

Introduction to Computer Graphics

Prof. Kim, Soo Kyun

Contents

- What is Computer Graphics?
- Demo Video
- Graphics Process
- Technical Demo

What is Computer Graphics?

- Producing Images Using a Computer
- Algorithms for Visual Simulations



Computer Graphics(1)

- 정의
 - 컴퓨터를 이용하여 영상을 제작하는 기술
- 예제
 - 광고: Milka Chocolate (Tippette Studio)



Downhill



Eagle



Computer Graphics(2)

- 정의
 - 컴퓨터를 이용하여 영상을 제작하는 기술
- 예제
 - 광고: Milka Chocolate (Tippette Studio)
 - 영화: Batman & Robin (Buf Campagne)



Computer Graphics(3)

- 이미징 (Imaging) - 2차원 이미지 표현
- 모델링 (Modeling) - 3차원 오브젝트 표현
- 렌더링 (Rendering)
 - 3차원 모델들로부터 2차원 이미지 생성
- 애니메이션 (Animation) : 인크레더블
 - 시간의 흐름에 따라 변화를 시뮬레이션

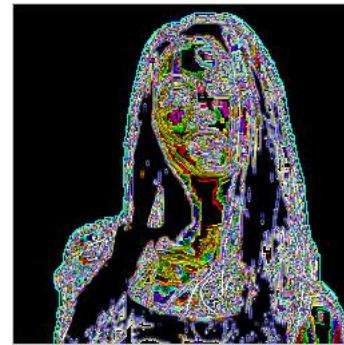


Imaging(1)

- 예술적 이미지를 생성



와핑 (Warping)



경계선 검출 (Edge Detection)

Imaging(2)

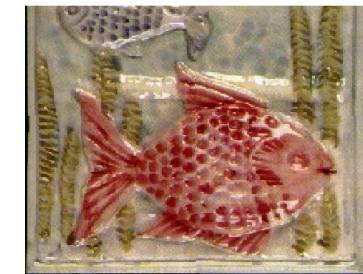
- Michael Jackson - Black Or White



Imaging(3)



모핑 (Morphing, Metamorphosis)



Modeling

- 3차원 모양을 묘사하고 디자인

폴리곤
(Polygon)



서브디비전
(Subdivision)



프랙탈
(Fractal)



Blobby

NURBS



CSG

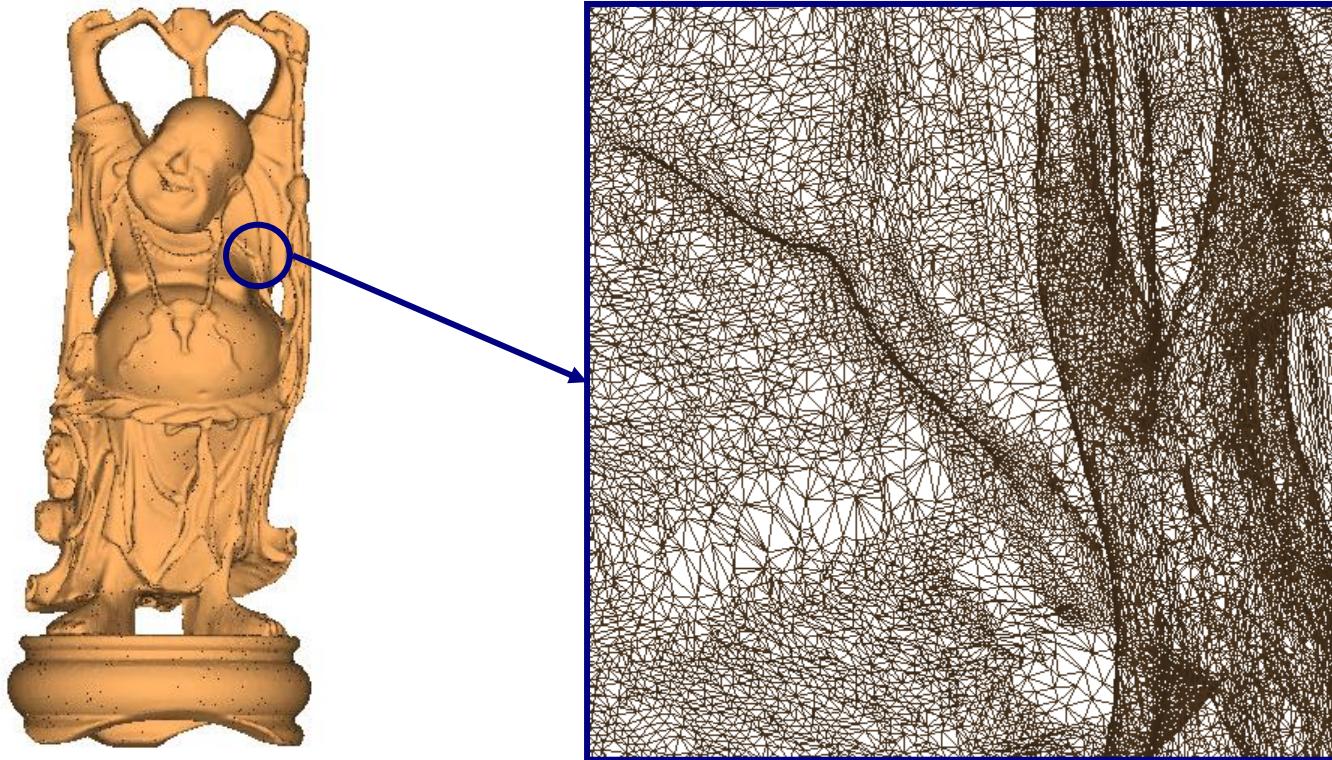


지형
(Terrain)



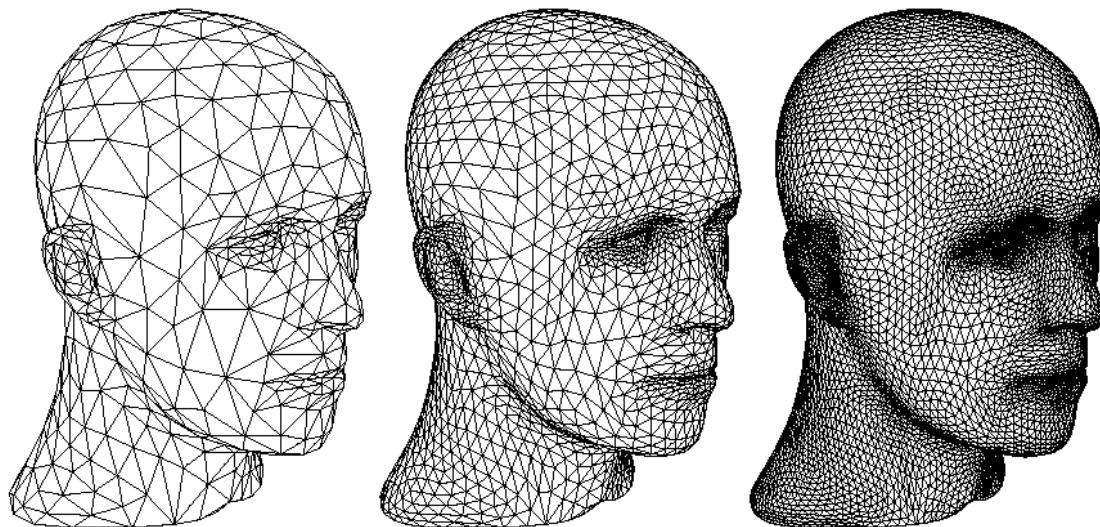
Modeling

- 폴리곤 (Polygon)



Modeling

- 메쉬 분할 (Subdivision Surface)

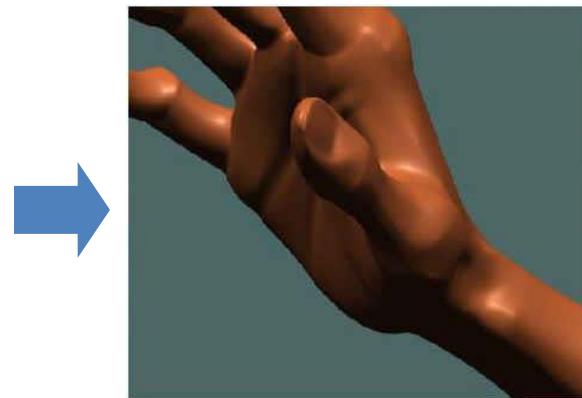


Modeling

- 메쉬 분할 (Subdivision Surface)



기본 메쉬



분할 메쉬



Pixar animation
[Geri's Game]

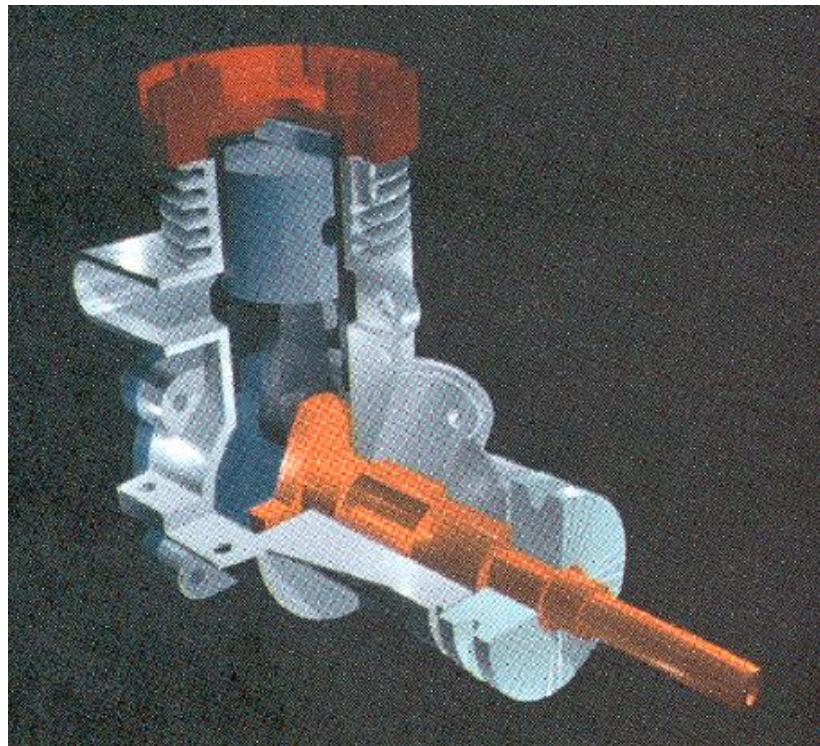
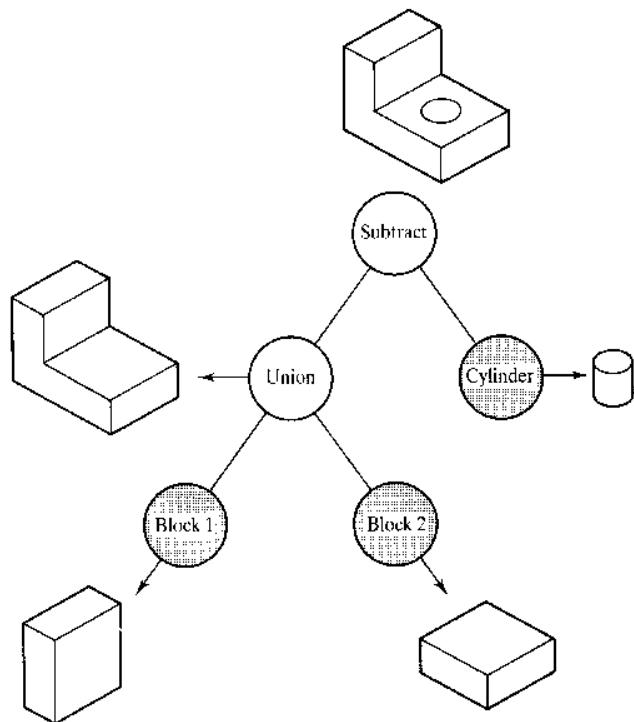
Modeling

- Geri's Game



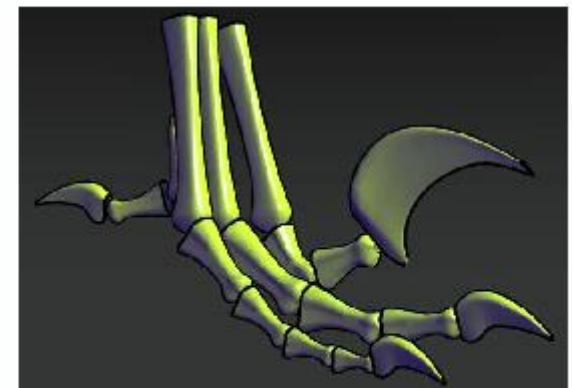
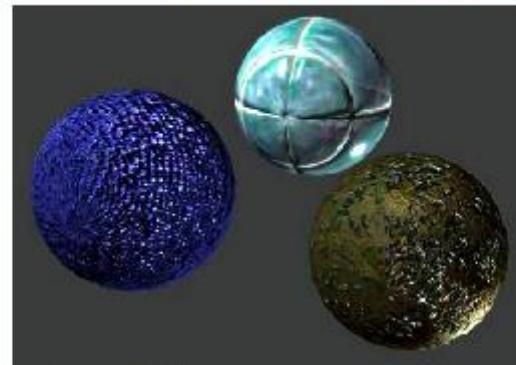
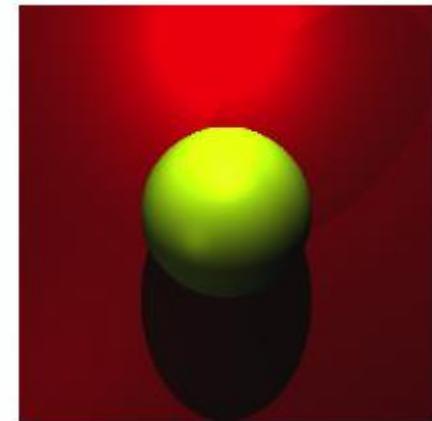
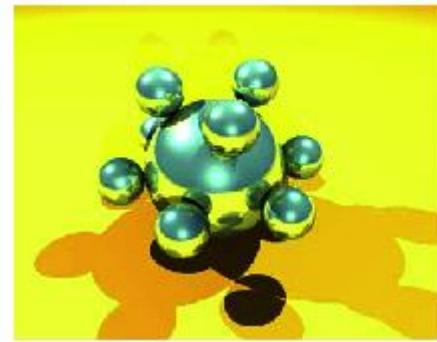
Modeling

- 간단한 모양의 물체들에 Boolean 연산 (합집합, 교집합, 차집합) 을 계층 (Hierarchy) 적으로 표현



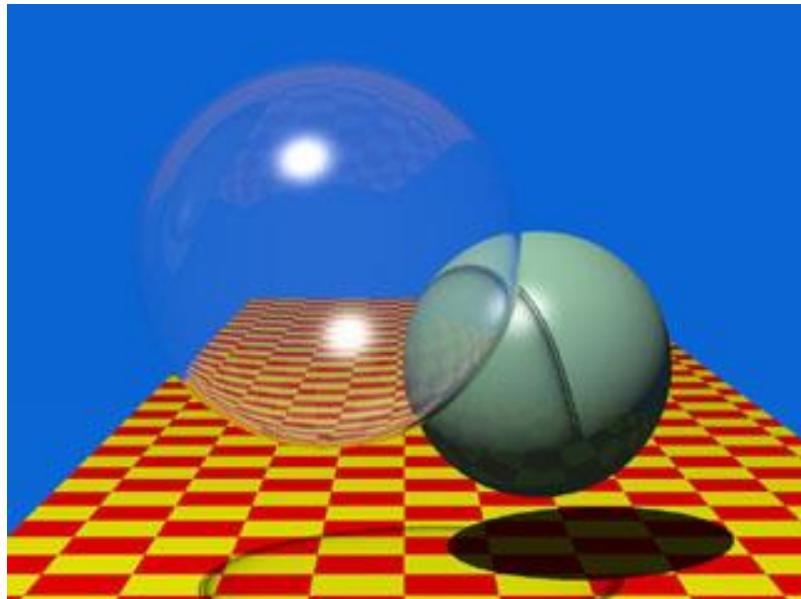
Rendering

- 빛의 움직임을 시뮬레이션 하여 이미지 형성



Rendering

- Photorealistic Rendering



1980 "An Improved Illumination model for shaded display" - Turner Whitted, SIGGRAPH



<http://www.oyonale.com/accueil.php?lang=en>

Rendering

- Non-Photorealistic Rendering



Traditional Rendering



Cartoon Rendering

Demo Video (1/8)



[Geri's game, 1997]

Demo Video (2/8)



[Pan's Labyrinth, 2006]

Demo Video (3/8)



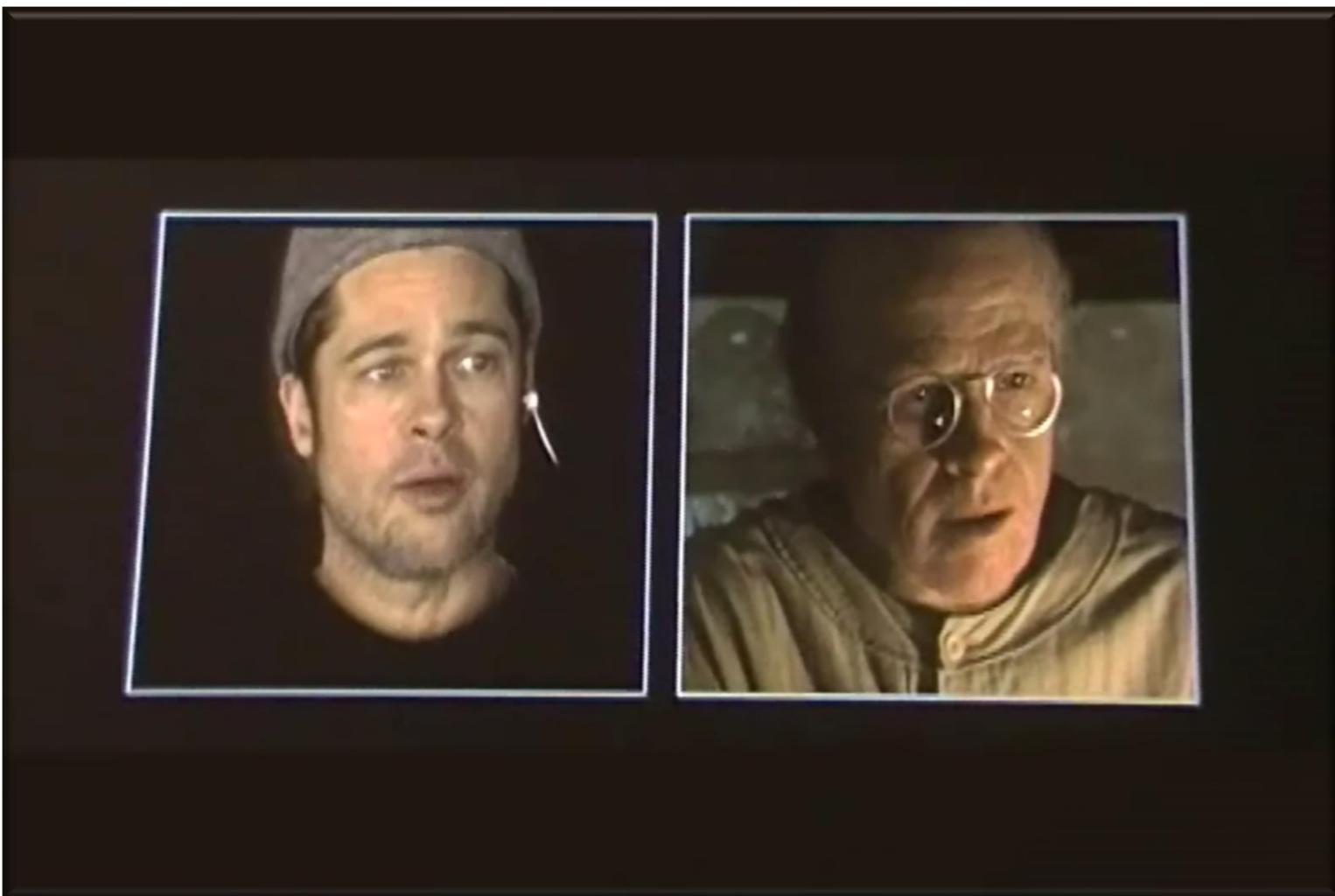
[The Chronicles Of Narnia: Prince Caspian, 2008]

Demo Video (4/8)



[Ice Age 3 : Dawn of the Dinosaur, 2008]

Demo Video (5/8)



[The Curious Case of Benjamin Button, 2008]

Demo Video (6/8)



[추노, 2010]

Demo Video (7/8)



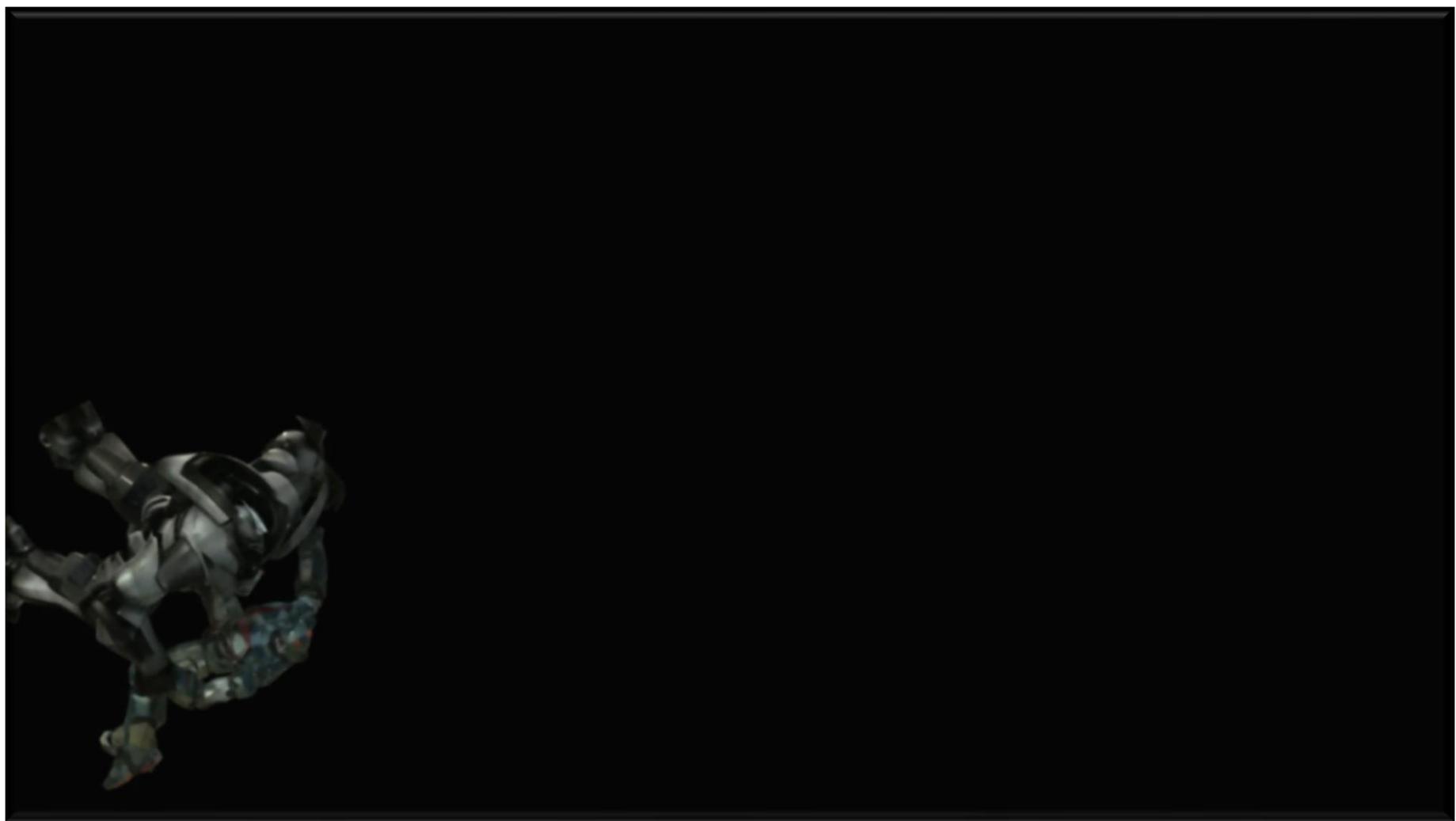
[The Last Airbender, 2010]

Demo Video (8/8)



[Inception, 2010]

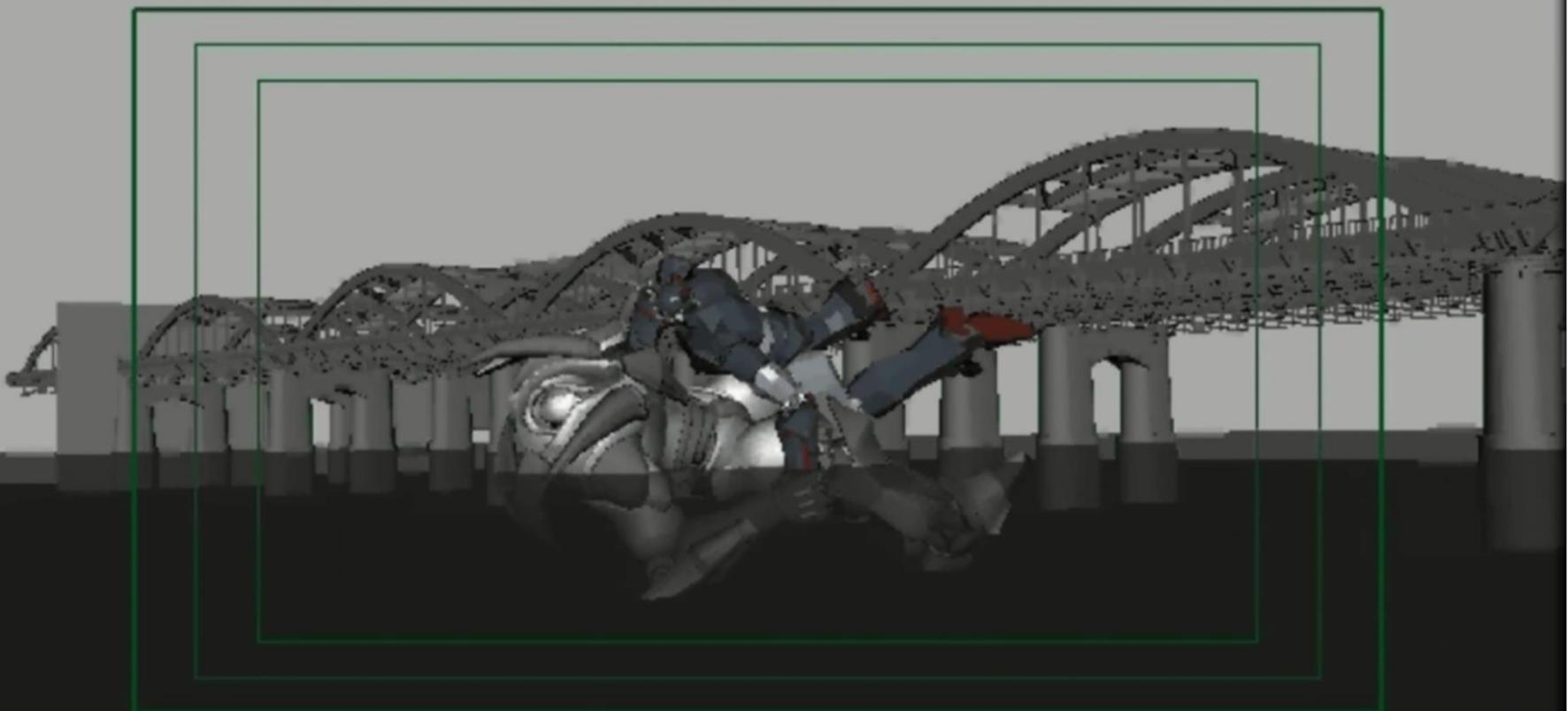
CG Production Process (1/2)



[Robot Taekwon V, 2009]

CG Production Process (2/2)

1920 x 1080



RF002_ShotCAM

RF002 Pre-version Animatics
FXGear / Mobydic / Puppetar Studio

[Robot Taekwon V, 2009]

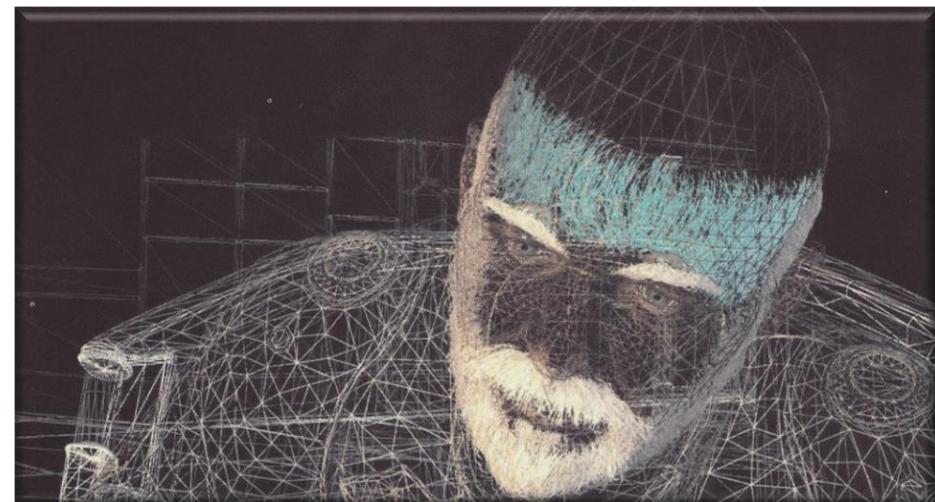
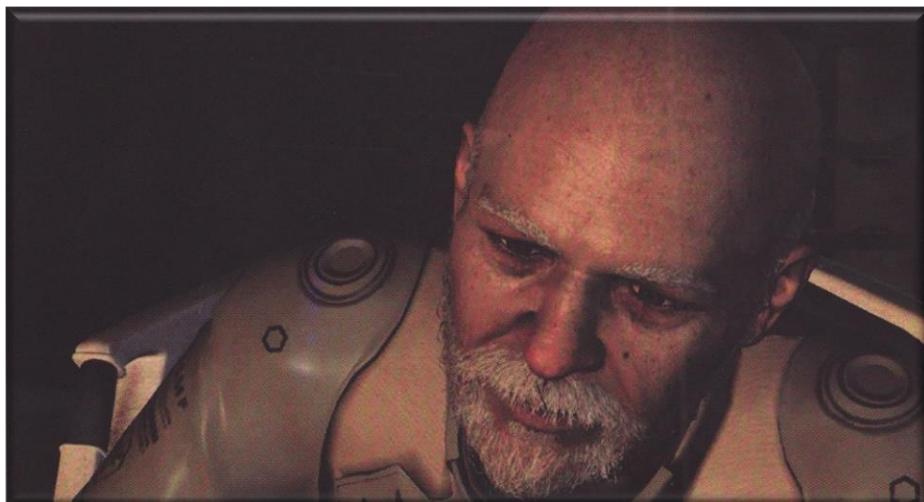
Real-time Rendering

- Normally means 3D rendering
- The frame rate at which images are displayed
 - Frames per second (fps) / Hertz (Hz)
 - 1 fps
 - The user painfully waits for the arrival of each new image
 - Around 6 fps
 - A sense of interactivity starts to grow
 - Around 15 fps : Interactive (almost real-time)
 - The user focuses on action and reaction
 - Above 30 fps : Real-time

Interactivity and some sense of connection to **3D space**

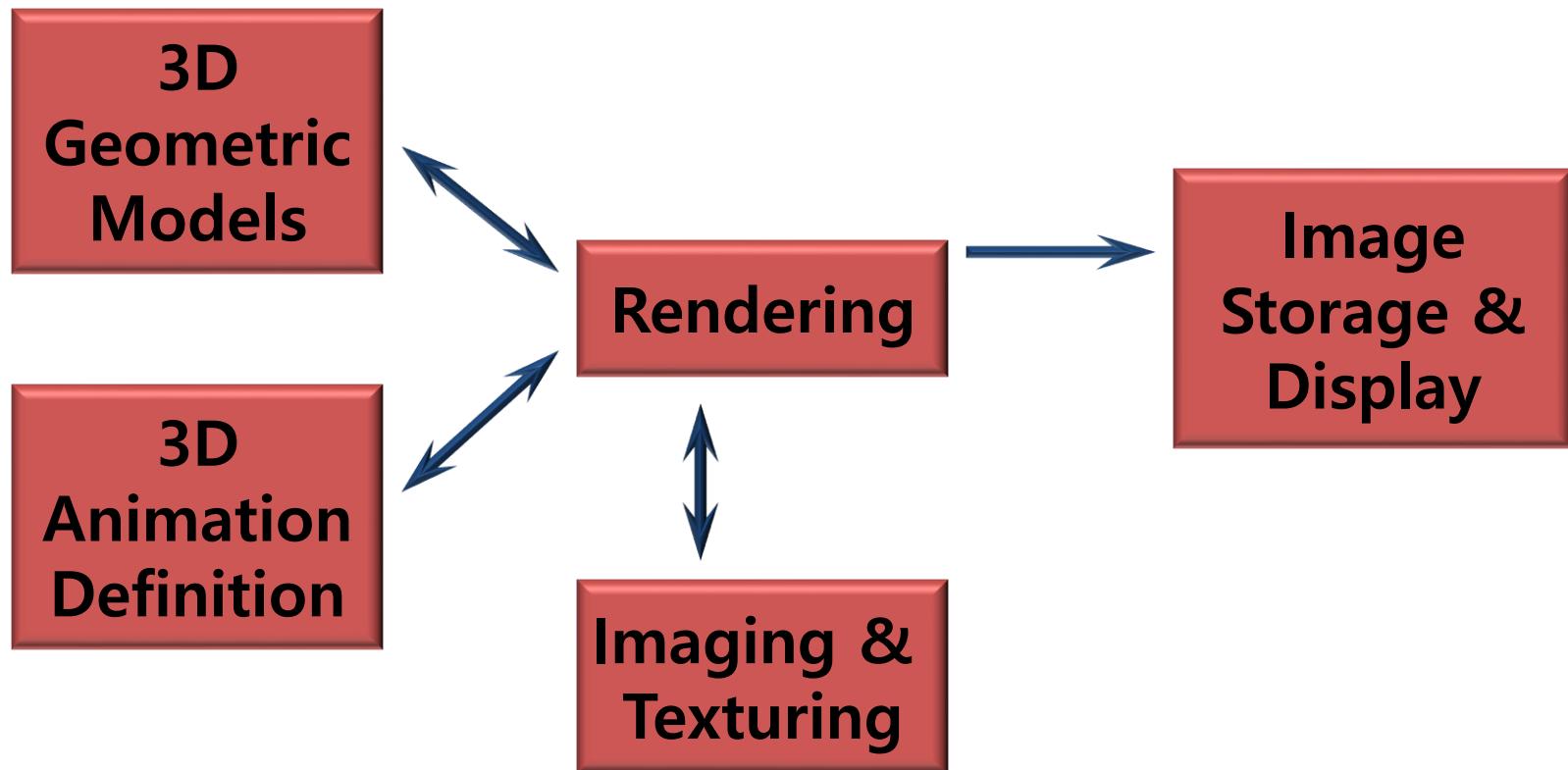
Graphics Acceleration Hardware

- Has become a part of real-time rendering
- Real beginning of the 3D accelerator at the consumer level
 - 3Dfx Voodoo 1 in 1996 : Add-on type

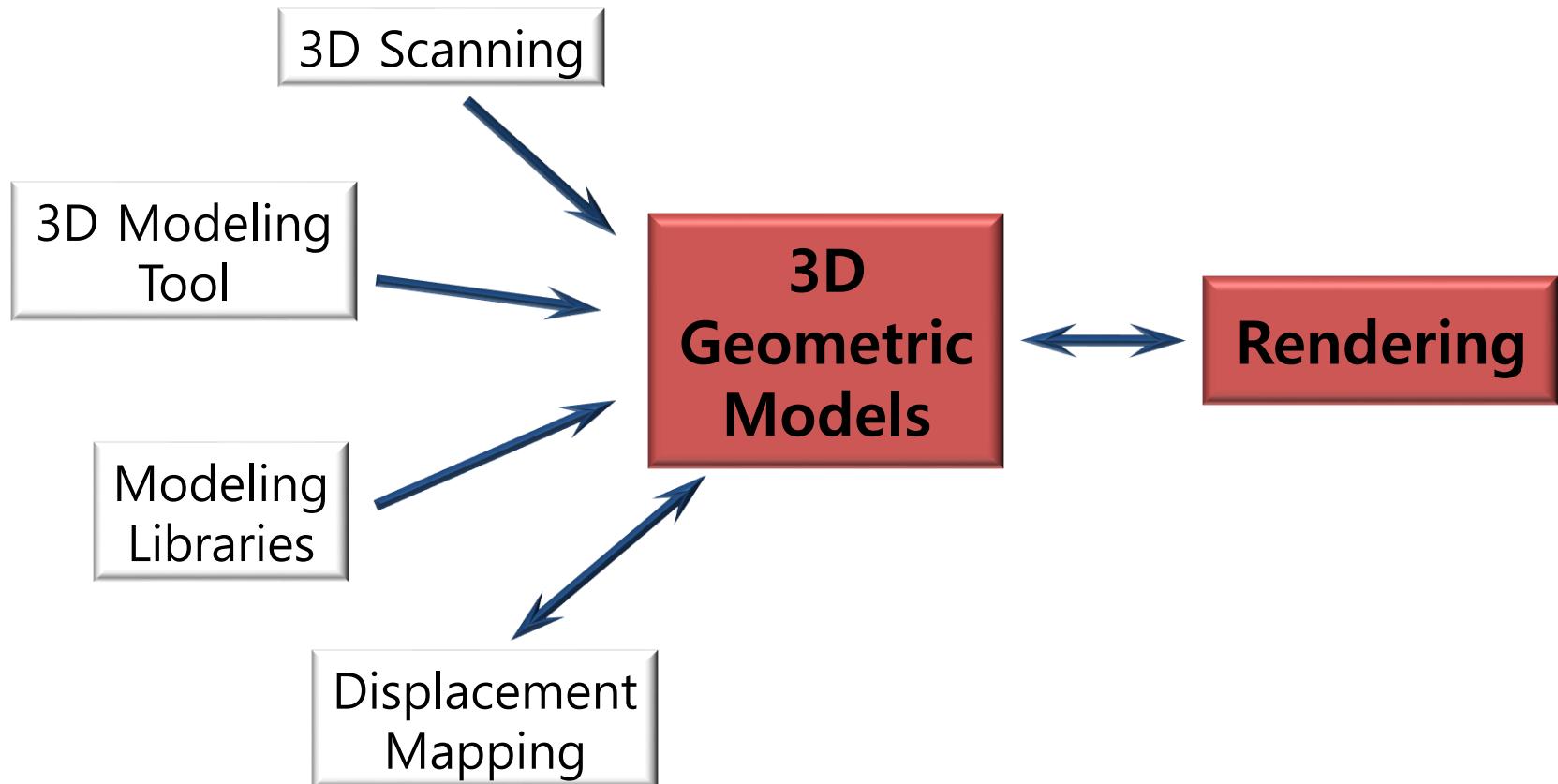


[Final Fantasy : The Spirits Within, 2001]

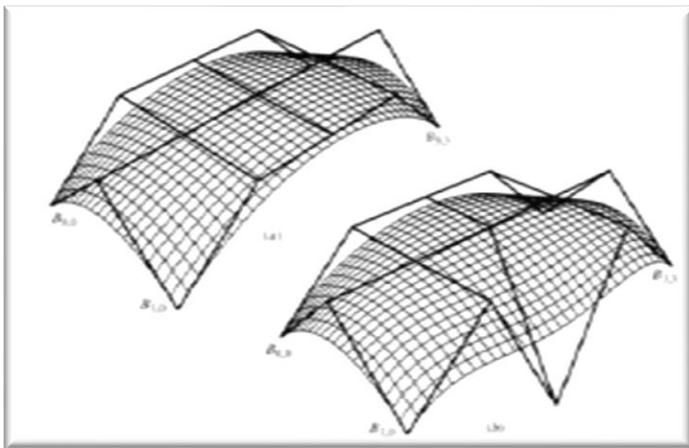
Graphic Process



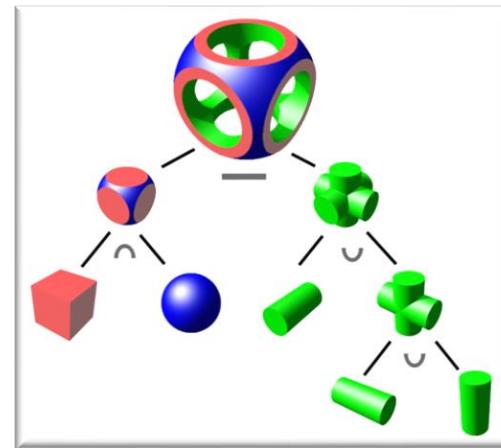
Graphics Process : Geometric Modeling



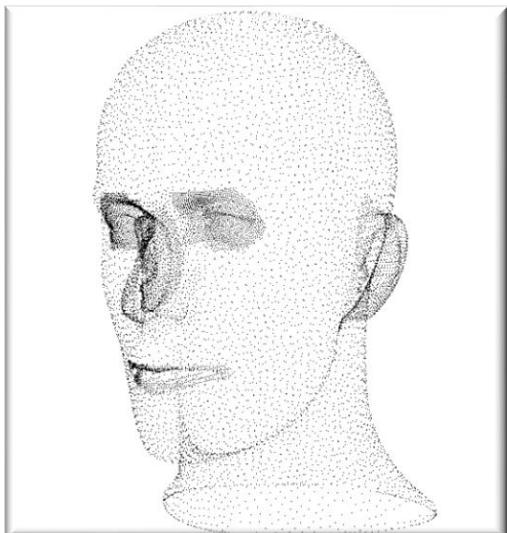
Geometric Modeling Examples



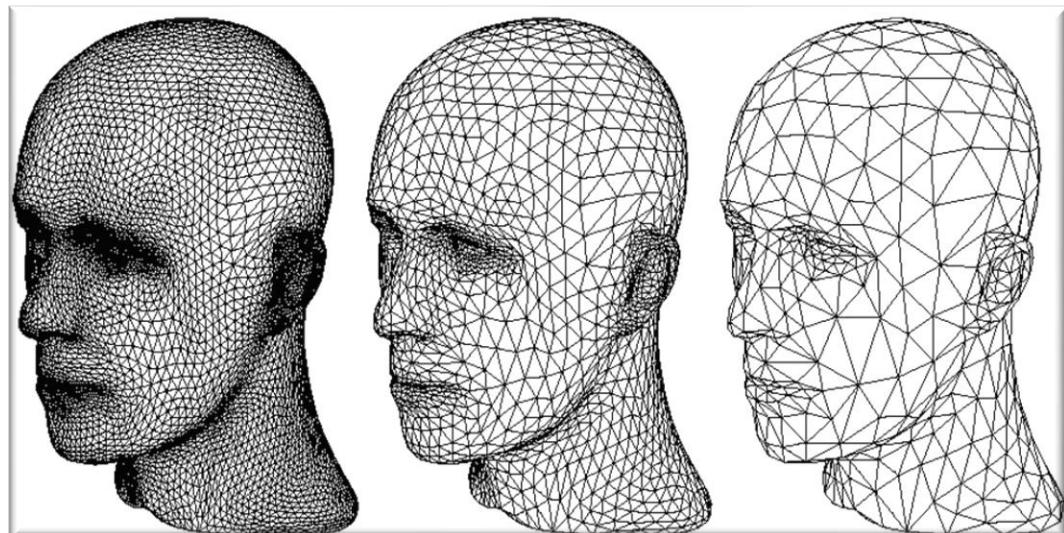
[Curved Surface]



[Constructive Solid Geometry]

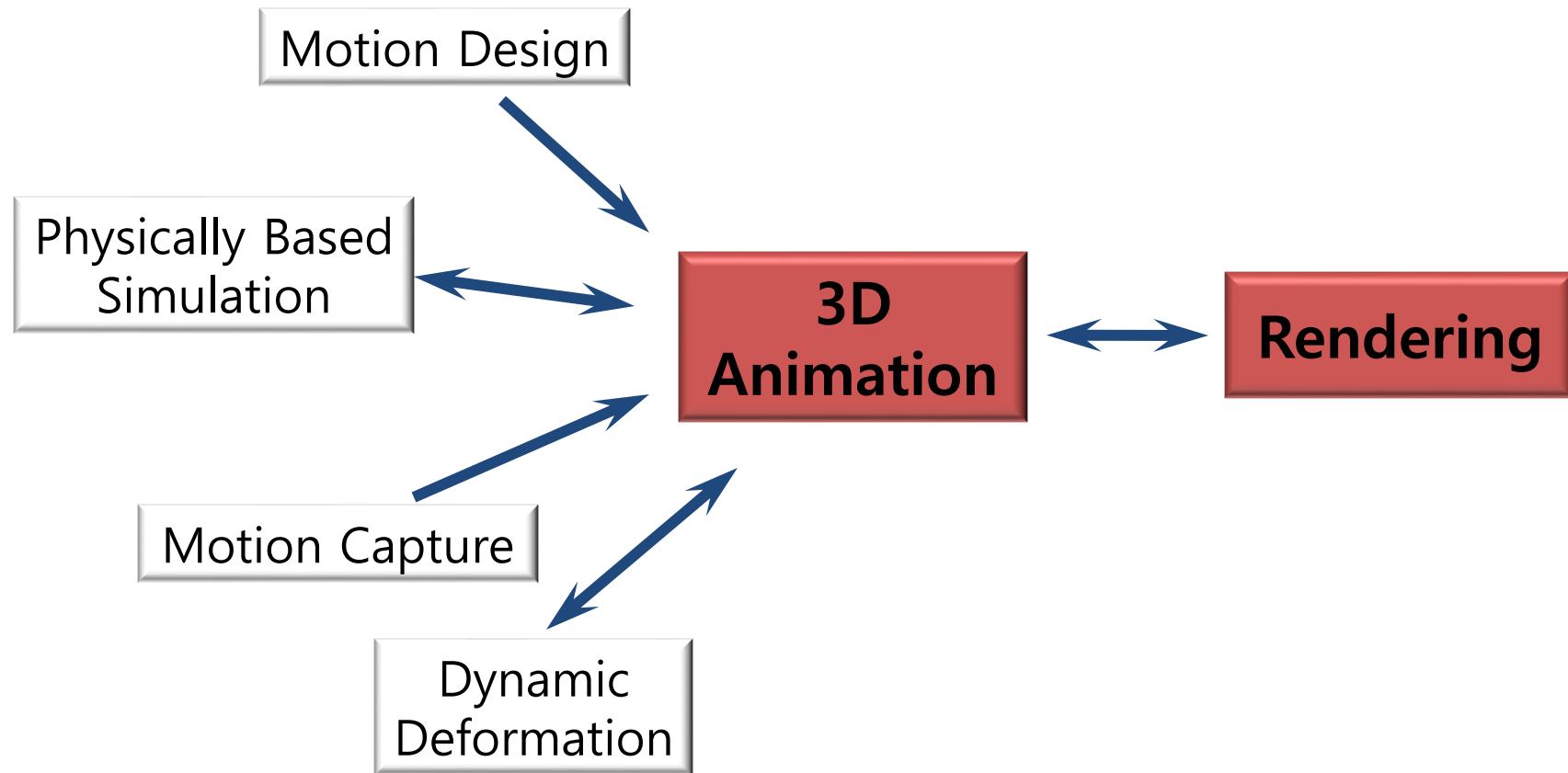


[Scanned Point Cloud]

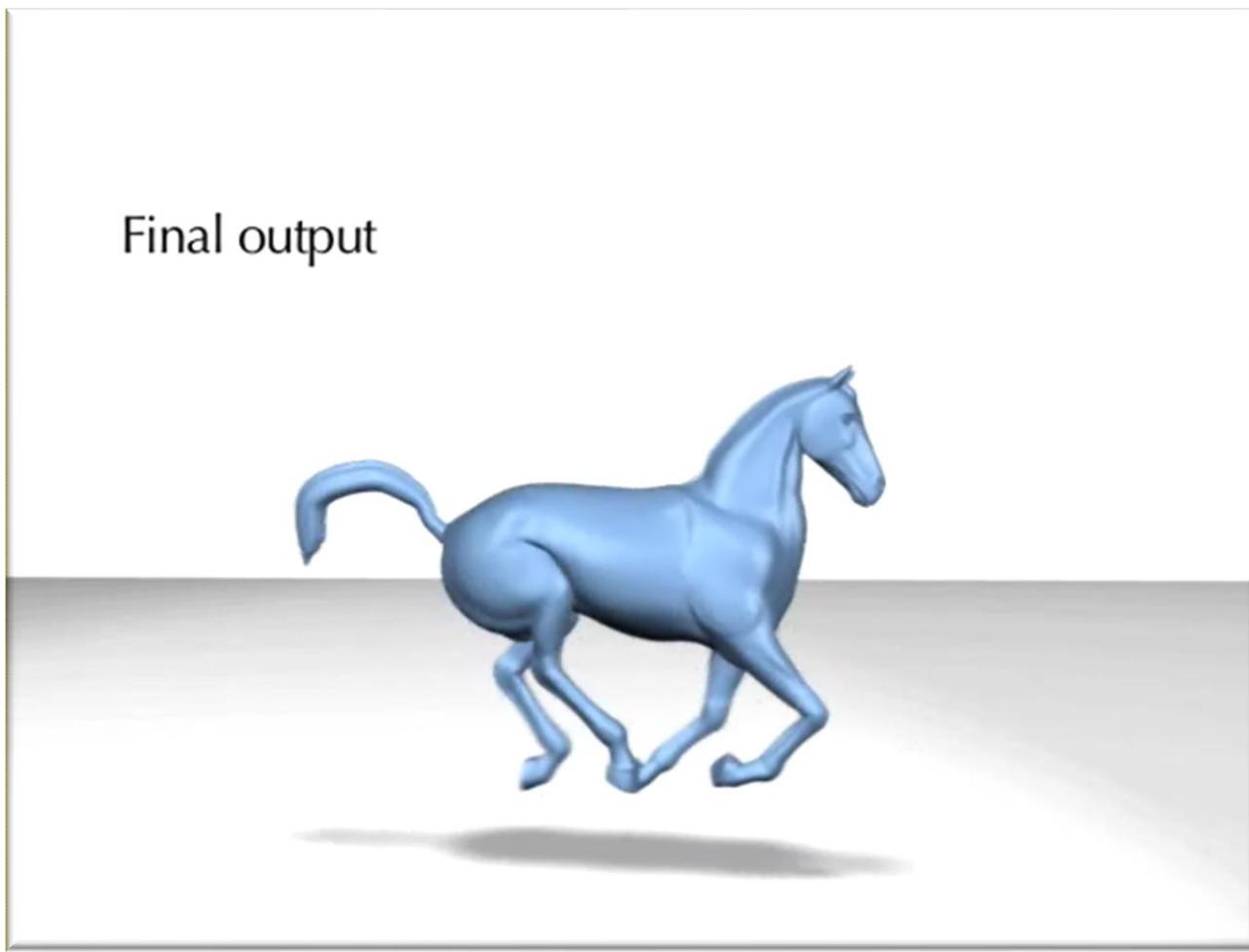


[Subdivision Surface]

Geometric Process : 3D Animation



3D Animation Example



[Embedded Deformation for Shape Manipulation]
(Robert W. Sumner et al., SIGGRAPH 2007)

Graphic Process : Imaging

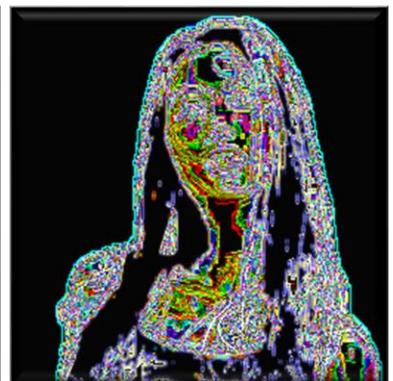
- Generating an Artistic Image



[Image Modification]



[Image Filtering]

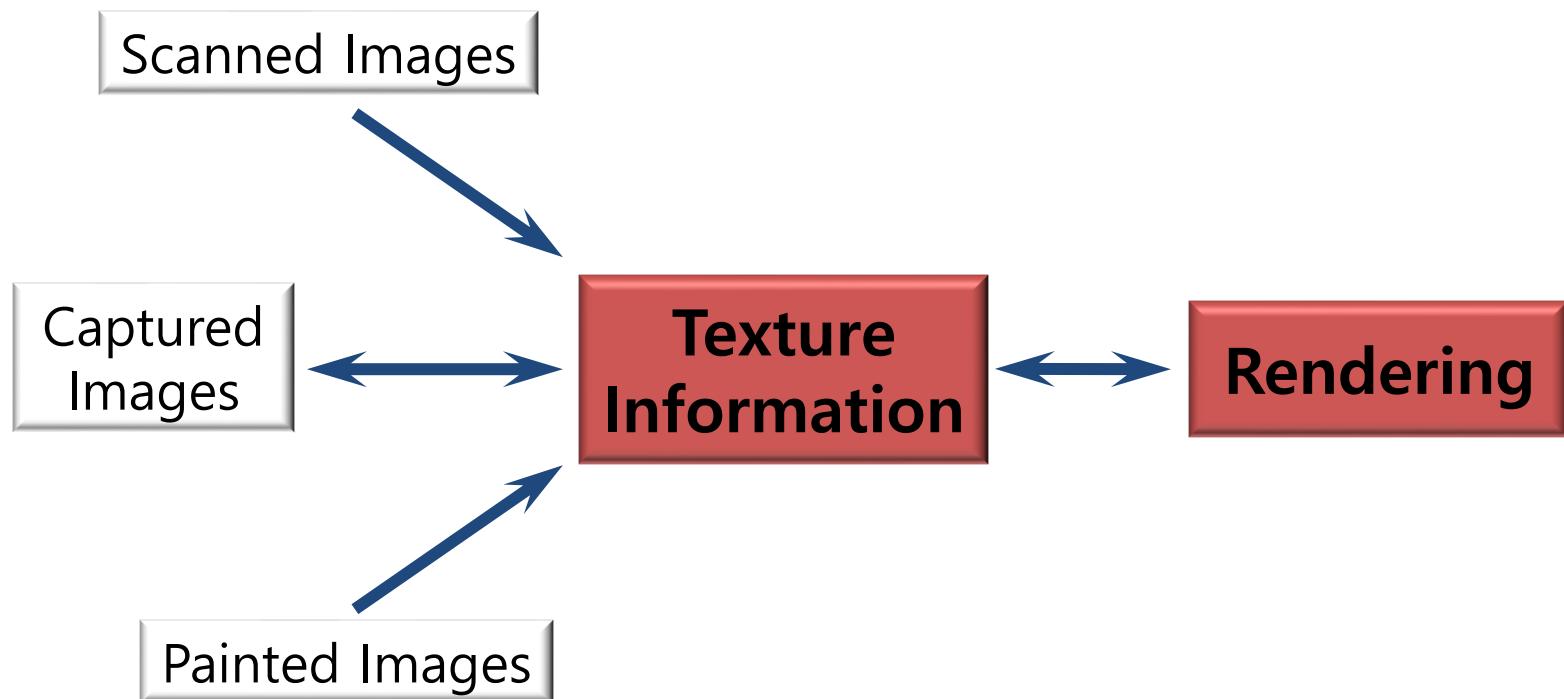


[Morphing]

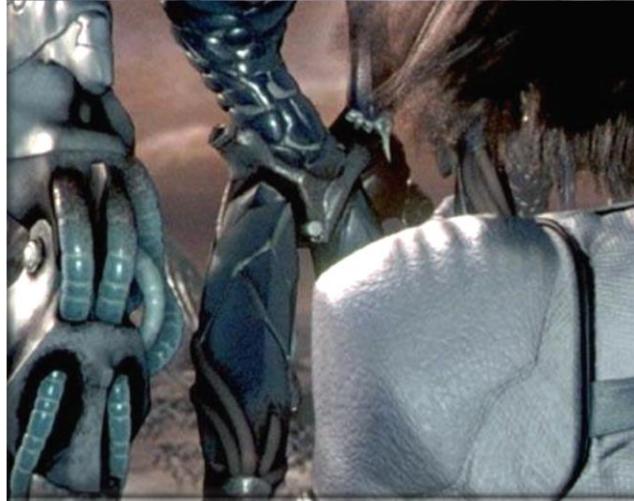
Introduction to Computer Graphics

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Graphics Process : Texturing



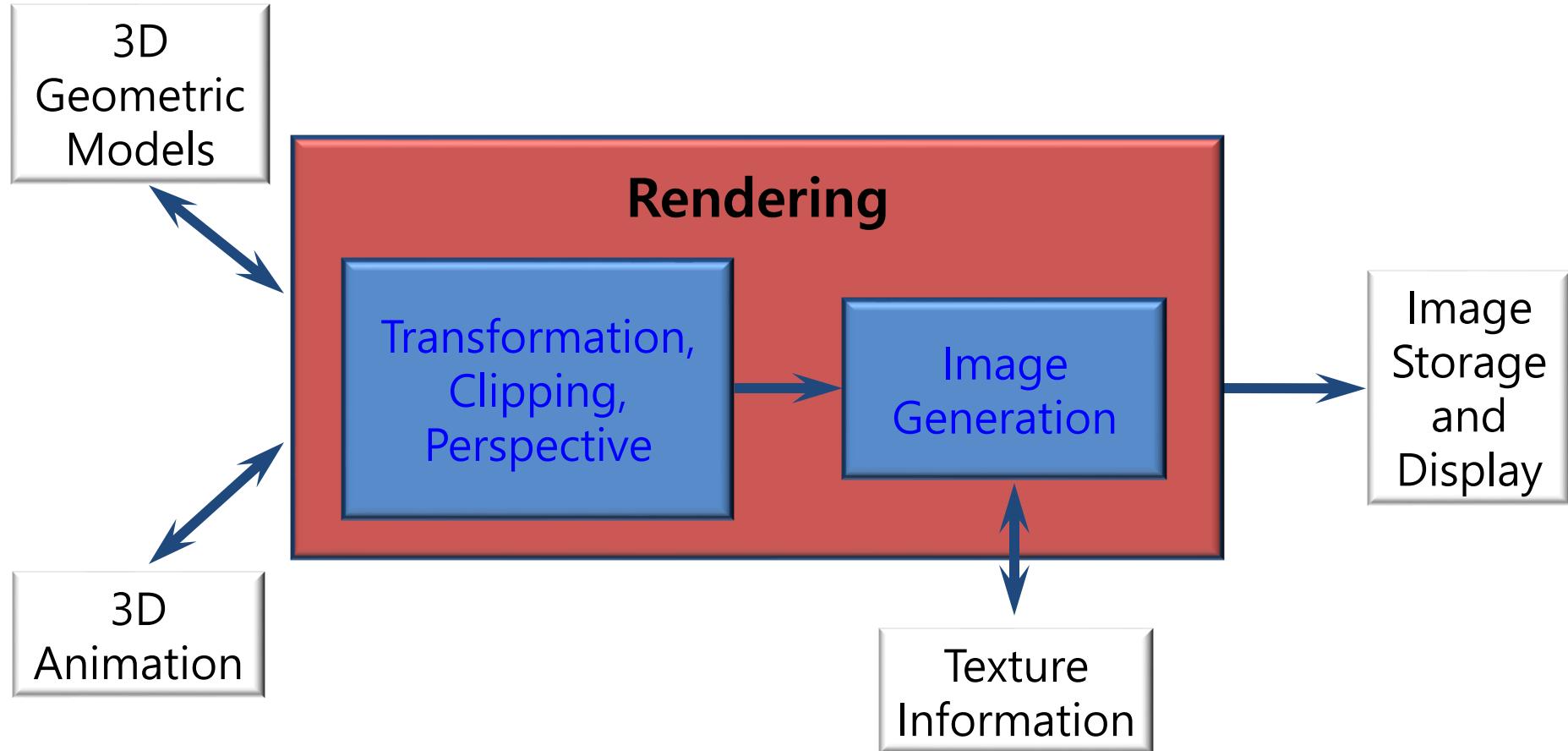
Texturing Examples



[Final Fantasy : The Spirits within, 2001]

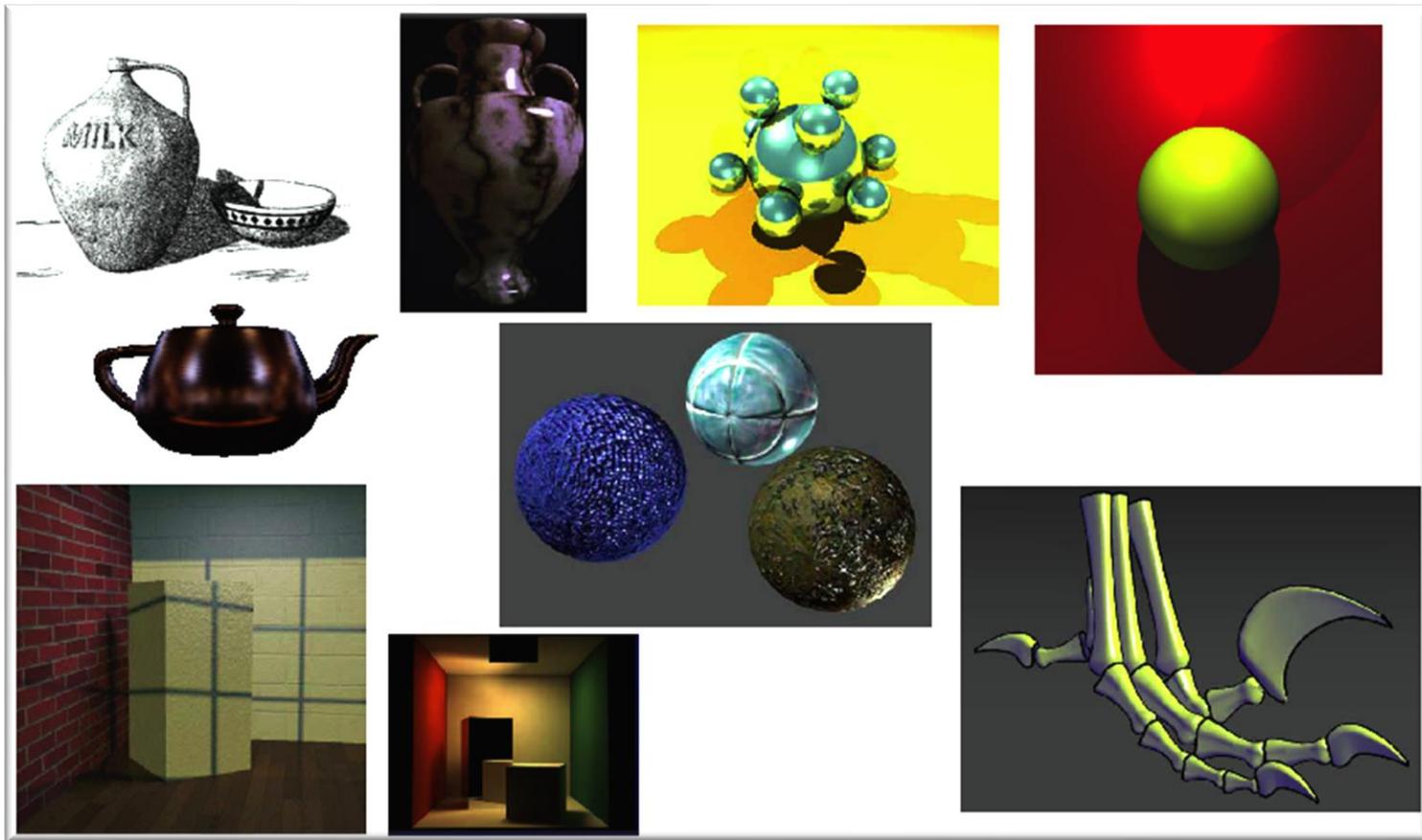
FINAL FANTASY
© 2001 Final Fantasy Film Studio

Graphic Process : Rendering

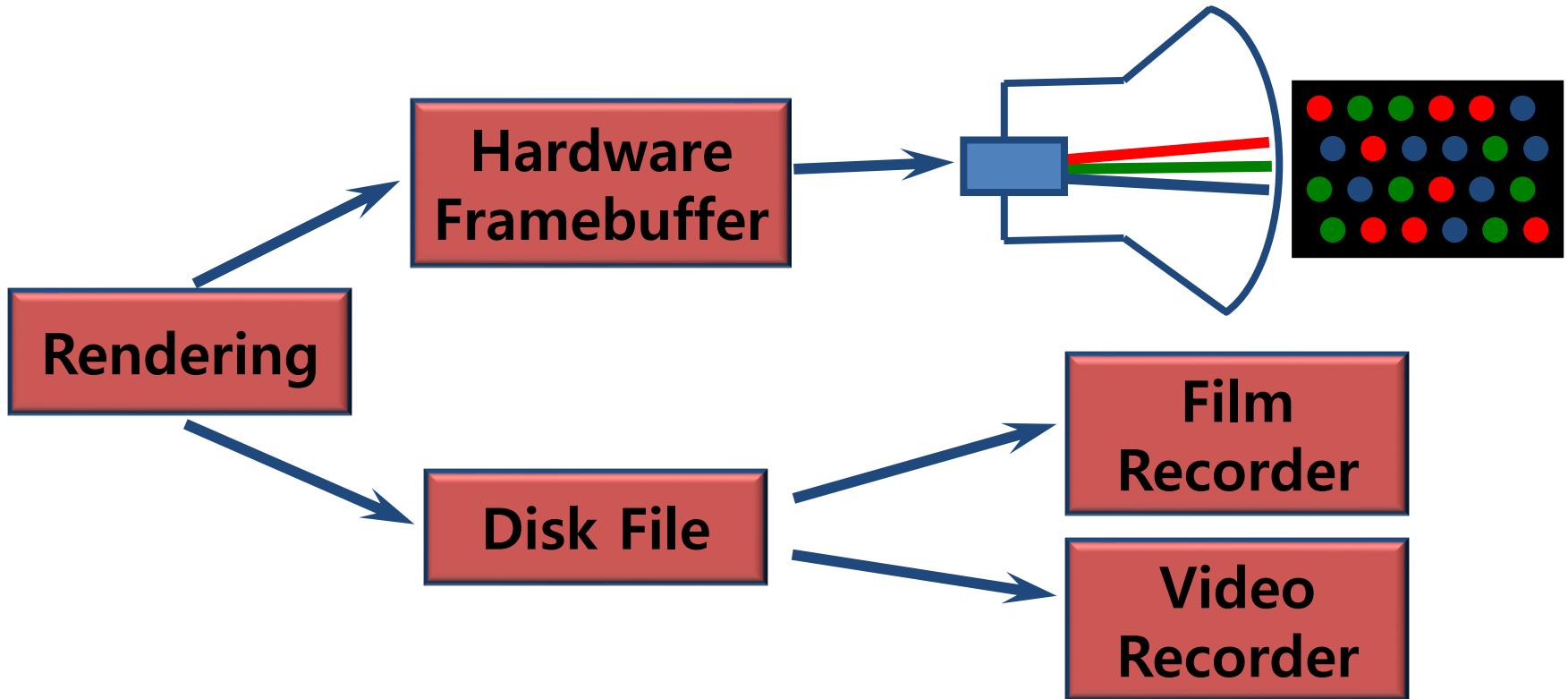


Graphic Process : Rendering

- Simulating Lights & Image Formation



Graphic Process : Image Storage & Display



Technical Demo : Flame Simulation



[Wrinkled Flames and Cellular Patterns]
(J. M. Hong et al., SIGGRAPH 2007)

Technical Demo : Hair Simulation

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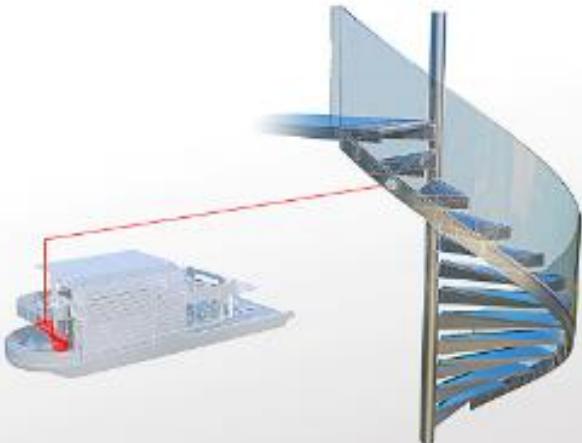
[Hair Simulation, 2005]

Applications

- CAD (Computer Aided Design)
- Simulation
- Computer Art
- Entertainment
- Data Visualization

CAD

- 건축 공학을 위한 그래픽 시스템
- 빌딩, 자동차, 비행기, 기계 등의 디자인



AutoCAD2022



AutoCAD를 통한 도시 재건

시뮬레이션

- 교육적인 목적을 위해 물리적 또는 경제적인 다양한 상황의 모델을 컴퓨터로 생성



비행 시뮬레이터
(Flight Simulator)



화성 탐사 시뮬레이터
(Mars Rover Simulator)

컴퓨터 아트

- 예술가들을 위한 그래픽스



• [Toy Story](#) Publicity still from *Toy Story* (1995), the first computer-animated feature film.

엔터테인먼트

- 영화, 게임, 가상 현실 등을 위한 그래픽스



파이널 판타지7



온라인 게임

데이터 시각화

- 과학, 공학, 또는 의학 데이터의 가시화를 위한 그래픽스



성운 (Nebula)



의학 이미지 (Medical Image)

The
End!