david/more-david.html>

Photo-realistic Rendering



Monte Carlo Ray Tracer
http://www.student.cs.uwaterloo.ca/~cs488/Contrib/a3patel/project/a3patel_index.html

Photo-realistic Rendering



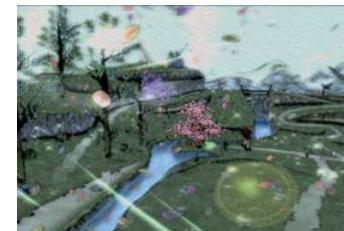
Radiosity on Graphics Hardware
<http://www.cs.unc.edu/~coombe/research/radiosity/>

Photo-Realistic Rendering

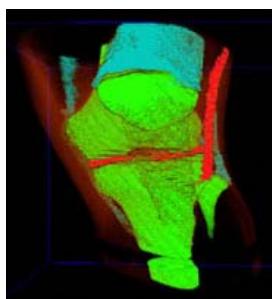


Pixar's RenderMan
<http://www-viz.tamu.edu/students/jd/gallery/renderman/rendermangallery.html>

Non Photorealistic Rendering (NPR)

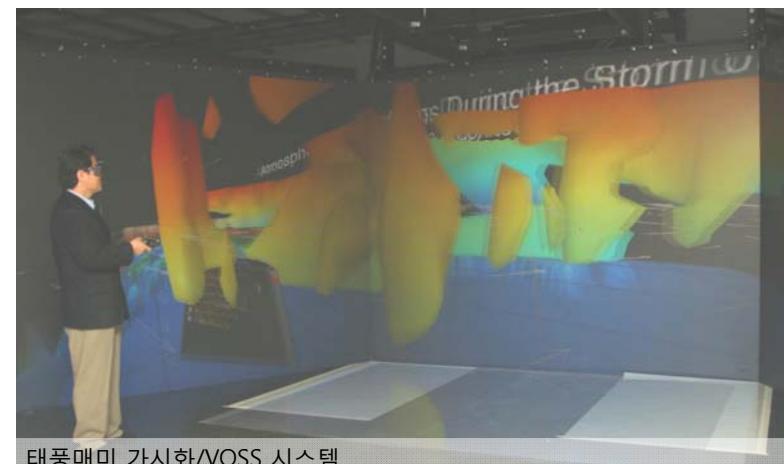


Volume Rendering



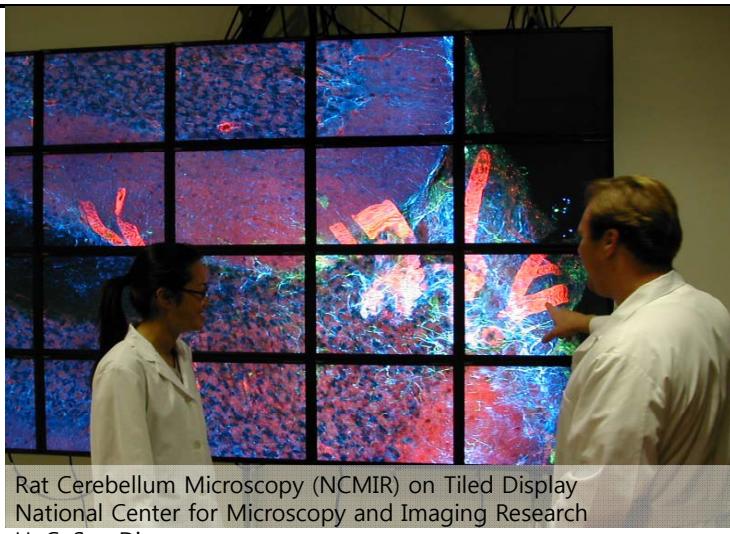
6.77GB Visible Male Data sets
<http://www.sgi.com/products/software/volumizer/techsum.html>

Scientific Visualization



태풍매미 가시화/VOSS 시스템
한국해양연구원 가상해양환경센터

Scientific Visualization

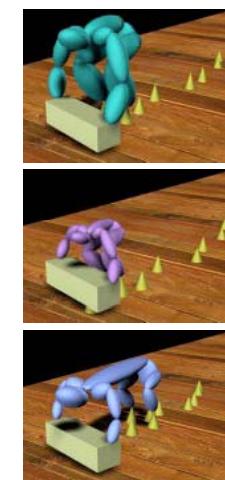


Rat Cerebellum Microscopy (NCMIR) on Tiled Display
National Center for Microscopy and Imaging Research
U. C. San Diego

Motion Capture for Character Animation

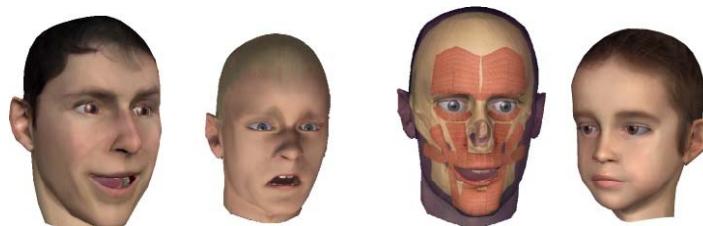


Motion capture



Retargetting motion

Facial Expression Animation



Facial animation and modeling
MPI Informatik
<http://www mpi-inf mpg de/resources/FAM/>

AI-based Behavior Animation



Panspermia
Karl Sims' Artificial Life
<http://www cyodine com/virtualife/DynamicEcos htm>

3D Films



Avatar (2009 film) directed by James Cameron

Real-Time Graphics



GPU programming by nVidia Cg, OpenGL/GLSL, DirectX/HLSL

http://en.wikipedia.org/wiki/Real-time_computer_graphics

<http://www.e-booksdirectory.com/details.php?ebook=2474>

The OpenGL Wiki is a collection of information about OpenGL, as well as frequently asked questions about OpenGL and its API. Tutorials are also welcome and can be hosted on this Wiki. Contributions on this wiki are open to the public, you only need to create a user account. We ask that you please respect the content on this wiki and post only information that is relevant to OpenGL.

Getting Started

- OpenGL development setup
- Loading OpenGL functions
 - tools to do this automatically
- Additional useful development tools

FAQs

- FAQ
- Common mistakes
 - Common legacy mistakes
 - Common GLSL mistakes

OpenGL Reference

- OpenGL 4.3 function reference
- GLSL 4.3 function reference

OpenGL Objects

- Buffer Objects
 - Buffer Object Streaming
 - Pixel Buffer Objects
- Textures
 - Sampler Objects
 - Image formats
 - Pixel transfer operations
 - Cubemap Textures
 - Array Textures
 - Buffer Textures
- Asynchronous query objects
- Framebuffer Objects
 - Default Framebuffer
 - Renderbuffer Objects
- Unconventional objects:
 - Sync Objects
 - Shader and program objects

Rendering pipeline

- Vertex Specification
 - Vertex Rendering
 - Primitive
- Vertex Processing
 - Vertex Shader
 - Tessellation
 - Geometry Shader
- Vertex Post-Processing
 - Transform Feedback
- Primitive Assembly
 - Face Culling
- Rasterization
- Fragment Shader
- Per-Sample Processing
 - Depth Test
 - Blending

OpenGL Shading Language

- The core language
- Shader compilation
 - Introspection
- Variable types
 - Type qualifiers
 - Uniform variables
 - Sampler variables
- Built-in variables
- Interface blocks
- Shader stages:
 - Vertex Shader
 - Tessellation
 - Geometry Shader
 - Fragment Shader
 - Compute Shader
- Other shading languages