Course Objectives: This course aims to familiarize graduate level students with the emergent and exciting field of high dynamic range (HDR) imaging. Students will learn about what is dynamic range and why it is important, what are the differences between low and high-dynamic range images, how to create, tone map, and display HDR images and video, and how to use HDR data in various applications in computer graphics.

Lecture Hours: Thursdays, 13:40 – 16:30 at G-102

Prerequisite: Being interested in the field of image processing and computer graphics. Having taken CENG 466 (Fundamentals of Image Processing Techniques) and CENG 477 (Introduction to Computer Graphics) is a plus, but not required. Programming experience in C/C++ and Matlab is a must.

Course Outline:

Week 1-2, Light and Color: In these first two weeks, we will cover the fundamental concepts that are required to understand the future subjects. These fundamental concepts can be broken down as:

a) Radiometry
b) Photometry
c) Colorimetry
d) Illuminants
e) Color spaces
f) Gamma
g) ICC profiles

Week 3, Human Visual System: Understanding of how we perceive the world around us visually is crucial to understand why HDR imaging matters and why various techniques are developed in the ways they are. As such, in this week we’ll cover the fundamentals of the human visual system (HVS):

a) Anatomy of the eye
b) Retina and the photoreceptors
c) Contrast sensitivity
d) Visual adaptation
e) Color appearance phenomena

Week 4-5, HDR Image Capture: During these weeks, we will learn about how to capture an HDR image/video together with how to solve various problems that may arise during the capture process:

a) Photography and light measurement
b) Multiple-exposures technique
c) Camera response functions
d) Image registration and alignment
e) Ghost removal
f) Direct capture of HDR imagery

g) HDR video

Papers to read:

Week 6, HDR Image and Video Storage: Now that you have an HDR image/video, we will learn how to store these in appropriate file formats:
- a) LDR vs. HDR encodings
- b) HDR image and video formats

Papers to read:

Week 7-8-9-10, HDR Image Display: Due to lack of direct hardware support to display HDR images (with the exception of emerging display technologies), HDR content needs some special treatment prior to being displayed on conventional display devices:
- a) Tone mapping problem
- b) Global operators
- c) Local operators
- d) Frequency domain operators
- e) Gradient domain operators
- f) Direct display of HDR imagery

Papers to read:
Week 11-12: Applications of HDR imaging
   a) Image based lighting
   b) Color transfer
   c) … (can be added later on)

Papers to read:

Week 13-14: Project presentations

Evaluation:

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<thead>
<tr>
<th>Evaluation</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Quizzes:</td>
<td>20% (mini exams about the reading assignments)</td>
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<tr>
<td>Presentations:</td>
<td>20% (student presentations of reading assignments)</td>
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<tr>
<td>Assignments:</td>
<td>20% (small programming assignments that must be done individually)</td>
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<tr>
<td>Project:</td>
<td>20% (larger programming assignment that can be done in teams)</td>
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<td>Final exam:</td>
<td>20% (overall assessment of the entire course)</td>
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Notes: Students are reminded that this is a research oriented class. This means that we will read, reflect on, implement, and present research papers. This partly due to the field of HDR imaging being a rapidly evolving and fluid field. But it is also due to my commitment to make this class fun, enjoyable, and up to date with the latest developments in the field. So get ready – the fun is about to start!

Reference Material:
   • Reinhard, E., Ward, G., Pattanaik, S., & Debevec, P. High Dynamic Range Imaging: Acquisition, Display and Image-based Lighting, Morgan Kaufmann, 2005 (the second edition
published in 2010 is also fine).


**Reading Material:**
Below is a general list of influential papers in the field of HDR imaging. This list will be updated throughout the course.


• More papers will be added ...