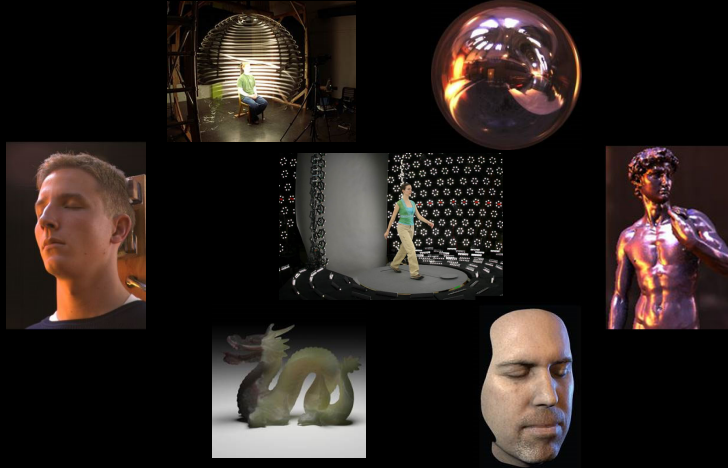


COMP70001 – Advanced Computer Graphics: Photographic Image Synthesis



Spring 2024

Abhijeet Ghosh

1

Instructor



Abhijeet Ghosh

abhijeet.ghosh@imperial.ac.uk

ghosh@imperial.ac.uk

<http://www.doc.ic.ac.uk/~ghosh>

Professor of Graphics & Imaging
Imperial College London 2012 – present
Realistic Graphics and Imaging group

Research Assistant Professor, Graphics Lab
USC Institute for Creative Technologies 2007 – 2012

Ph.D. University of British Columbia 2007
“Realistic Materials and Illumination Environments”

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Realistic Graphics and Imaging



<https://wp.doc.ic.ac.uk/rqi/>

Realistic Graphics and Imaging

[Home](#) [Events](#) [Grants](#) [News](#) [People](#) [Projects](#) [Publications](#) [Resources](#) [Alumni](#)



Welcome to the **Realistic Graphics and Imaging** group in the **Department of Computing** at **Imperial College London**. We conduct research in **realistic computer graphics** spanning acquisition, modeling and rendering of real world materials, objects and scenes, as well as **imaging** for graphics and vision including computational photography and illumination. We are affiliated to the **Visual Computing** research theme within DOC.

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Research in Graphics and Imaging



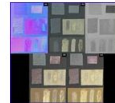
Surface Reflectometry



Continuous SH illumination
SIGGRAPH 2013



Circularly polarized spherical illumination
SIGGRAPH Asia 2010



Second order statistics
EGSR 2009



Basis illumination BRDF acquisition
ICCV 2007

Facial Acquisition and Reflectance



Diffusion from spherical gradients
IEEE CG&A 2013



Facial micro-geometry
Eurographics 2013



Multiview face capture
SIGGRAPH Asia 2011



Layered facial reflectance
SIGGRAPH Asia 2008

Image-based Lighting



SH and point lights for relighting
CVMP 2011



Diffuse-specular separation with EM illumination
ICCP 2009

4

Impact in film VFX (USC-ICT)

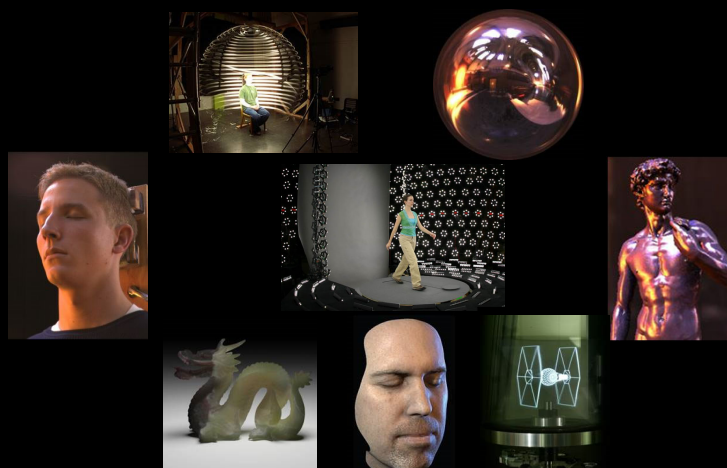


- Lightstage based facial capture for film VFX
 - Credited on **AVATAR** for layered facial reflectance
 - State-of-the-art** method: Multiview face capture (35+ films)
 - Contributed to **Technical Achievement Award** (2019) from the Academy of Motion Picture Arts and Sciences



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Photographic Image Synthesis



Past offerings: Spring 2009 & 2010 at USC
with Paul Debevec and Pieter Peers

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Phorealistic Computer Graphics



Special Effects / Movies



7

Phorealistic Computer Graphics

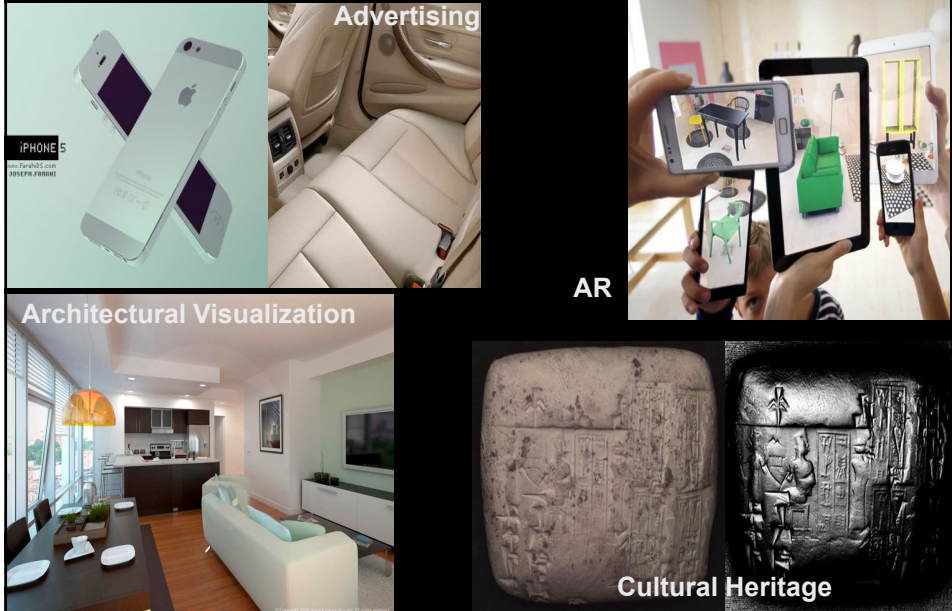


Games



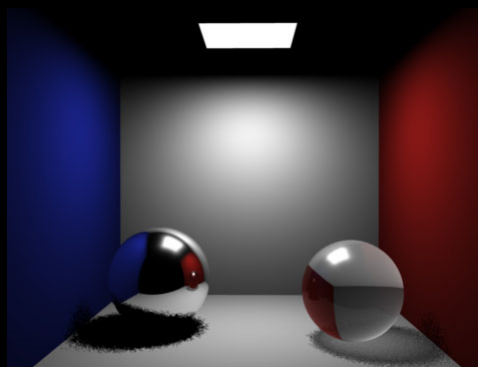
8

Phorealistic Computer Graphics



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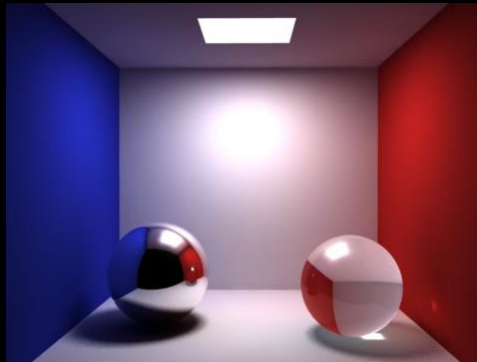
Light transport simulation



Cornell box with direct illumination

10

Light transport simulation



How real does this scene really look?

Cornell box with global illumination

11

Light transport simulation



Measured data!

Peers et al. 06

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Image-based rendering



Canon EOS -1D Mark III



Point Grey Grasshopper



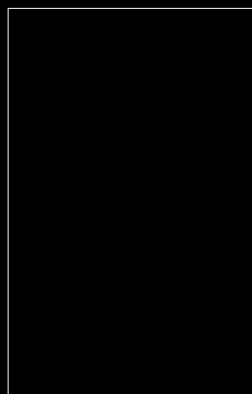
Grace Cathedral



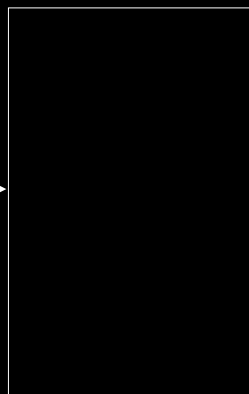
Debevec et al. 00

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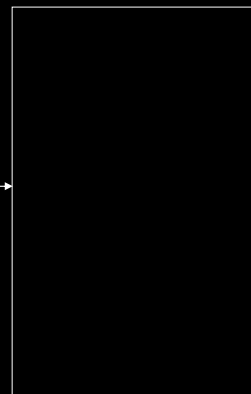
Modern Image Synthesis



Measurement



Modeling



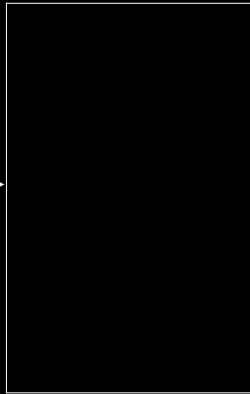
Rendering

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Modern Image Synthesis



Measurement



Modeling



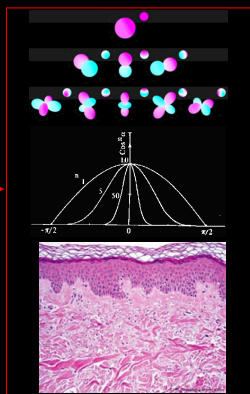
Rendering

15

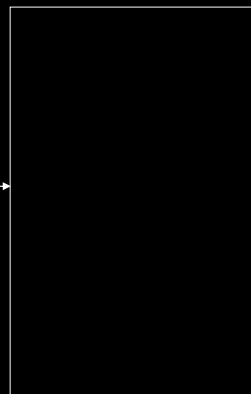
Modern Image Synthesis



Measurement



Modeling



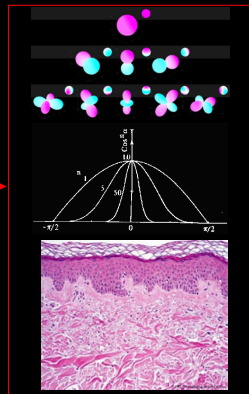
Rendering

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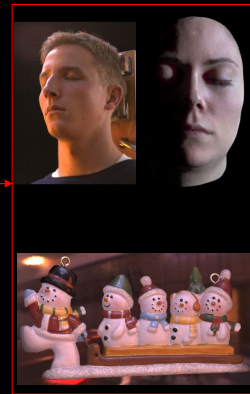
Modern Image Synthesis



Measurement



Modeling



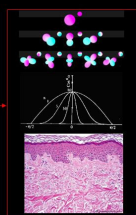
Rendering

17

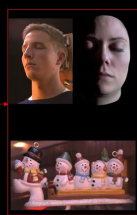
Modern Image Synthesis



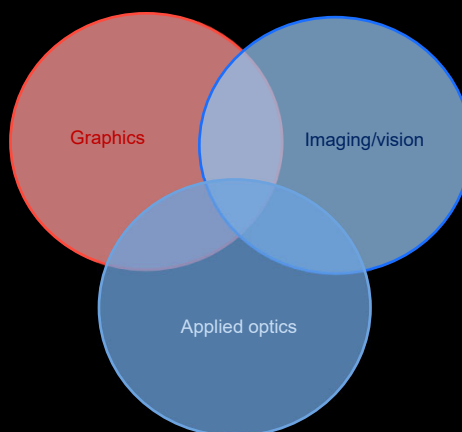
Measurement



Modeling



Rendering



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Administrativa 70001 (formerly C417)

- **Day and Time** Tuesday 11:00 am – 1:00 pm (RODH 422)
Friday 4:00 pm – 6:00 pm (Hux 145)
(Weeks 2 – 8, Week 9 -10 revision)
- **First class** January 16, 2024 (11am – 1pm) (Hux 315)
- **Lecture Slides/Notes/Recordings**
<https://scientia.doc.ic.ac.uk/2324/modules/70001/materials>
- **Discussions** - <https://edstem.org/us/courses/46837/discussion/>
- **Prerequisites** COMP60005 Graphics, or equivalent
Familiarity with linear algebra, calculus

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Grading scheme

- **Assignments (implementation)** total 2 (2 weeks each)
33% of grade
- **Final examination** 2 sets of questions
67% of grade

TAs: Ekin Ozturk ekin.ozturk17@imperial.ac.uk
Arvin Lin arvin.lin19@imperial.ac.uk

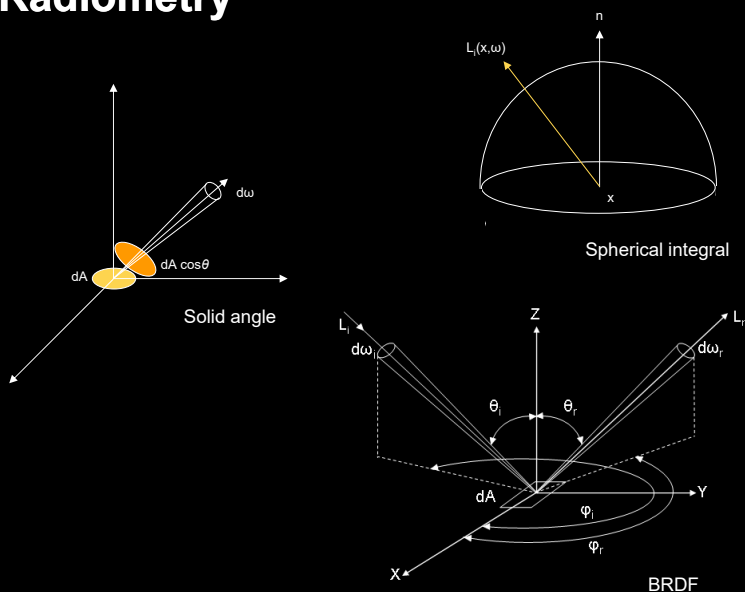
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Assignments (Scientia)

- Teams of two (joint submissions but with individual subparts)
 - Email TAs your teams by Tuesday, Jan. 23rd (Week 3)
- Assignment 1: High Dynamic Range Imaging
 - Goes out on Tuesday, Week 3
 - Due on Tuesday, Week 5
- Assignment 2: Sampling and Rendering
 - Goes out on Tuesday, Week 5
 - Due on Tuesday, Week 7

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Radiometry



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HDRI and Image-Based Lighting



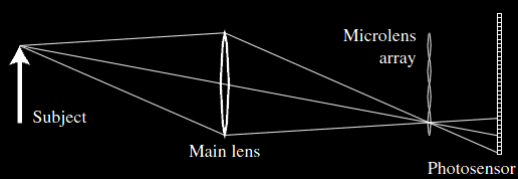
Light probes

Rendering

Relighting

23

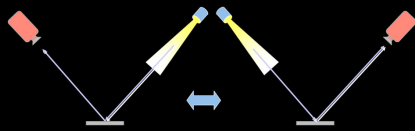
Light Fields



Synthetic refocusing

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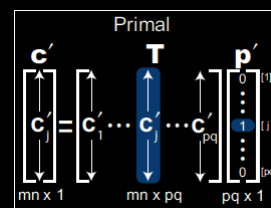
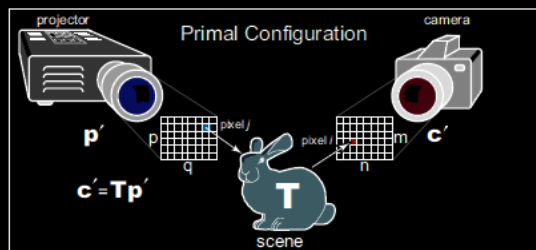
Light Transport



Reciprocity

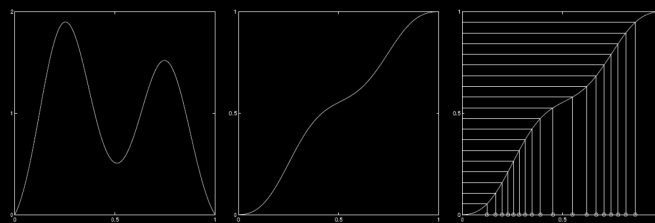
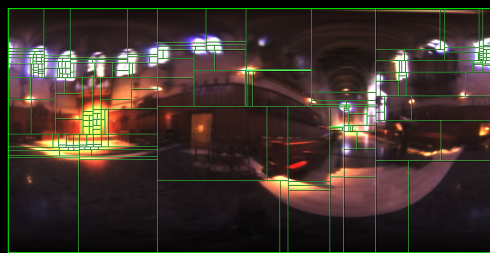


Virtual relighting



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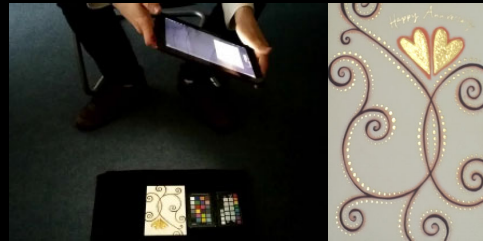
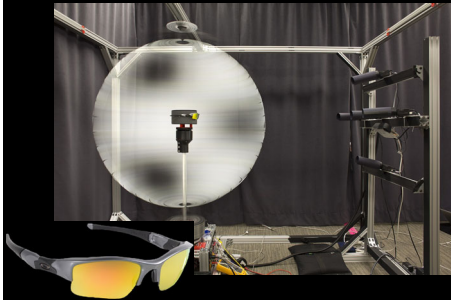
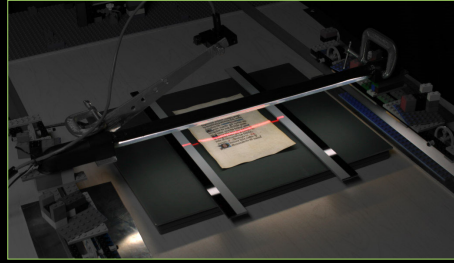
Environmental Illumination



Monte Carlo Sampling

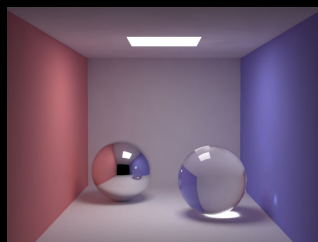
26

Reflectance capture techniques



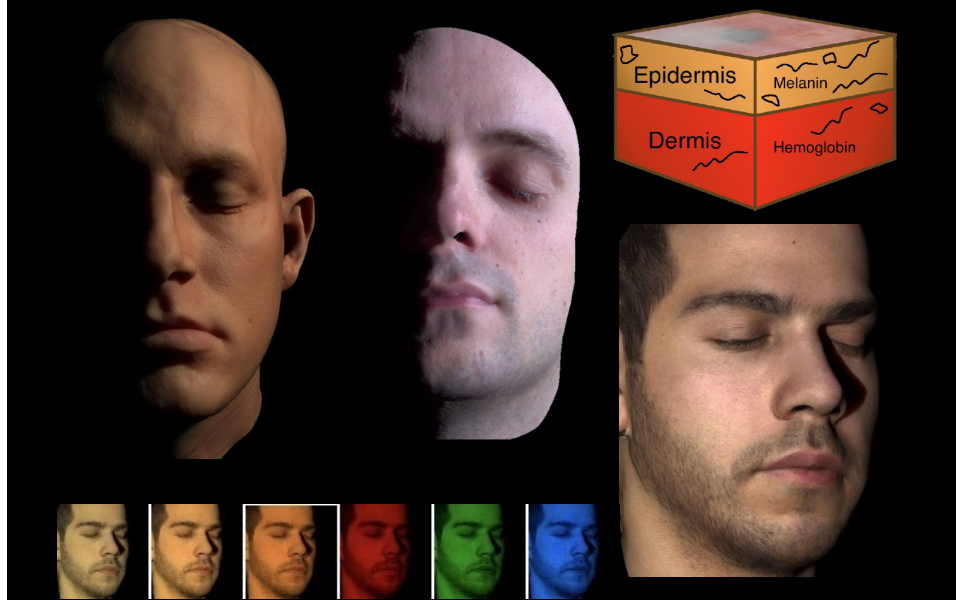
27

Global Illumination



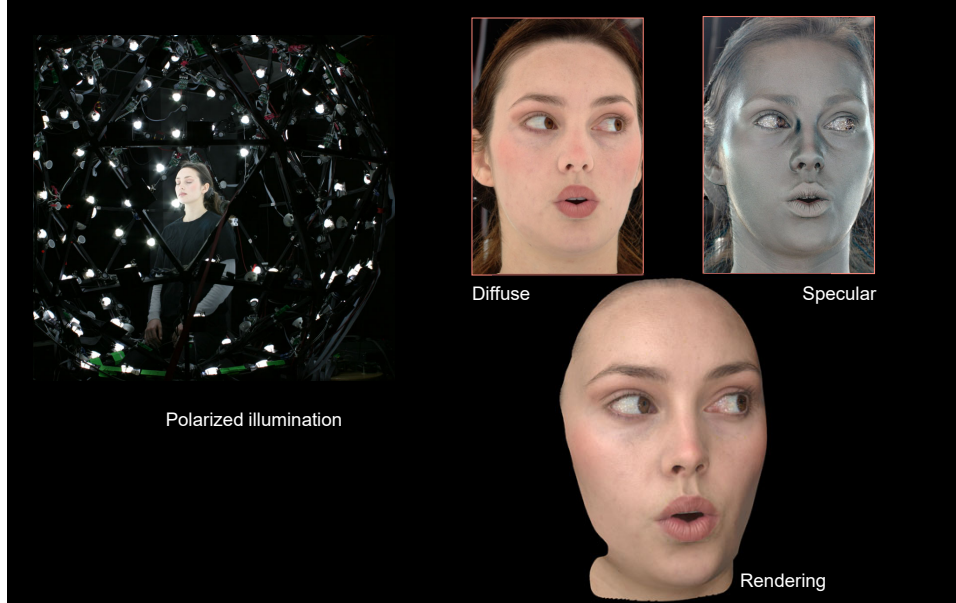
28

Facial modeling and skin rendering



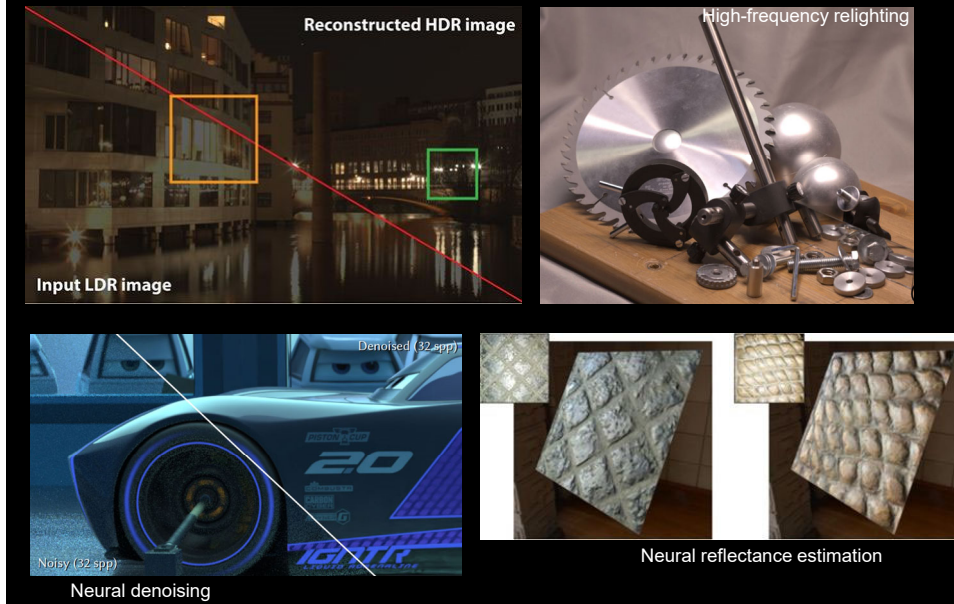
29

Facial capture techniques



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Machine learning applications



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Course material

- **Lecture slides on Scientia**
 - additional notes will be made available periodically
- **"Physically Based Rendering : From Theory to Implementation"**,
Morgan Kaufmann, ISBN-13: 978-0125531801
- **"High Dynamic Range Imaging: Acquisition, Display, and Image-Based Lighting"**,
Morgan Kaufmann, ISBN-13: 978-0125852630

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Multispectral lightstage – Hux 221

(demo end of class)



<https://youtu.be/JqH7IRDQKpg>



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