



VU Rendering SS 2012

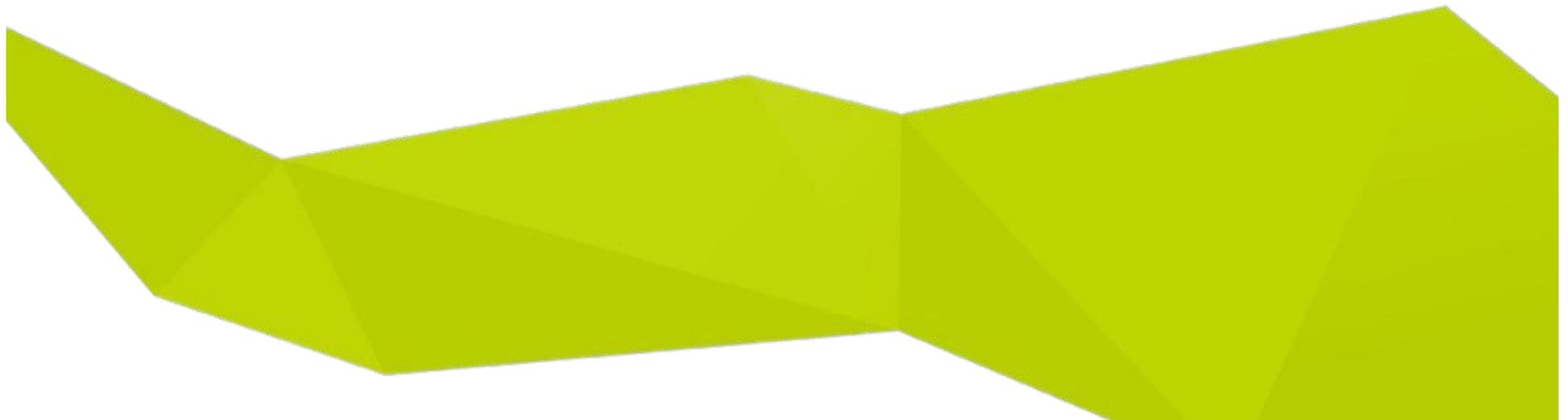
Unit 1: Introduction





Agenda

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





Lecture Organization

- When & where
 - 10.5., 12.5., 24.5, 26.5.: 10.00 - 14.00
 - 11.5., 25.5.: 13.00 - 17.00
- Lecture notes
 - Overhead slides on the web after lecture
 - Additional literature available
- Exams
 - Written test
 - No homework assignments!



RTT



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Lecture Topics

- Rendering theory
 - Units of Computation & physics, rendering algorithms (Ray tracing, path tracing, photon tracing, ...)
- Surface representations
 - BRDFs (Phong, Oren-Nayar, Torrance-Sparrow etc.), measurements, sampling
- Appearance modelling
- Spectral rendering
- Participating media (scattering, absorption, ...)
- Tone reproduction (tone mapping, white balance, ...)
- Camera models
- Renderman: Practical example



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



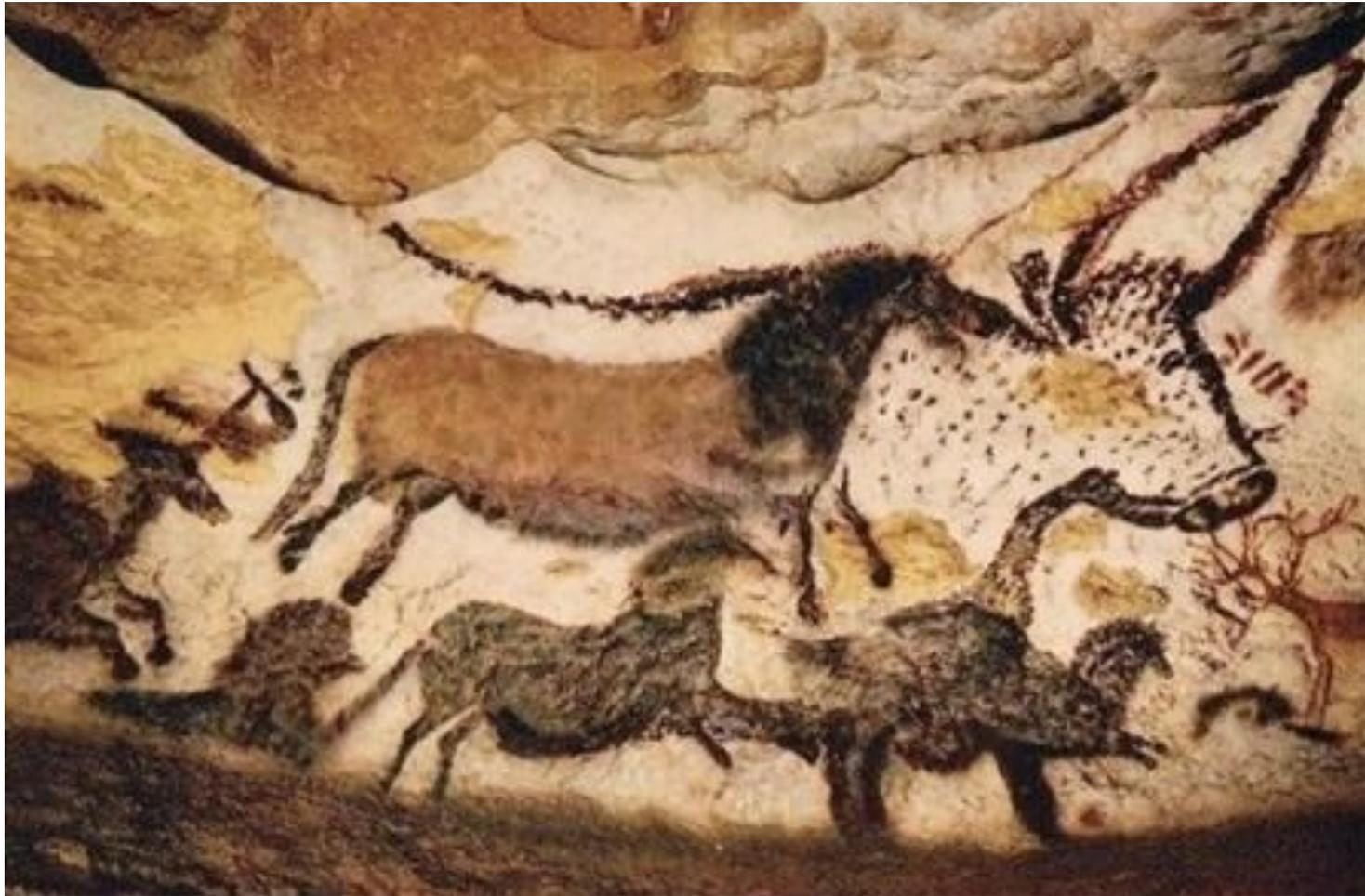


Visual Accuracy in Western Art

- **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)



Cave of Lascaux



Pompej - Roman Art (80 AD)



Pompej



Mediaeval Art #1





Mediaeval Art #2



Domine labia mea aperies. Et
os meum annuntiabit lau-
dem tuam.
Dico in adiutorium me-
um in corde domine
ad adiuvandum me festina-
tionem patris et filii et spiri-
tus sancti. Spiritus in pi-
nquo et in fine et semper et in se

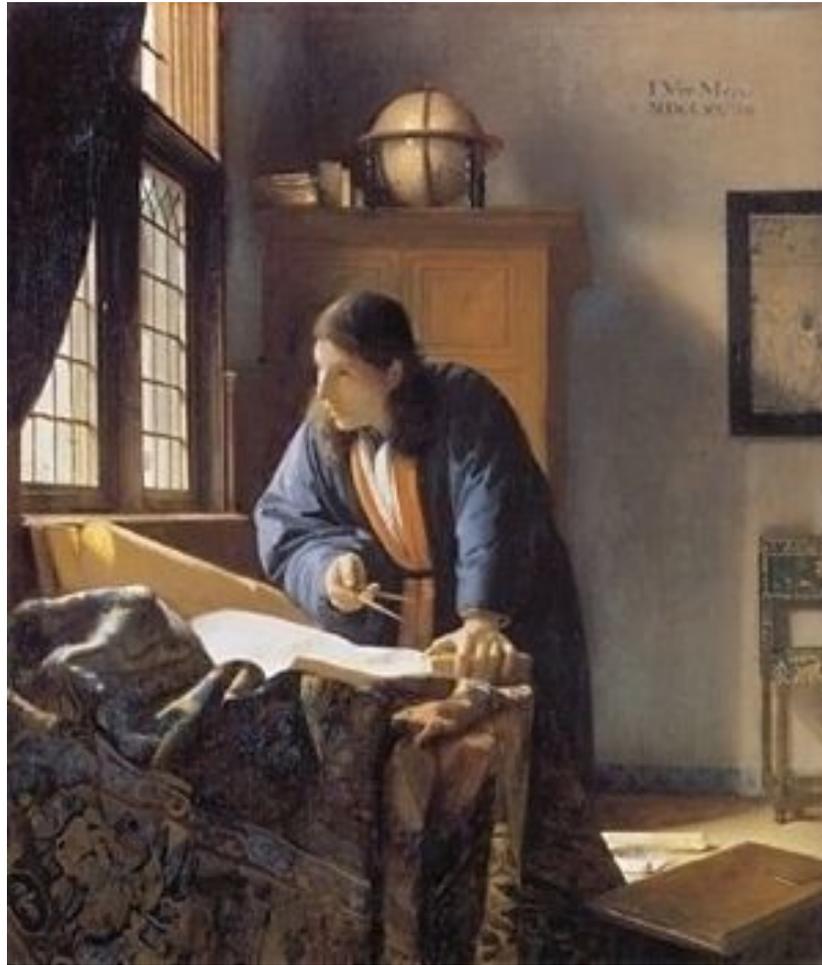


Albrecht Altdorfer (~1520)





Renaissance



Vermeer: The Geographer (1668 - 1669)



Daguerrotypie (1848)





Expressionism



Monet: Woman with a Parasol (1875)



Colour Photo (1910)





Picasso: Three Musicians (1921)





Picasso vs. Velasquez



Velasquez



Picasso



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

Computer Games, Immersive 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!



Skyrim (2011)





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



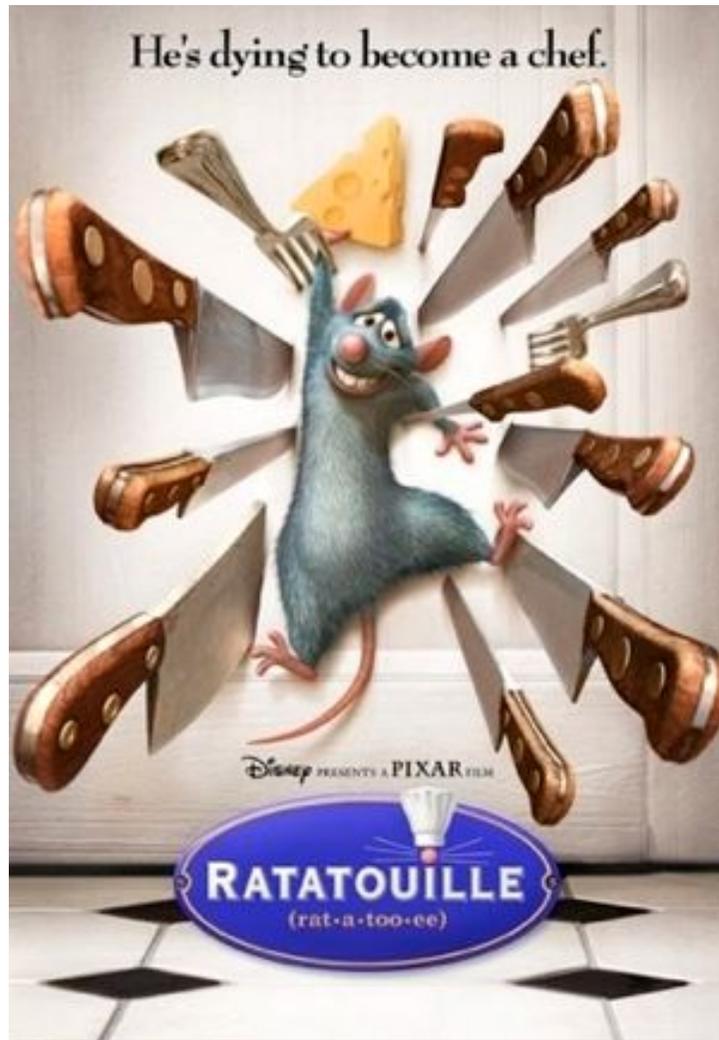
Pixar RenderMan



Cars (2005)

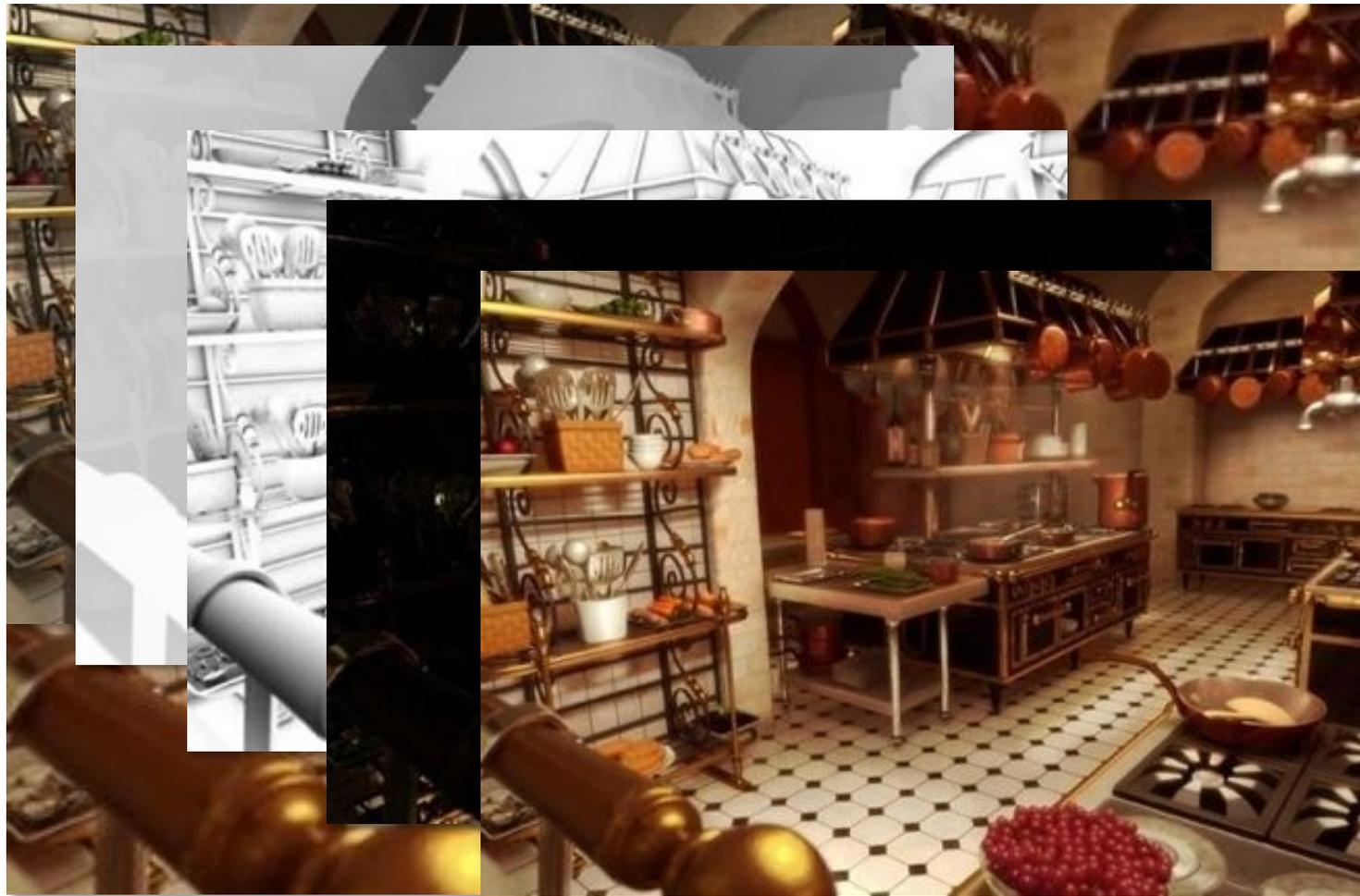


Pixar RenderMan: Ratatouille





Lighting Scenes





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



Virtual Prototyping



- Reliable result necessary, but often not 100% physically correct
- Geometry and material prototyping
- Virtual Prototyping is not marketing!



Automobile Industry (RTT)





Automobile Interieur



Opel Interieur (RTT)



Architecture (Maxwell Renderer)



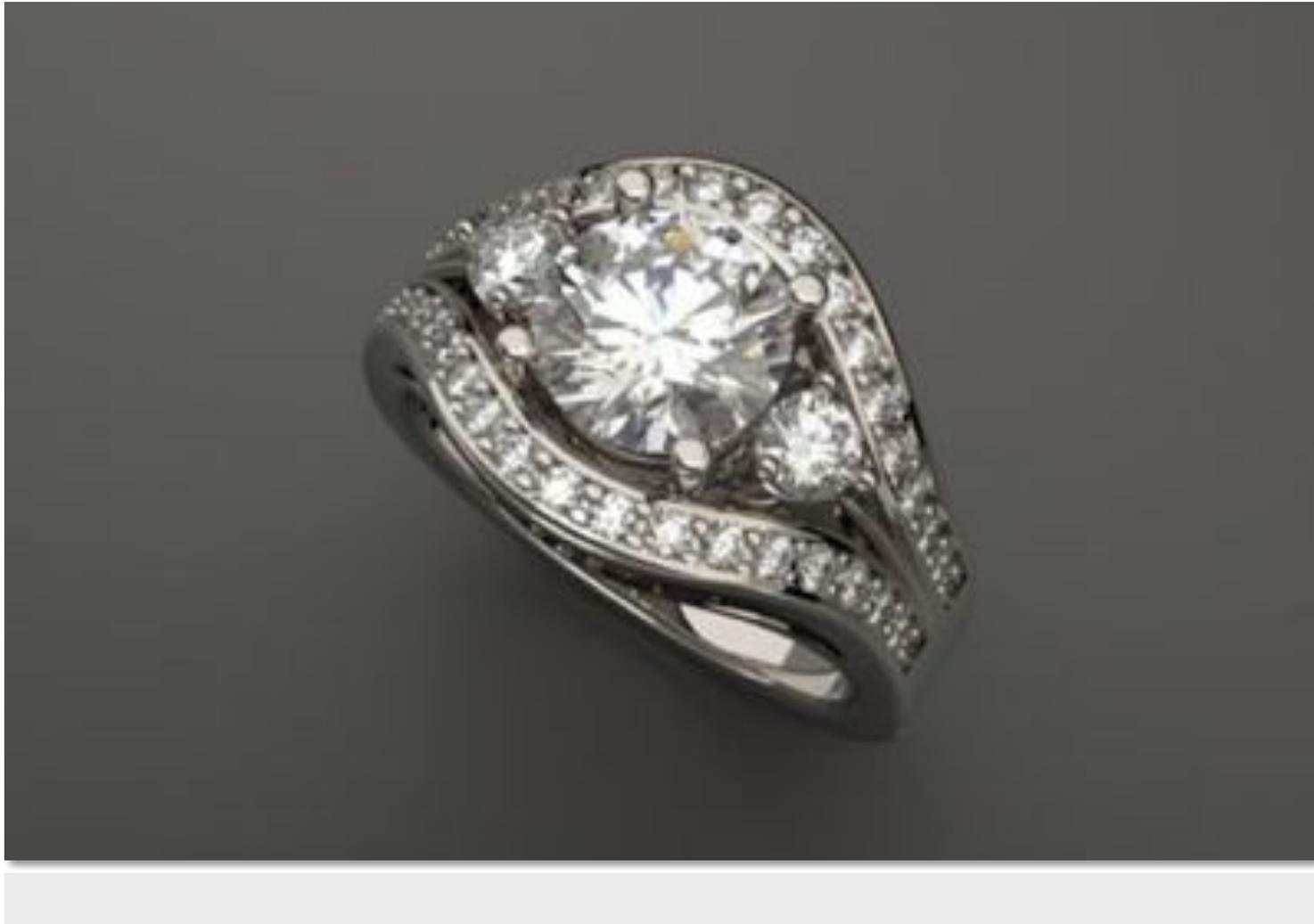
Daylight Illumination



Candlelight Illumination



Gemstones (Maxwell Renderer)





Predictive Rendering in Art (POVRay)





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



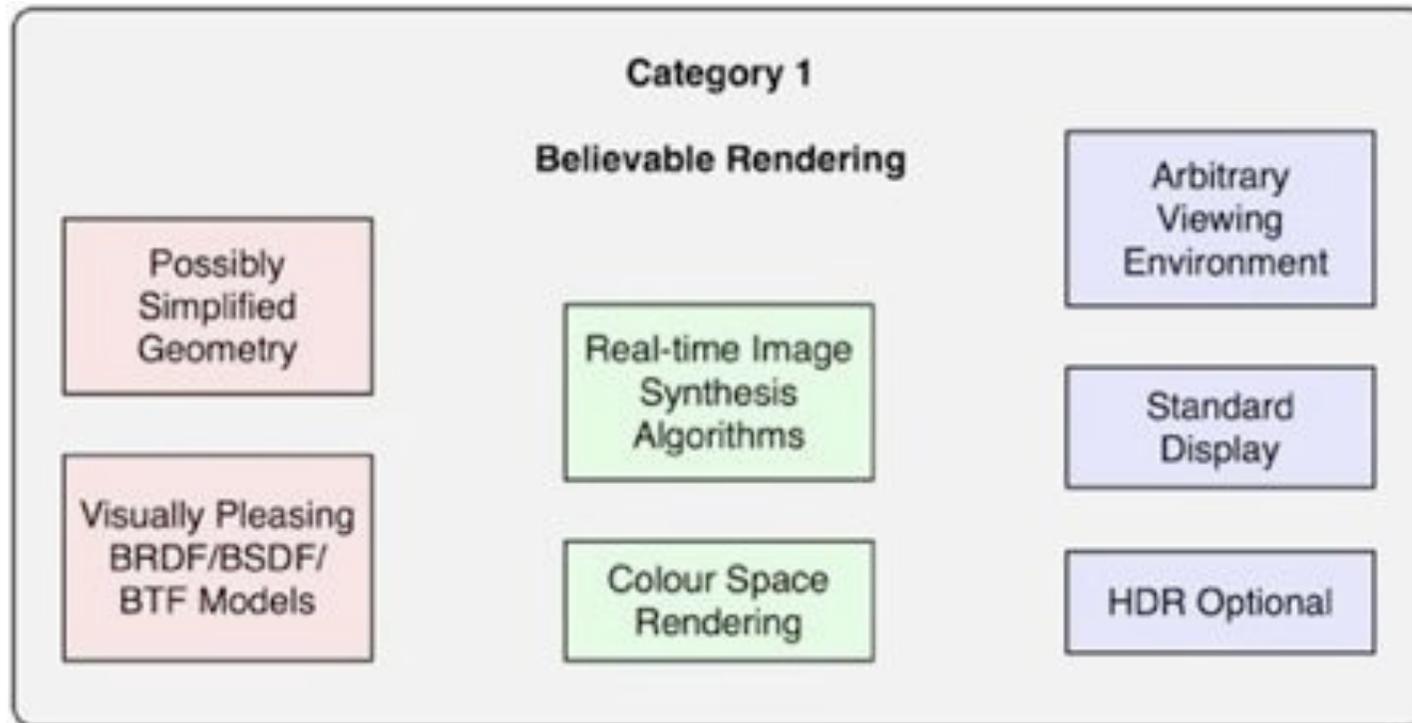
Category 2: predictive rendering

- Prediction of reality
- Based on simulations of reality
- Constraints for expression similar to photos



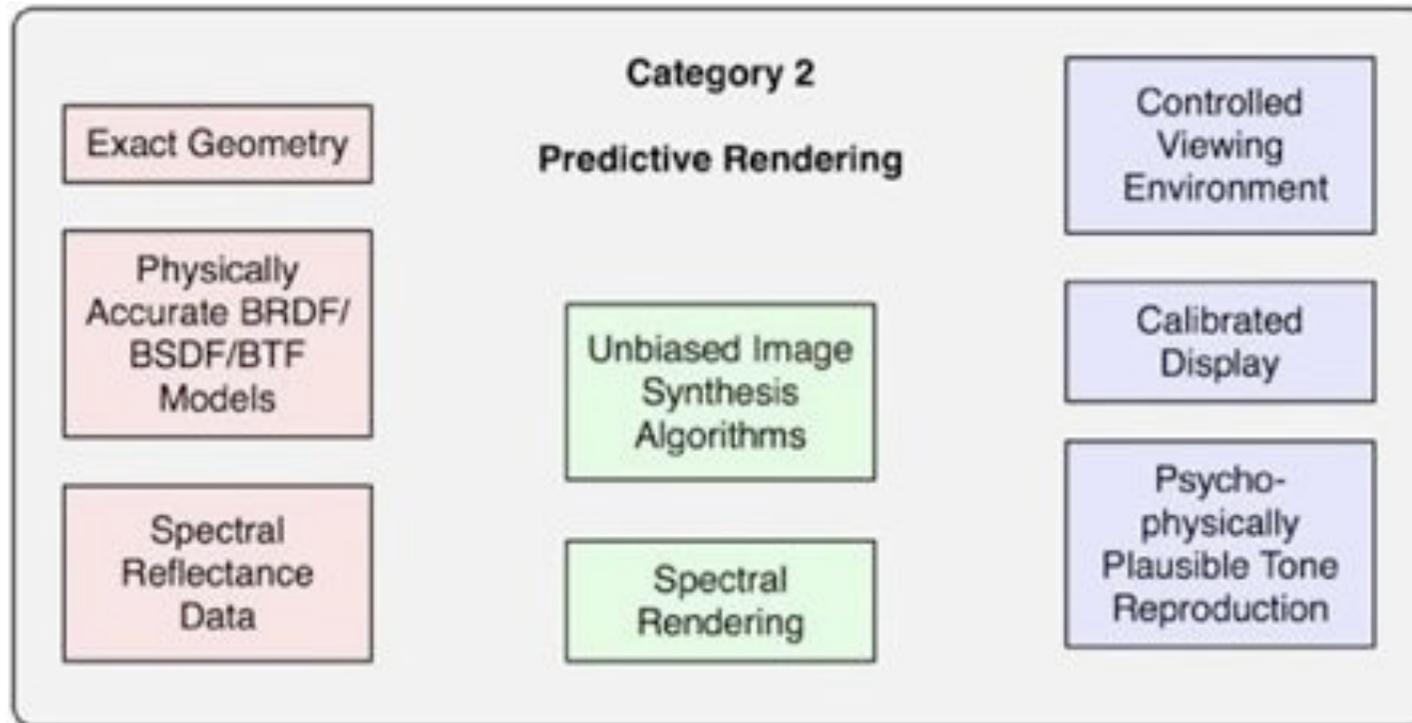


The Believable Rendering Pipeline





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)



Questions?

