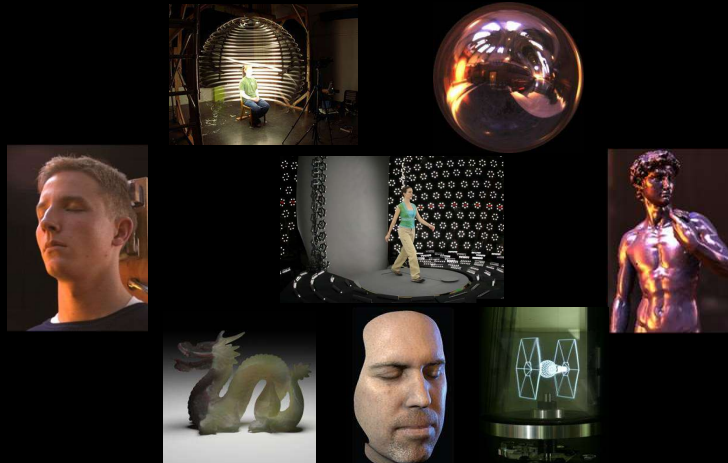


# CO417 – Advanced Computer Graphics: Photographic Image Synthesis



Spring 2019

Abhijeet Ghosh

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## Instructor



Abhijeet Ghosh

[abhijeet.ghosh@imperial.ac.uk](mailto:abhijeet.ghosh@imperial.ac.uk)

[ghosh@imperial.ac.uk](mailto:ghosh@imperial.ac.uk)

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

Senior Lecturer in Computing

Imperial College London 2012 – present

Realistic Graphics and Imaging group

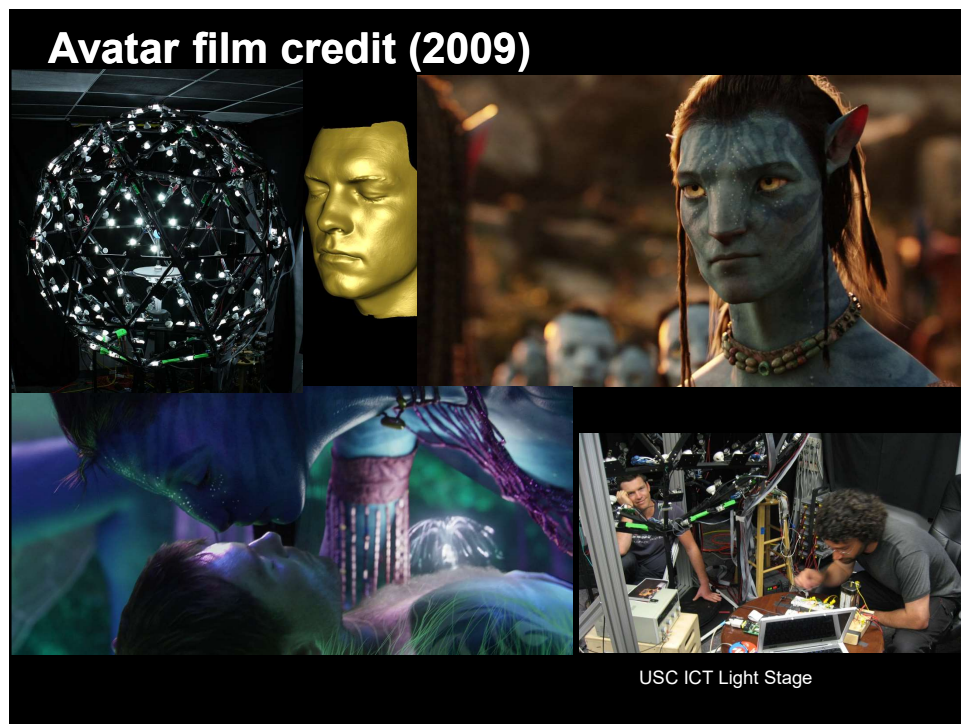
Research Assistant Professor, Graphics Lab

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/rgi/>

### Realistic Graphics and Imaging

Home Events Grants News People Projects Publications Resources Alumni



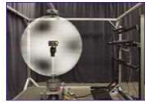
Welcome to the **Realistic Graphics and Imaging** group in the **Department of Computing** at **Imperial College London**. We conduct research in **realistic computer graphics** spanning acquisition, modeling and rendering of real world materials, objects and scenes, as well as **imaging** for graphics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

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## Research in Graphics and Imaging



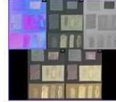
### Surface Reflectometry



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

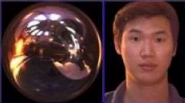


Multiview face capture  
SIGGRAPH Asia 2011



Layered facial reflectance  
SIGGRAPH Asia 2008

### Image-based Lighting



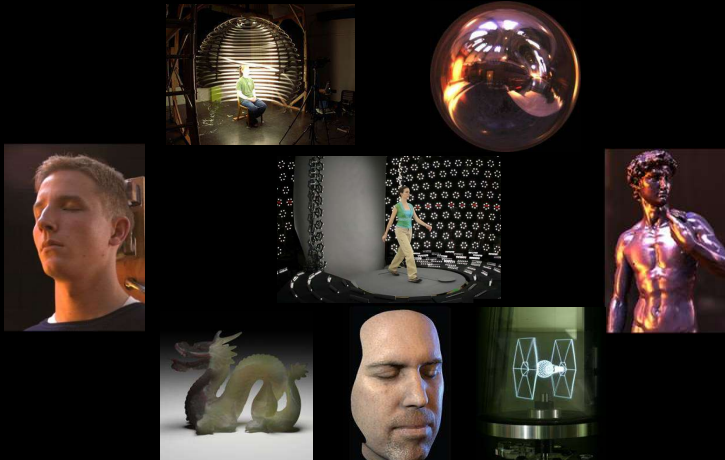
SH and point lights for relighting  
CVMP 2011



Diffuse-specular separation with EM illumination  
ICCP 2009

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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



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## Phorealistic Computer Graphics



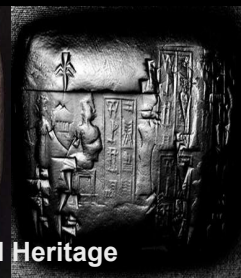
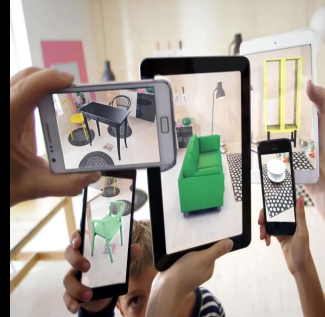
Games



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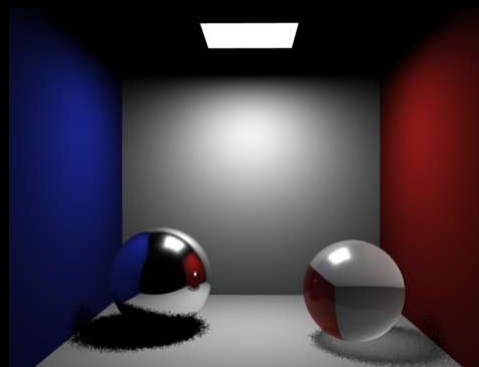


## Phorealistic Computer Graphics



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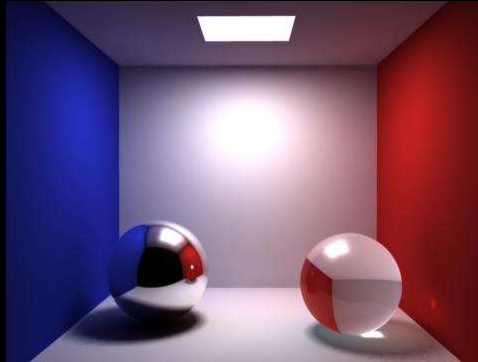
## Light transport simulation



Cornell box with direct illumination

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## Light transport simulation



How real does this scene really look?

Cornell box with global illumination

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## Light transport simulation



Measured data!

Peers et al. 06

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## Image-based rendering



Canon EOS-1D Mark III



Point Grey Grasshopper



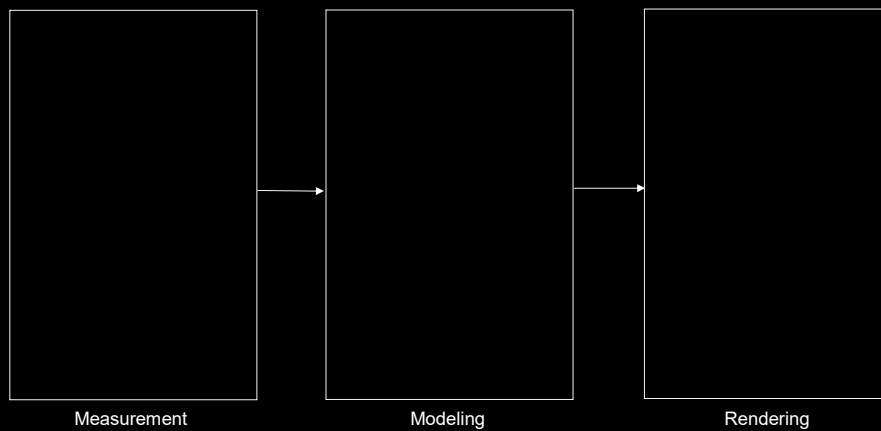
Grace Cathedral



Debevec et al. 00

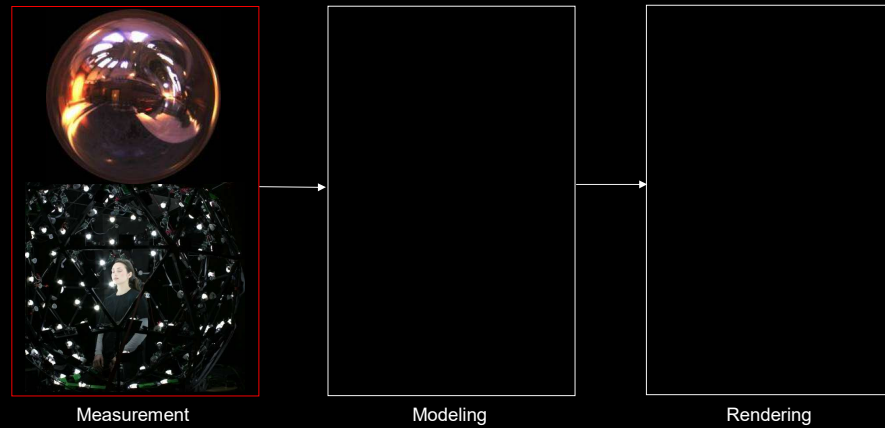
13

## Modern Image Synthesis



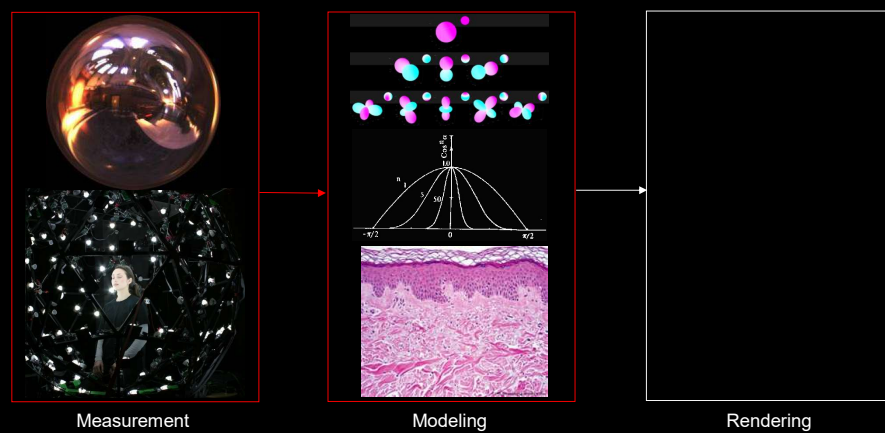
14

## Modern Image Synthesis



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## Modern Image Synthesis



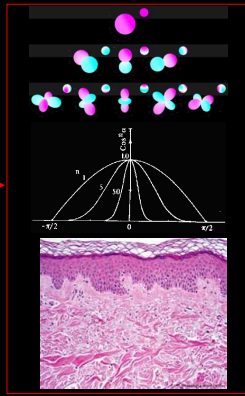
16



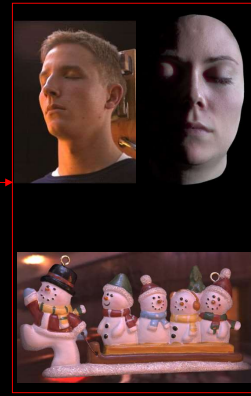
## Modern Image Synthesis



Measurement



Modeling



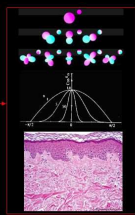
Rendering

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## Modern Image Synthesis



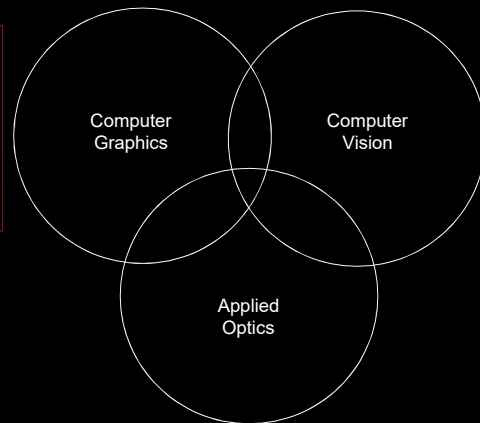
Measurement



Modeling



Rendering



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## Administrativa

- **Day and Time** Monday 9:00 am – 11:00 am  
Friday 2:00 0m – 4:00 pm  
(Weeks 2 – 9, Week 10 revision)
- **First class** January 14, 2019 (Week 2)
- **Location** Hux 140 (Mon), 145 (Fri)
- **Prerequisites** CO317, 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 out of 3 questions  
**67% of grade**

**TAs:** Yuliya Gitlina [yuliya.gitlina13@imperial.ac.uk](mailto:yuliya.gitlina13@imperial.ac.uk) (Primary)  
Yiming Lin [yiming.lin11@imperial.ac.uk](mailto:yiming.lin11@imperial.ac.uk) (Marking)  
(TA Office hours, Wednesdays 2:00pm – 3:00pm, Hux 304)

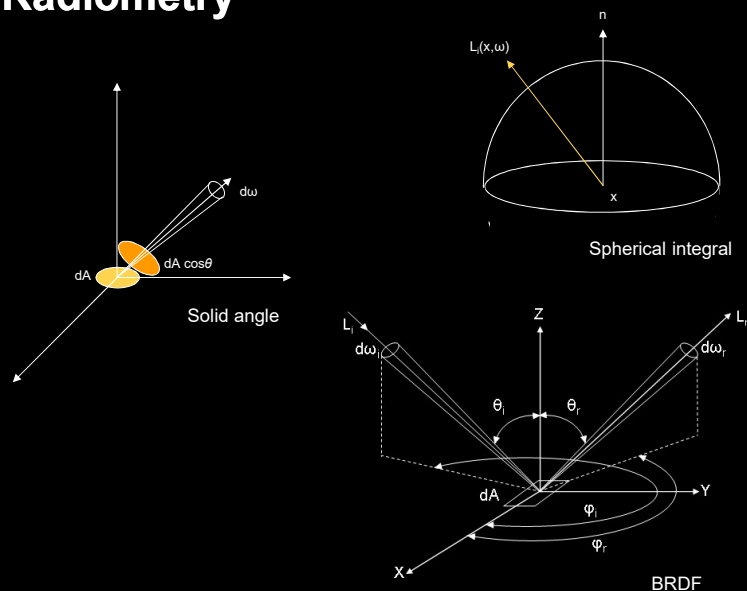
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## Assignments

- Teams of two (joint submissions but with individual subparts)
  - Email TAs your teams by Friday, Jan. 25<sup>th</sup> (Week 3)
- Assignment 1: High Dynamic Range Imaging
  - Goes out on Monday, Week 3
  - Due on Monday, Week 5
- Assignment 2: Sampling and Rendering
  - Goes out on Monday, Week 6
  - Due on Monday, Week 8

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## Radiometry



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## HDRI and Image-Based Lighting



Light probes



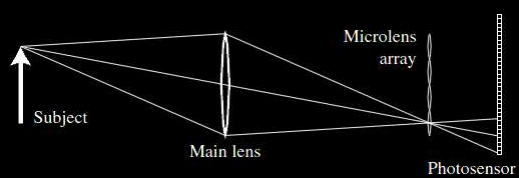
Rendering



Relighting

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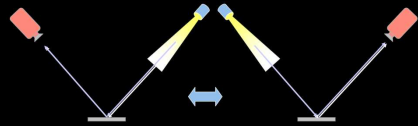
## Light Fields



Synthetic refocusing

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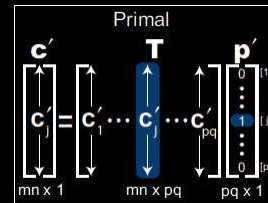
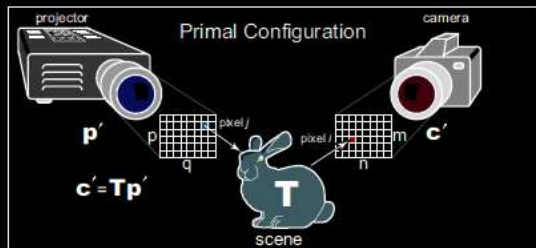
# Light Transport



Reciprocity

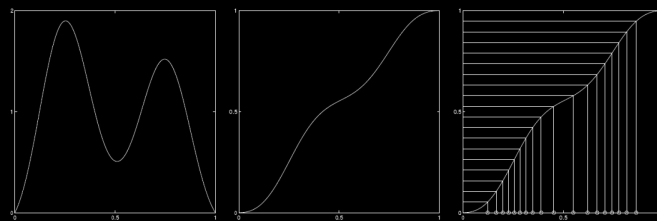
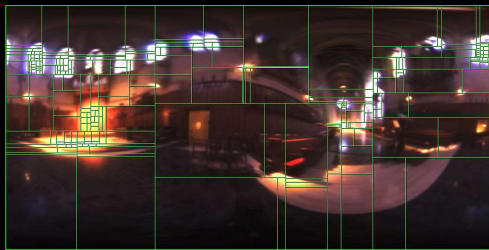


Virtual relighting



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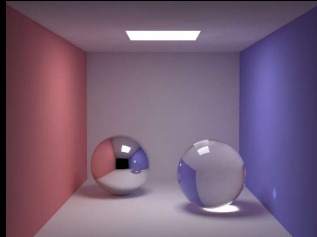
# Environmental Illumination



Monte Carlo Sampling

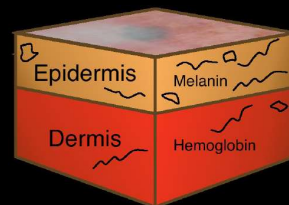
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## Global Illumination



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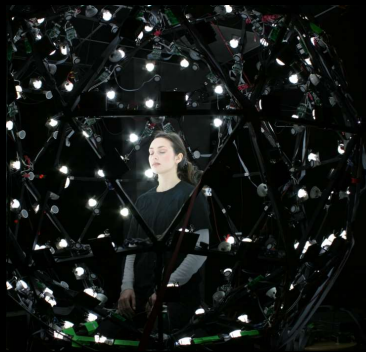
## Facial Modeling and Rendering



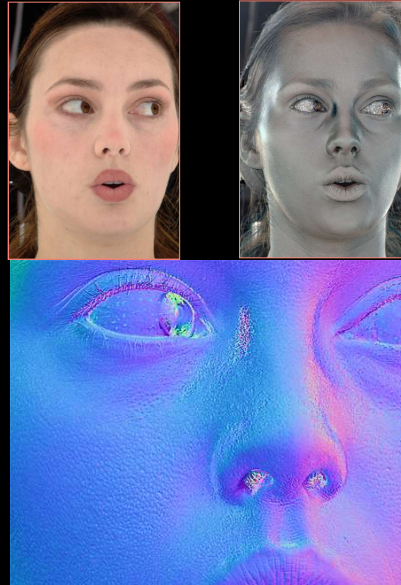
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## Facial capture techniques

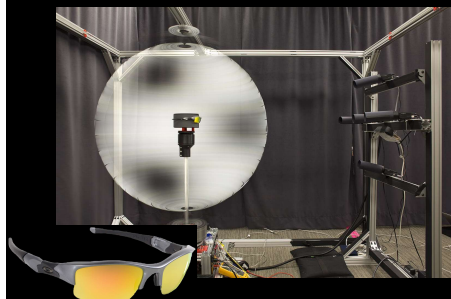
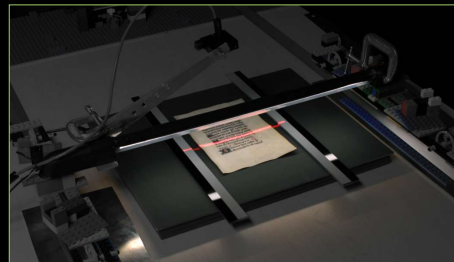


Polarized illumination



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## Reflectance capture techniques



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## Machine learning techniques



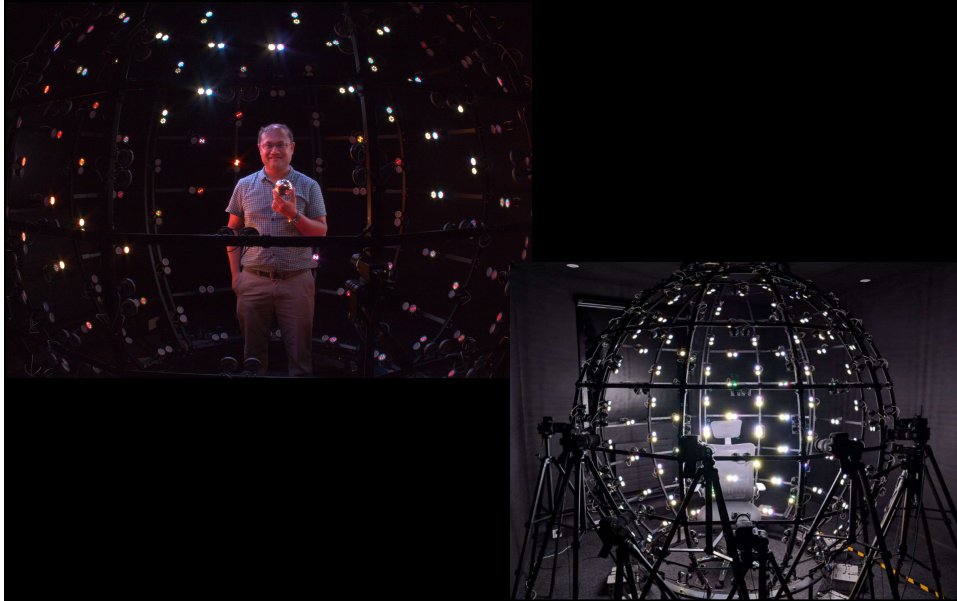
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## Course material

- Lecture slides on CATE
  - 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 demo – Hux 221



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