Welcome!

- Introductions
  - Instructor
  - Class
- About this course
- What is Image-Based Modeling and Rendering?
- Course topics and course outline
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Research Scientist

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Swiss citizen
MS in EE from ETH Zürich, Switzerland
PhD in CS from SUNY Stony Brook
Worked for the last 6 years at MERL
  - Chief architect of VolumePro
    • http://www.terarecon.com/
More than a decade of fun in graphics
  - Image-based Rendering
  - 3D Scanning
  - Point-based Graphics
  - Graphics hardware
  - Scientific visualization
About you...

- Your name
- Where do you work / study / hang out?
- Are you in the Extension School ALM/CAS program?
- Programming experience
- Previous experience in computer graphics
- What you expect to learn in this course

TAs

- TAs? We don’t need no stinkin’ TAs!
- Well… that means you are on your own!
- Make active use of the mailing list
- Look up resources on the web
- Google should become your best friend
- Read papers and (maybe) books in addition to the class readings
Outline

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Meeting Times

- Wednesdays, 7:00 - 8:30 pm, here at MERL
- 5-10 minute break
- 15 classes (until May 14)
What is this course about?

- This is a study group for image-based modeling and rendering (IBMR).
- Very (!) informal gatherings each week.
- We will read some of the relevant papers in IBMR.
- You will present papers in class.
- You complete an IBMR project throughout the course.
- We’ll have some fun!

What do you need to know?

- Programming in C/C++
  - At least 2-3 years of working experience
- Computer graphics and OpenGL
  - CSCI E-234 or equivalent
  - See [http://courses.dce.harvard.edu/~cscie234/](http://courses.dce.harvard.edu/~cscie234/)
- Linear algebra
  - What we covered in CSCI E-234
Course Web Page

- [http://courses.dce.harvard.edu/~indre399/](http://courses.dce.harvard.edu/~indre399/)

Mailing List

- **URL:** [https://lists.dce.harvard.edu/mailman/listinfo/indre399](https://lists.dce.harvard.edu/mailman/listinfo/indre399)
- Post message: [indre399@lists.dce.harvard.edu](mailto:indre399@lists.dce.harvard.edu)
- Please sign up this week.
- Send an email to the list with a link to an IBMR web page and a brief description what it is.
Registration

- Print the Harvard paper enrollment form (link is on course web page)
- Enroll for course INDR E-399, "CAS Independent Research", catalog #20302
  - Fee $1425.-
- No need to enroll in the ALM/CAS program! (sorry)
- After you pick your course project, send an email about it to Henry Leitner (leitner@harvard.edu)
- This course counts as an elective course at the Harvard Extension School

Your homework

- Weekly reading assignments
  - Two 8-10 page papers or more each week
- Paper presentations
  - Two or more presentations throughout the course
  - Read the paper(s), prepare the PPT slides, give the talk
  - 30 minutes each, including 10 minutes Q&A
- Course project
  - Choose from a list of projects in the next two weeks
  - Hand in two project milestones (to get you going)
  - Project due date: May 14, 2003
  - Final project presentation: May 21, 2003
Grading

- All grades are given as points between 0 and 100
- The final grade is a weighted sum of:
  - Class and mailing list participation: 10%
  - Paper presentations: 20%
  - Project milestones: 20%
  - Final project: 50%
- The letter grade is assigned as follows:
  - 95-100 points: A
  - 90 - 94 points: A-
  - 85 - 89 points: B+
  - 80 - 84 points: B
  - 75 - 79 points: B-
  - 70 - 74 points: C+ etc.

Academic Honesty

- You absolutely must **acknowledge** any code that was **not** written by you. Preferably, you make a mention of the original source directly in your source (.h/.cpp) files. You can also acknowledge them in your README.txt file if you used whole classes or libraries.
- Without prior written approval by the instructor you may not submit the same material to two courses.
- Plagiarism, cheating, and other forms of academic dishonesty will be reported to the Dean and can have very serious consequences.
- If you have any questions about the use of source code derived from other sources please contact the course instructor.
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SIGGRAPH '99 Course

Traditional Modeling and Rendering

For Photorealism:

Modeling is Hard  Rendering is Slow

Paul Debevec, http://www.debevec.org
Can we model and render this?
What do we want to do with the model?

Paul Debevec, http://www.debevec.org

Stereo Image Pair
Depth Map

SIGGRAPH '99 Course

Immersion '94
Michael Naimark
John Woodfill
Paul Debevec
Leo Villareal
Interval Research
Corporation

Stereo Image Capture Rig

Paul Debevec, http://www.debevec.org

SIGGRAPH '99 Course

Image-Based Modeling and Rendering

Images, user input, range scans

Model

Images

Image-Based Modeling
Image-Based Rendering

Paul Debevec, http://www.debevec.org
Image-Based **Modeling**

*Images (photographs, renderings) are used to determine*
- Scene Appearance
- Scene Geometry
- Lighting
- Reflectance Characteristics
- Kinematic Properties

=> *Modeling scenes photorealistically is easier*

Paul Debevec, http://www.debevec.org
# The Spectrum of IBMR

![Image-Based Models Spectrum](image_url)

**Model**: Kinematics, etc.

**Image-Based Modeling**: Images, renderings, user inputs, range maps

**Geometry + Materials**: Geometry + Images

**Images + Depth**: Light Field, Movie Map

**Panorama**

**Image**

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# Image-Based Models: What do they allow?

<table>
<thead>
<tr>
<th>Model</th>
<th>Movement</th>
<th>Geometry</th>
<th>Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometry + Materials</td>
<td>Continuous</td>
<td>Global</td>
<td>Dynamic</td>
</tr>
<tr>
<td>Geometry + Images</td>
<td>Continuous</td>
<td>Global</td>
<td>Fixed</td>
</tr>
<tr>
<td>Images + Depth</td>
<td>Continuous</td>
<td>Local</td>
<td>Fixed</td>
</tr>
<tr>
<td>Light Field</td>
<td>Continuous</td>
<td>None</td>
<td>Fixed</td>
</tr>
<tr>
<td>Movie Map</td>
<td>Discrete</td>
<td>None</td>
<td>Fixed</td>
</tr>
<tr>
<td>Panorama</td>
<td>Rotation</td>
<td>None</td>
<td>Fixed</td>
</tr>
<tr>
<td>Image</td>
<td>None</td>
<td>None</td>
<td>Fixed</td>
</tr>
</tbody>
</table>

Paul Debevec, http://www.debevec.org
SIGGRAPH '99 Course

Leonard McMillan

SIGGRAPH '99 Course

Computer Graphics

Michael Cohen
But, vision technology falls short

... and so does graphics.
IBMR Applications

- Advertisement (image morphing)
- Image Mosaics (travel industry, QuickTime VR)
- Virtualized Reality (tele-conferencing, etc.)
- Entertainment (movies, games, etc.)
- Web3D (e-commerce, etc.)
- Virtual actors
- Visualization (volume visualization, etc.)
- 3D reconstruction and modeling (architecture, design, etc.)
- Material scanning
- Hmm, sounds like computer graphics...
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This Course

- We will talk about computer vision
  - Computer graphics: Given a 3D model, render it
  - Computer vision: Given images, create a 3D model
- We will talk about images and models
  - Depth images, layered depth images (LDIs), LDI trees, etc.
  - Sprites and 3D point models
  - Visual hulls, voxel models, polygon models etc.