Lecture 20:

Course Summary +
Graphics at Stanford Today

Computer Graphics: Rendering, Geometry, and Image Manipulation
Stanford CS248A, Winter 2024
As accomplished CS248A students you’ve now learned the basics of drawing shapes, representing surfaces/light/materials, manipulating images, etc.

(and you have been introduced to core graphics ideas like sampling, anti-aliasing, acceleration data structures, etc.)

What’s next?
Visual Computing classes (coming quarters) at Stanford

SPRING

CS348K: “Visual Computing Systems”, creating efficient systems for photography, 3D graphics, and generative AI (Fatahalian) - TTh 10:30am
CS 231N: “Deep Learning for Computer Vision” (F. Li) - TTh 12:00pm
EE267: “Virtual Reality” (Wetzstein) - TTh 12:00pm
CS348E: “Character Animation: Modeling, Simulation, and Control of Human Motion” (Liu) (not offered next quarter, but look for it again soon)

FALL

CS448B: “Data Visualization” (Agrawala)
CS149: “Parallel Computing” (Fatahalian, Olukotun)

WINTER

CS348C: “Animation and Simulation”, deep dive into animation and simulation techniques (James)
EE367/CS448i: “Computational Imaging and Display”, advanced course on display design (Wetzstein)
CS205L: “Continuous Mathematical Methods with an Emphasis on Machine Learning” (Fedkiw)
Modern trends in graphics

Video generated by OpenAI's Sora.
Graphics Research at Stanford Today
ControlNet: more precise ways to control generative AI
Agrawala: neurosymbolic approaches to generative AI

**Prompt:** Generate a 3D model of a Chair

**Output Code**

```python
def Chair():
    bbox = Cuboid(1.2, 1.4, 1, T)
    base = Base(.9, .5, .8, T)
    seat = Seat(.1, .1, .9, T)
    back = Back(1.1, .9, 2, F)
    arm = Cuboid(.1, .4, .7, F)
    attach(base, bbox, .5, 0, .5, 0, .5)
    squeeze(back, bbox, base, top, .5, 1)
    attach(seat, base, .5, 0, .5, 1, .5)
    attach(arm, back, .5, .5, 0, .1, .3, .5)
    attach(arm, seat, .5, 0, .5, .1, .7, .5)
    reflect(arm, X)
    ...

def Back(l, w, h, aligned):
    bbox = Cuboid(l, w, h, aligned)
    surface = Cuboid(1.16, .64, .13, T)
    slat = Cuboid(.04, .76, .1, F)
    attach(surface, bbox, .5, 1, .5, .5, 1, .7)
    attach(slat, bbox, .5, 0, .5, 2, 0, .45)
    attach(slat, surface, .5, .6, .8, 2, .3, .2)
    reflect(slat, X)
```

**Output 3D Model**
Human motion synthesis and estimation

Scene-aware human behaviors

Human-robot interaction

Human dexterity
Leo Guibas
Recent Guibas Lab projects

- Computer vision and sensor networks
- Geometric and topological data analysis
- 3D machine learning and 3D representations
- 3D shape/scene analysis and synthesis
- Neural methods for navigation and manipulation
- Affective computing

Algorithmic problems in modeling physical objects and phenomena in vision/graphics/robotics
Gordon Wetzstein
Stanford Computational Imaging Lab

Neural Rendering  XR & Wearable Computing  Deep Optics

Single-photon Imaging  Computational Microscopy  Computational Cameras
Efficient 3D GANs – Latent Code Interpolation
Doug James
Improved Water Sound Synthesis using Coupled Acoustic Bubbles

Kangrui Xue, Ryan M. Aronson, Jui-Hsien Wang, Timothy R. Langlois, Doug L. James

ACM SIGGRAPH 2023

A framework for automatically synthesizing bubble-based water sounds for fluid animations.

We model inter-bubble coupling forces to simulate the collective oscillations of bubble clouds.

We also improve sound rendering speed and robustness using a GPU wavesolver with sample-and-hold geometry.

(The following sounds were generated by our method)
Jiajun Wu
Kayvon Fatahalian (me)
Zoom Out Example Simulator:
Controlling generative AI by making collages

User creates a composition with standard graphics tools
Defines what should be in the image, where it goes, and what it should look like

Generative AI harmonizes the starting composition into a “plausible” realistic image

Prompt: “a bento box with rice, edamame, ginger, and sushi”
A fun resource
Ke-sen Huang’s famous site with all the SIGGRAPH papers!
http://kesen.realtimerendering.com/

SIGGRAPH 2023 papers on the web

Page maintained by Ke-sen Huang. If you have additions or changes, send an e-mail.

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Note that when possible I link to the page containing the link to the actual PDF or PS of the preprint. I prefer this as it gives some context to the paper and avoids possible copyright problems with direct linking. Thus you may need to search on the page to find the actual document.


A Material World

A Sparse Non-parametric BRDF Model
Tanboon Tongebsuwanrak, Jonas Unger (Linkoping University), Christine Guillemonet (INRIA), Ehsan Miandji (Linkoping University)

SpongeCake: A Layered Microflake Surface Appearance Model
Beibei Wang* (Nankai University) and Nanjing University of Science and Technology), Wenhua Jin* (Nanjing University of Science and Technology), Milos Hasan (Adobe Research), Ling-Qi Yan (University of California, Santa Barbara) *Authors contributed equally.

A Practical Wave Optics Reflection Model for Hair and Fur
Menqri (Mandy) Xu (Cornell University) and EPFL, Bruce Walter (Cornell University), Christophe Hery, Olivier Maury (Meta Reality Labs), Eric Michielssen (University of Michigan), Steve Marschner (Cornell University)

Microfacet theory for non-uniform heightfields
Eugene e'On, Benedikt Bitterli, Andrea Wedlich, Tizian Zeltner (NVIDIA)

Generating Procedural Materials From Text or Image Prompts
Yiwei Hu (Yale University) and Adobe Research, Paul Guerrero, Milos Hasan (Adobe Research), Holly Rushmeier (Yale University), Valentin Deschaintre (Adobe Research)

A Realistic Surface-based Cloth Rendering Model
Jingyi Zhu (University of California, Santa Barbara), Adrian Jarabo-Carlos Aliaga (Meta Reality Labs Research), Ling-Qi Yan (University of California, Santa Barbara), Matt Jen-Yuan Chiang (Meta Reality Labs Research)
Discussion: graphics jobs
Discussion: how to get involved in graphics at Stanford

- Email your graphics professors and ask to talk to them about independent study
  - Although to be honest... the best intro line is ("I took and loved your 300-level graphics class and did well and want to keep going)

- A common way to get started
  - Hack code to contribute to a Ph.D. student’s research project
  - Then peel off and explore your own addition to the project
Why research (or independent study)?

- You will learn way more about a topic than in any class.
- You think your undergrad friends are very smart? Come hang out with Stanford Ph.D. students! (you get to work side-by-side with them and with faculty). Imagine what level you might rise to.
- It’s way more fun to be on the cutting edge. Industry might not even know about what you are working on. (imagine how much more valuable you are if you can teach them)
- It widens your mind as to what is possible.
Thanks for being a great class!

Good luck finishing projects.
Make sure you have fun, that’s the point!