

VO Rendering SS 2010

Unit 1: Introduction

Overview

- Organisational stuff
- Thoughts on Visual Realism
- Predictive Rendering vs. Believable Rendering



Lecture Organization

- When & where
 - ◆ 28.4., 29.4.: 9.00 – 13.00
 - ◆ 30.4.: 14.00 – 18.00
- Lecture notes
 - ◆ Overhead slides on the web after lecture
 - ◆ Additional literature available
- Exams
 - ◆ New: Written test



Why?



Lecture Topics

- Rendering theory
- Units of Computation & Physics
 - ◆ Spectral rendering
- Surface representations
 - ◆ Phong, Oren-Nayar, Torrance-Sparrow etc.
- Rendering algorithms
 - ◆ Ray tracing, path tracing, photon tracing
- Camera models
- Modelling of natural objects
- Tone mapping



Thoughts On Visual Realism



Visual Realism



- Has intrigued man for as long as one can tell
- Degree of sophistication in the arts was considered indicator for cultural achievement (With exceptions, e.g. Islamic cultures)
- Development of photography led to a crisis in the graphic arts



Visual Accuracy in Western Art



- **Antiquity:**
 - ◆ realistic style, almost none survives
- **Mediaeval times:**
 - ◆ abstraction prevails
- **Renaissance:**
 - ◆ the new golden age of realism begins – and with some changes lasts right up to the
- **19th century:**
 - ◆ photography and perfection of existing styles lead to new developments



Cave Paintings (17000 – 15000 BC)



Pompej - Roman Art (80 AD)



Mediaeval Art #1



Mediaeval Art #2



Albrecht Altdorfer (~1520)



Vermeer: The Geographer (1668 - 1669)



Daguerrotypie (1848)



Monet: Woman with a Parasol (1875)



Colour Photo (1910)



Picasso: Three Musicians (1921)



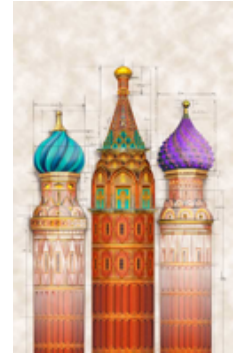
Picasso vs. Velasquez



Visual Realism Today



- **Pure art:** No real link left
- **Graphical art:** Realistic drawing/painting as trainable skill
- **Photography:** Realism „out of the box“
- **Computer Graphics:** True photorealism as a sideline to the „Photoshop revolution“, the „RenderMan revolution“ and the „Doom/Quake revolution“



Visual Realism in Computer Graphics 1



- **Quake, Doom, Half-Life et al.**
 - ◆ **Goal:** *immersion in an interactive virtual world*
 - ◆ Frame-rate more important than plausibility of individual frames
 - ◆ Realism in the narrow, photographic sense of the word is usually neither necessary, nor desirable!
 - ◆ The majority of 3D graphics will probably remain like that, even if alternatives become available!



Cryengine 3



Visual Realism in Computer Graphics 2



- **RenderMan, Maya, 3DMax et al.**
 - ◆ **Goal:** *believable (still) images*
 - ◆ Rendering technology as tool for artistic expression in the realm of 3D images
 - ◆ Correctness of results almost irrelevant



Pixar RenderMan



Pixar RenderMan



Visual Realism in Computer Graphics 3



■ Radiance, Brazil, Maxwell et al.

- ◆ Goal: *prediction of reality, still images*
- ◆ "Predictive rendering"
- ◆ Radiometrically correct images → slow!
- ◆ Allows practically no deviations from reality
- ◆ Dependent on measured surfaces & lights
- ◆ Constrained to physically possible scenes
- ◆ Not in widespread use



Predictive Rendering



- Allows practically no deviations from reality
- Commercially used when it is expensive or impossible to build a real prototype
- Only few applications
 - ◆ Architecture
 - ◆ Automobile design
 - ◆ Gemstone prototyping



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Automobile Industry (RTT)



Architecture (Maxwell Renderer)



Gemstones (Maxwell Renderer)



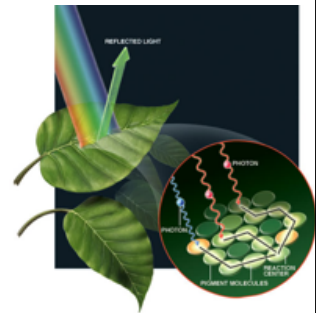
Predictive Rendering in Art (POVRay)



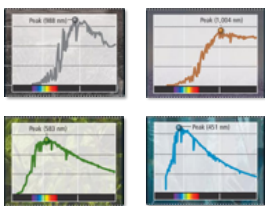
Beyond Everyday Life



- Predictive rendering also allows to simulate how alien worlds would look
- Example: What colour would plants have on a different planet?
 - ◆ Colour of plant depends on emission spectrum of the sun
 - ◆ Photosynthesis is adapted to the sunlight



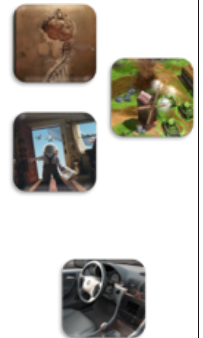
Alien Plant Colours



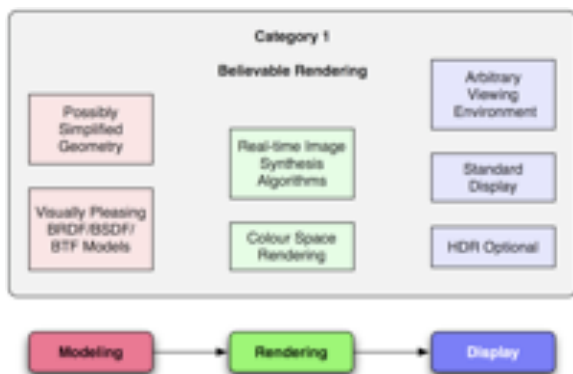
Predictive vs. Believable Rendering



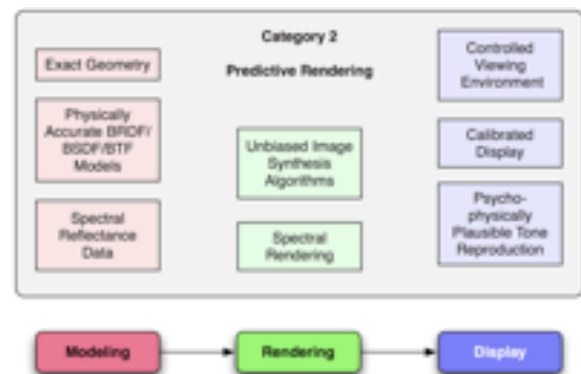
- **Category 1: believable rendering**
 - ◆ Most of current CG: RenderMan, Maya, RTR
 - ◆ It's okay if it looks good enough
 - ◆ Realistic to a widely varying degree
 - ◆ Trade-offs are intentional, and one of the dimensions of artistic expression
- **Category 2: predictive rendering**
 - ◆ Prediction of reality
 - ◆ Based on simulations of reality
 - ◆ Constraints for expression similar to photos



The Believable Rendering Pipeline



The Predictive Rendering Pipeline



CG as Extension of Traditional Art



- PR and BR can be seen as modern extensions of the traditional fields of expressive art and photography



Rendering: Defining the Problem



- Realistic images of synthetic scenes have to exhibit:
 - ◆ Correct handling of perspective
 - ◆ Correct perceived brightness and colour for all portions of the scene
- Artists usually painted „from life“
- How does one reliably compute this for a hitherto unseen scene?
 - ◆ A mathematical formulation of the problem is needed!



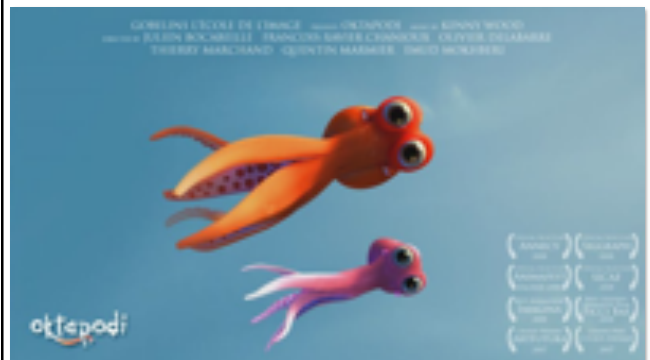
In Practice...



- It is usually impossible to solve this task exactly
- Various heuristics of increasing complexity exist
- Full perceptual models are still very computationally expensive
- Animations pose additional challenges (time dependency)



Oktapodi



Rendering VO Unit 1



The End

Thank you for your attention!

