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

CS248B: "Fundamentals of Computer Graphics: Animation and Simulation " (Liu, James)

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)

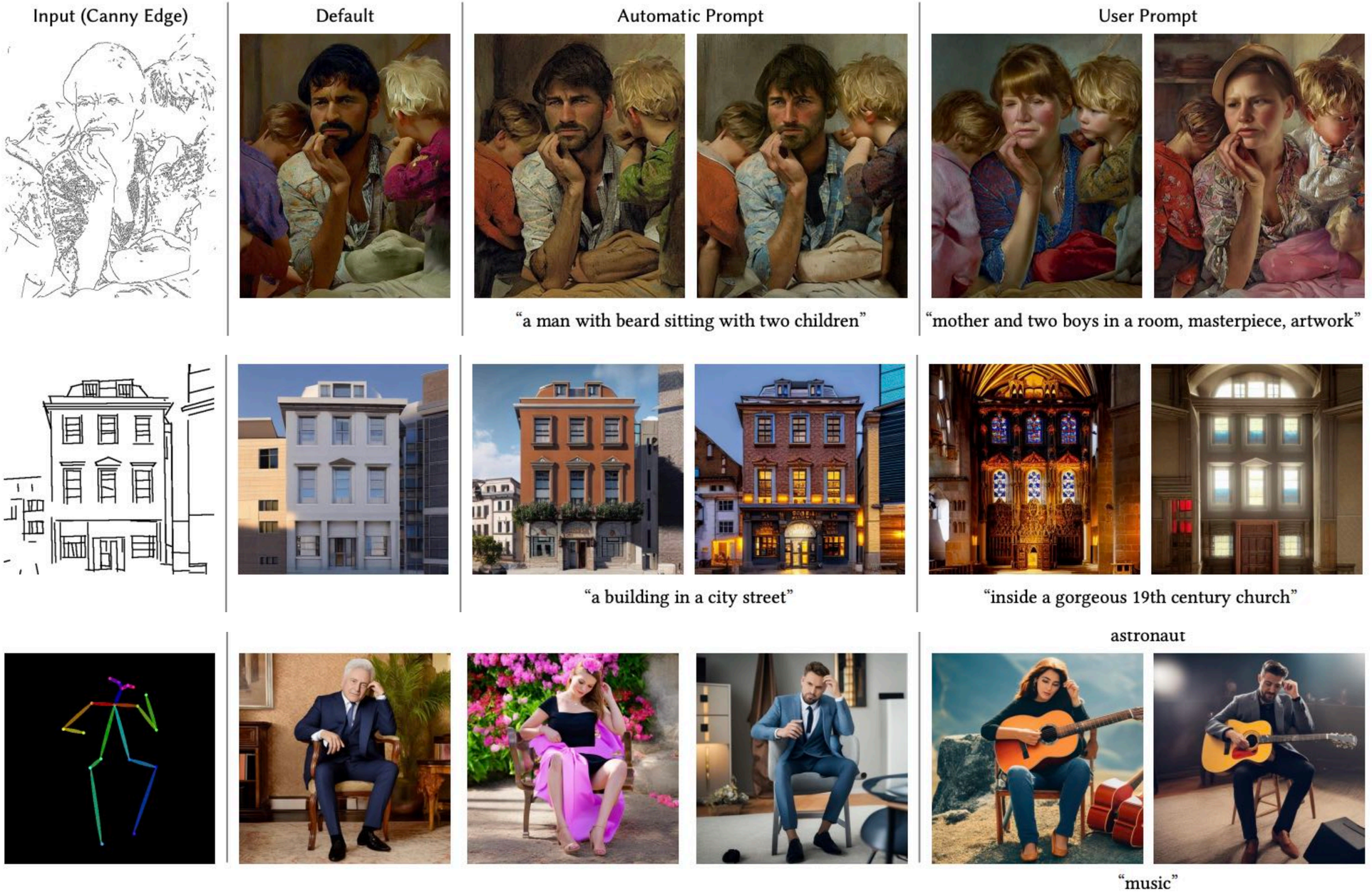
Modern trends in graphics

Video generated by OpenAI's Sora.

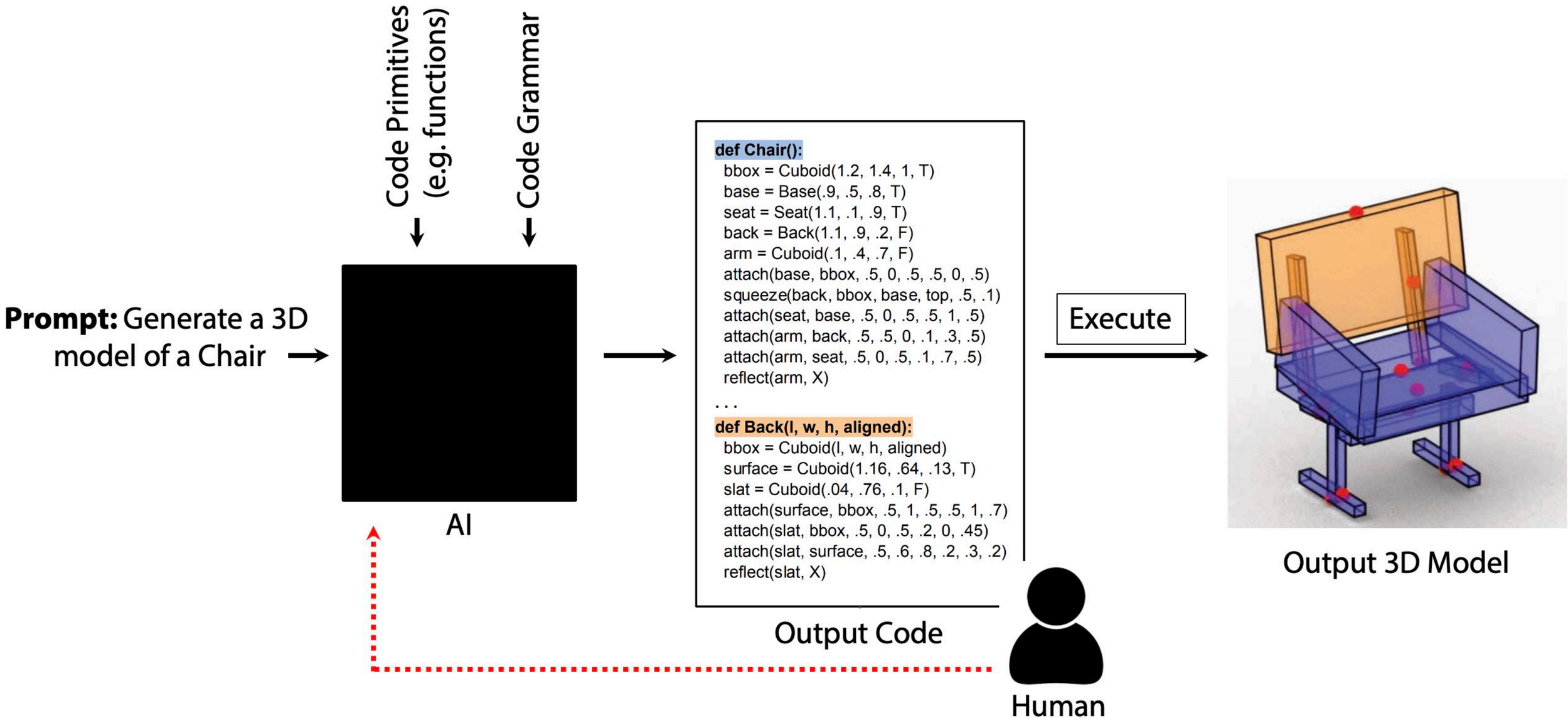
Graphics Research at Stanford Today

Maneesh Agrawala

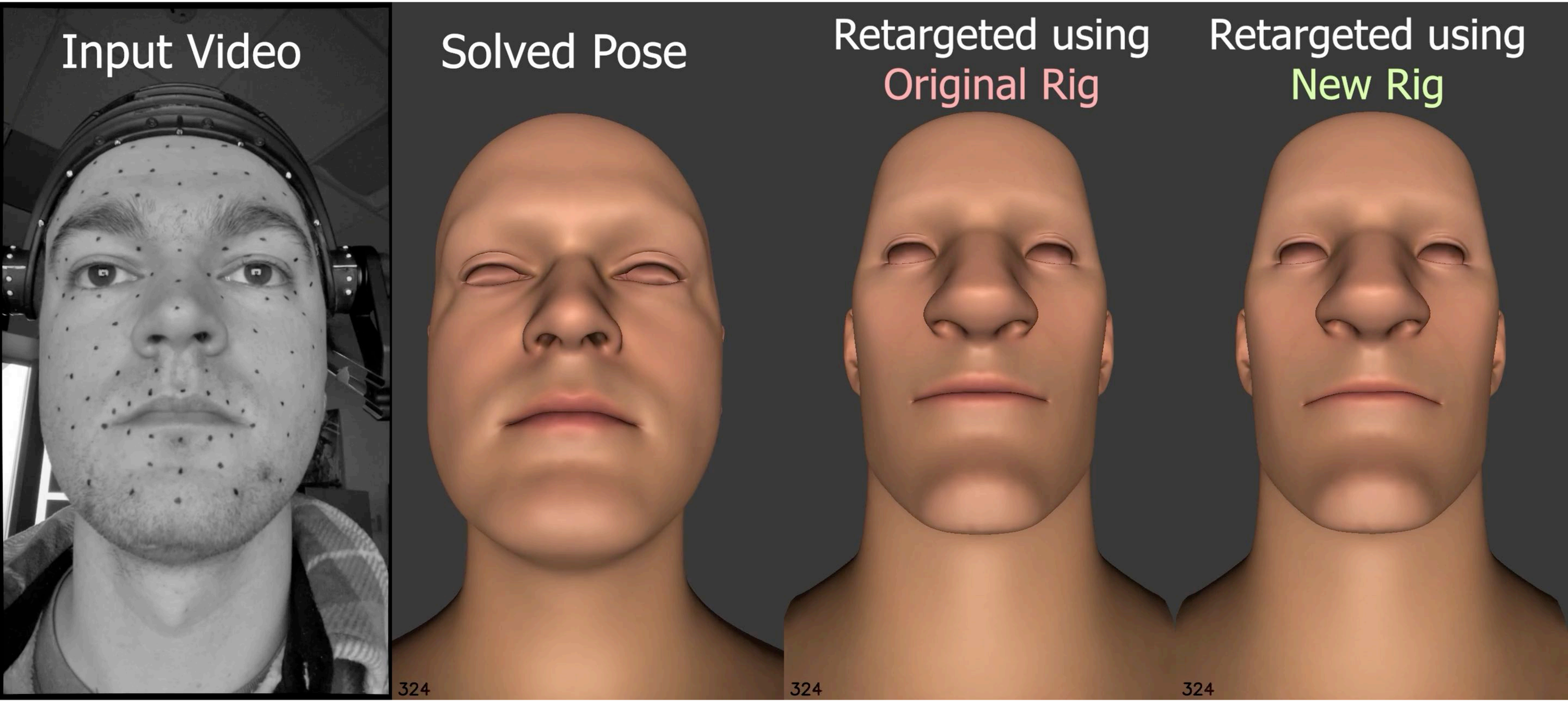
ControlNet: more precise ways to control generative AI



Agrawala: neurosymbolic approaches to generative AI



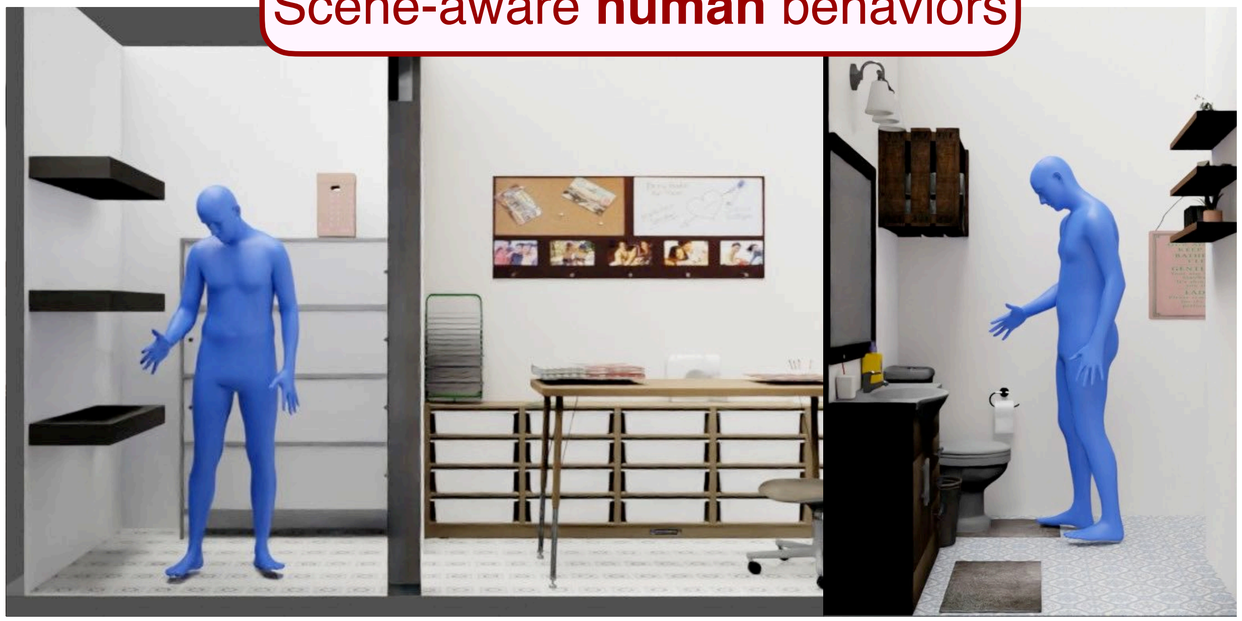
Ron Fedkiw

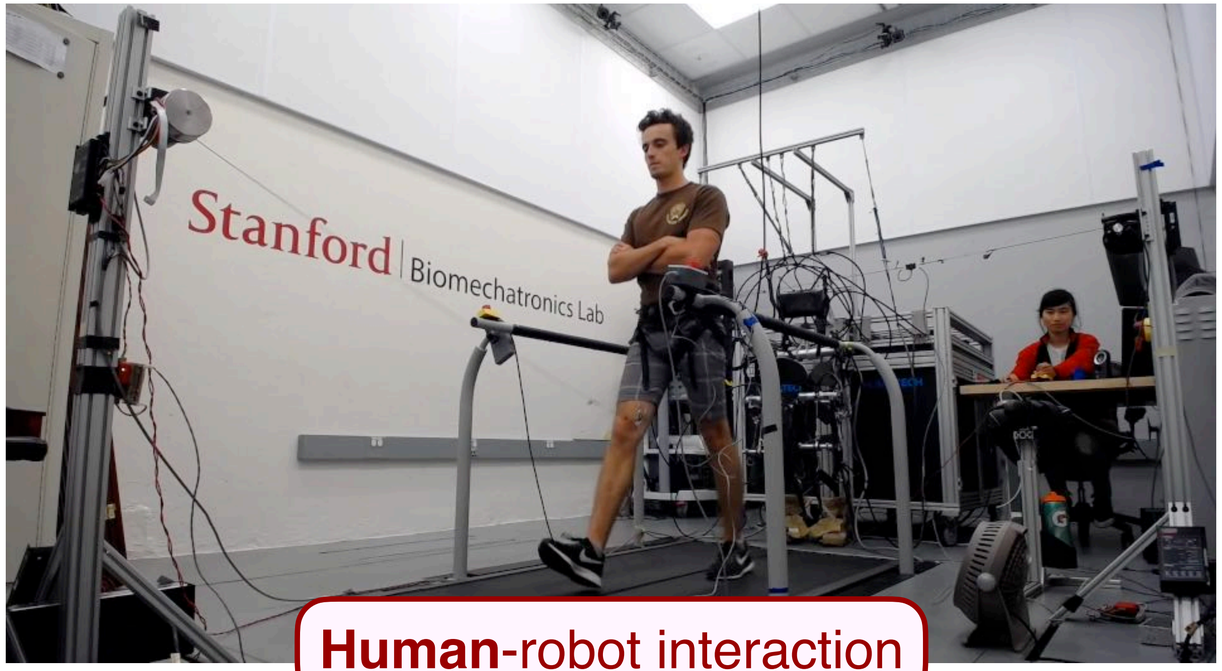

Input Video
Solved Pose
Retargeted using
Original Rig
Retargeted using
New Rig
324
324
324

Karen Liu

Human motion synthesis and estimation

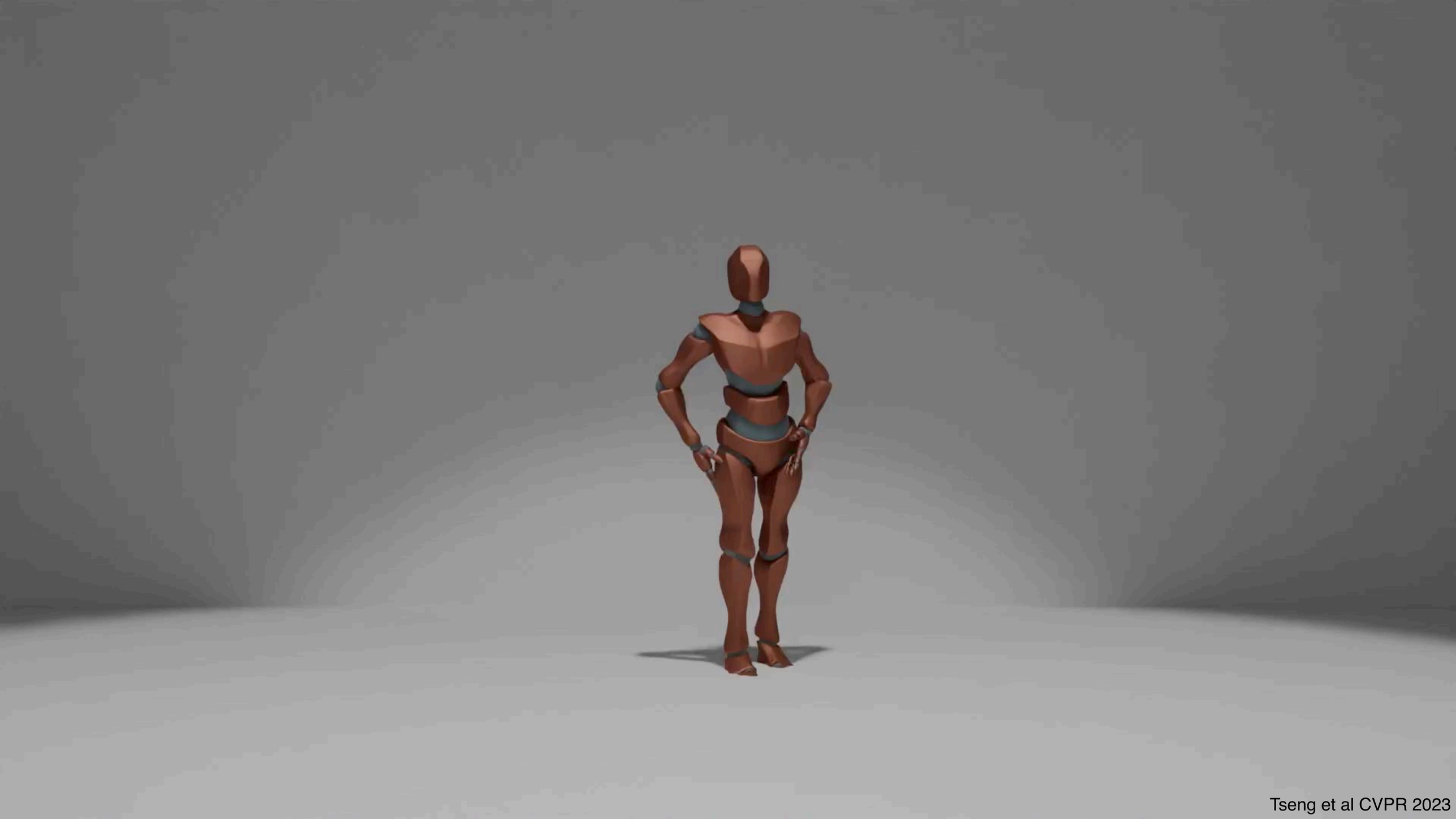
Scene-aware **human** behaviors





Human-robot interaction

Human dexterity



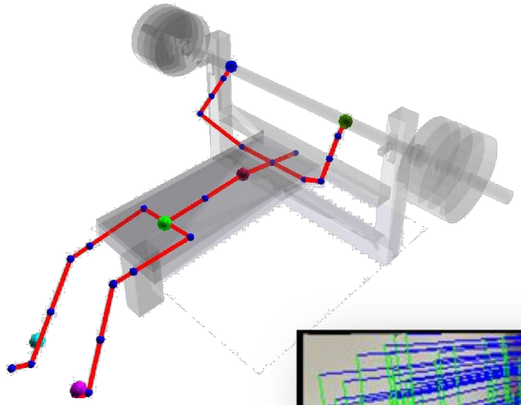
Tseng et al CVPR 2023

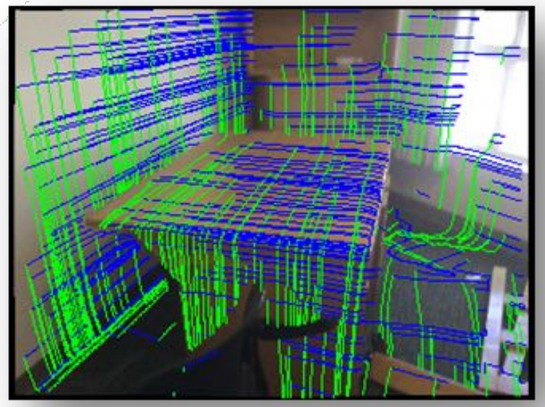
Leo Guibas

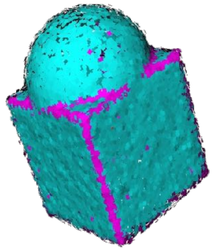
Recent Guibas Lab projects

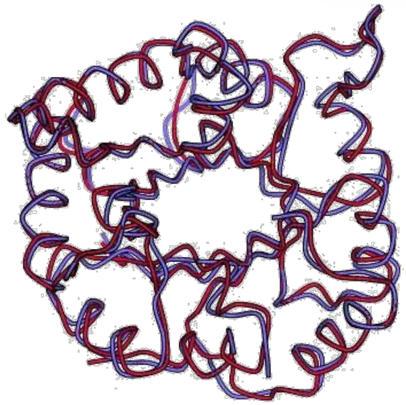
- Computer vision and sensor networks
- Geometric and topological data analysis
- 3D machine learning and 3D representations
- 3D shape/scene analysis and synthesis
- Neural methods for navigation and manipulation
- Affective computing

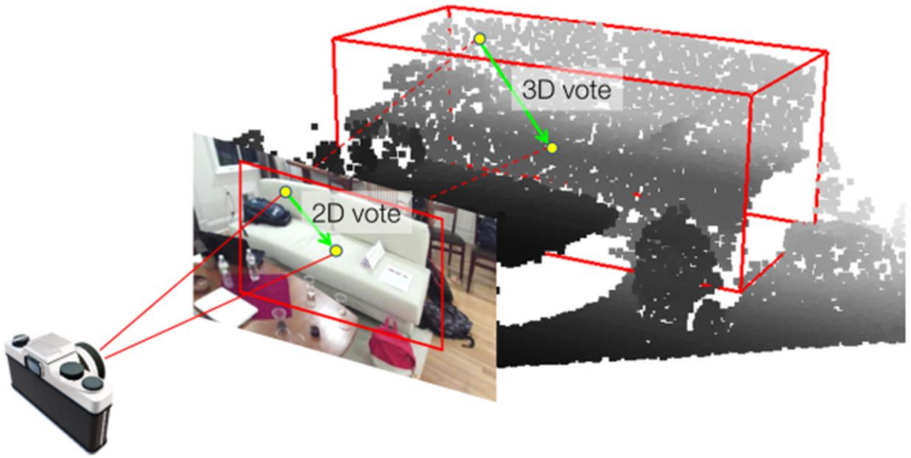
Algorithmic problems in modeling physical objects and phenomena in vision/graphics/robotics





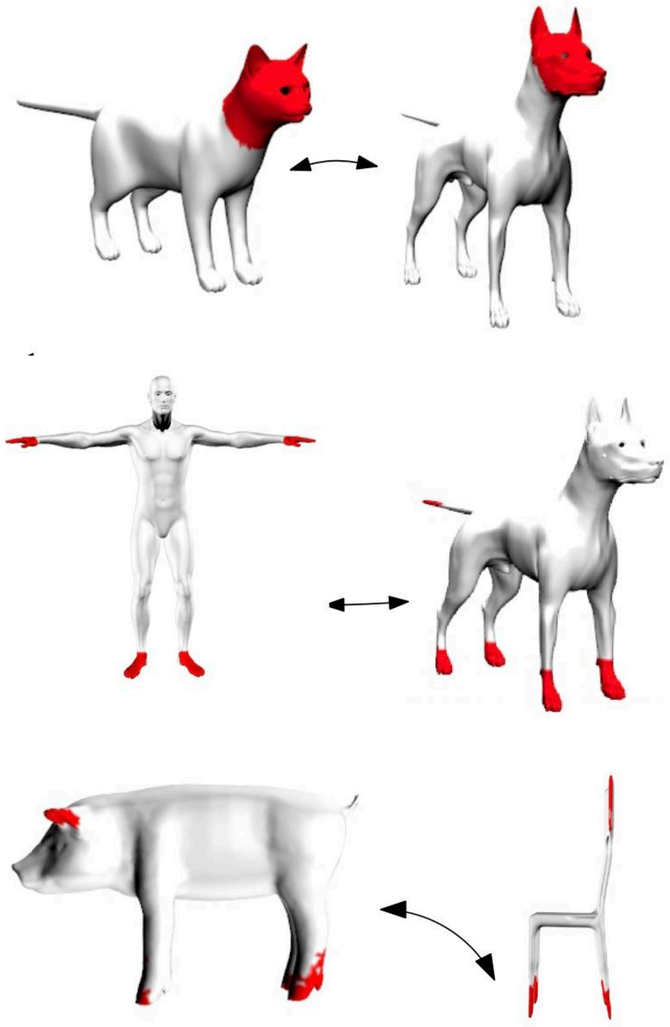




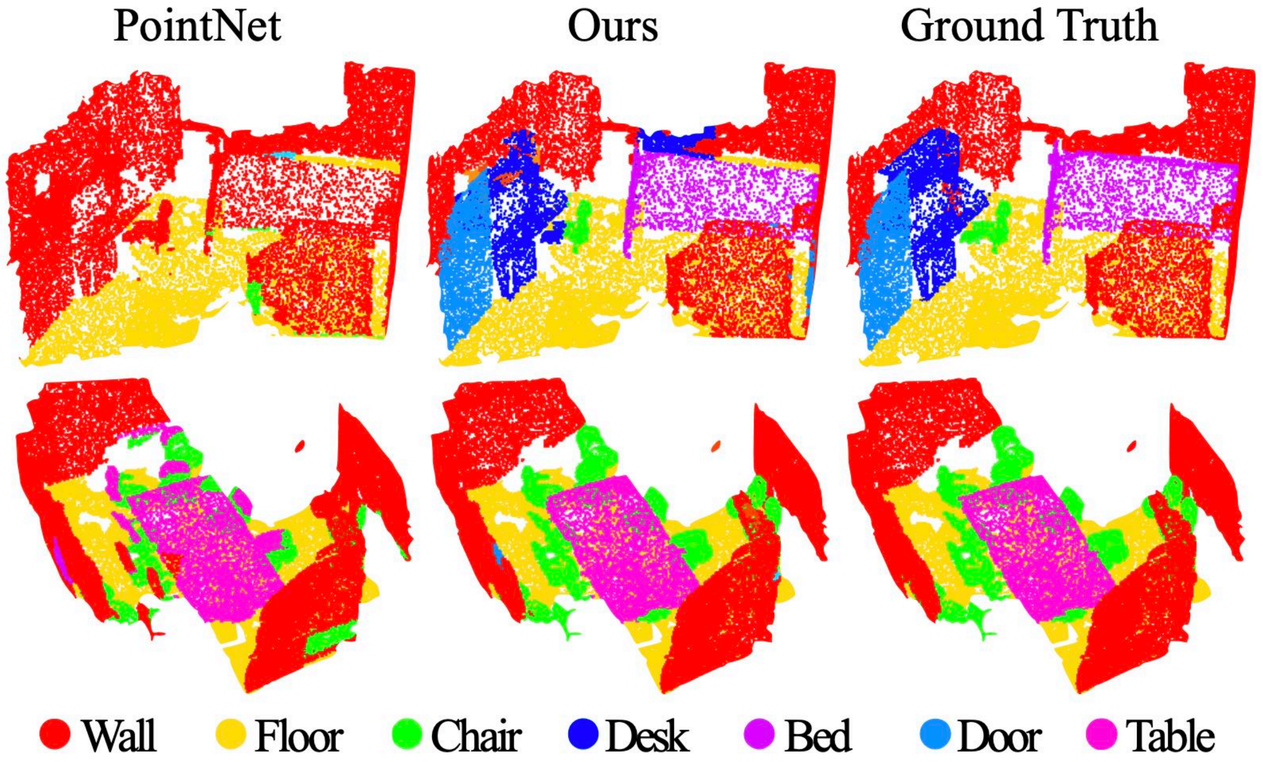


Leo Guibas

Geometry processing and analysis



Shape Similarity and Correspondence



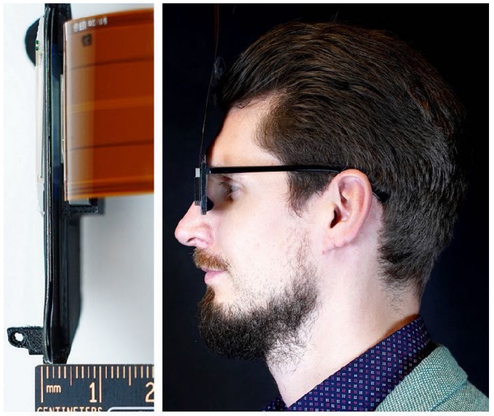
PointNet: Deep Learning on Point Clouds

Gordon Wetzstein

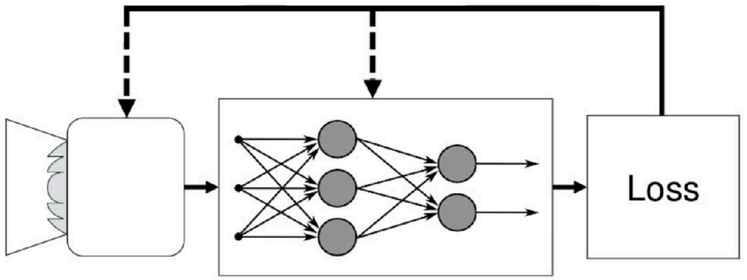
Stanford Computational Imaging Lab

Neural Rendering

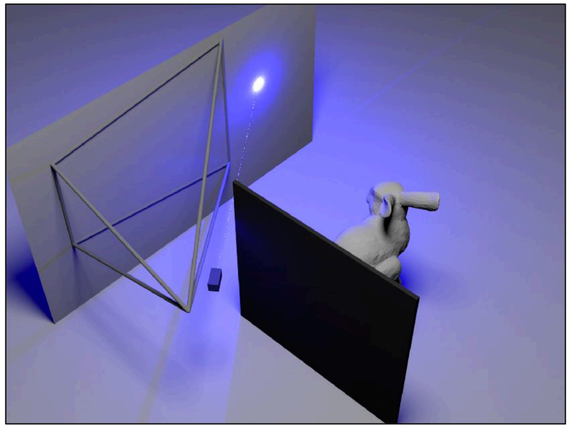
XR & Wearable Computing



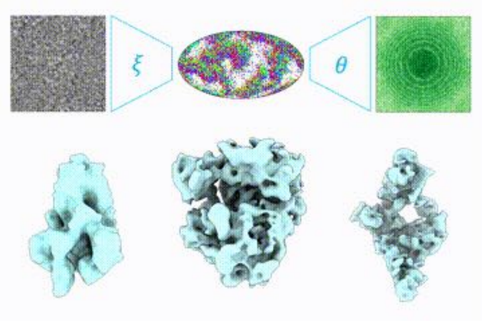
Deep Optics



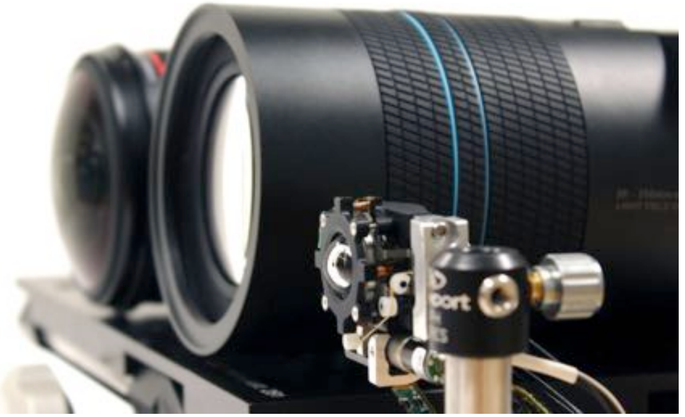
Single-photon Imaging



Computational Microscopy



Computational Cameras



Efficient 3D GANs – Latent Code Interpolation

Chan et al. CVPR 2022

Doug James

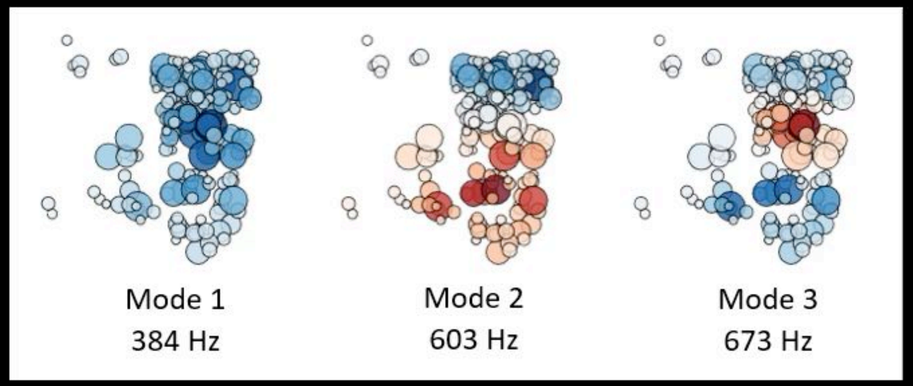
Improved Water Sound Synthesis using Coupled Acoustic Bubbles

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

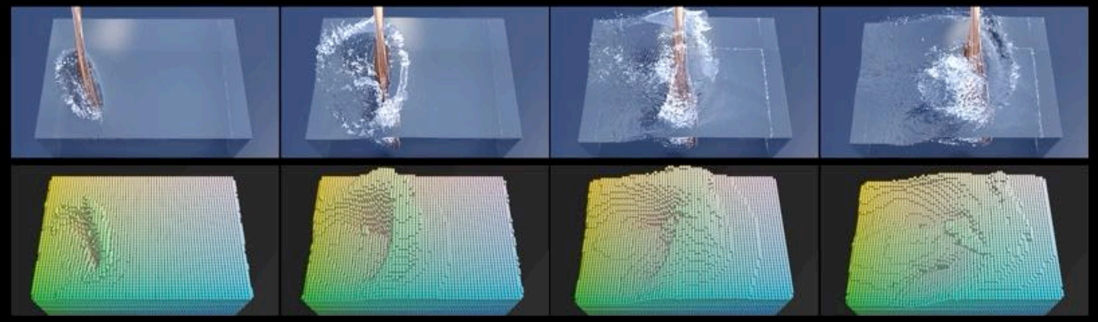
ACM SIGGRAPH 2023

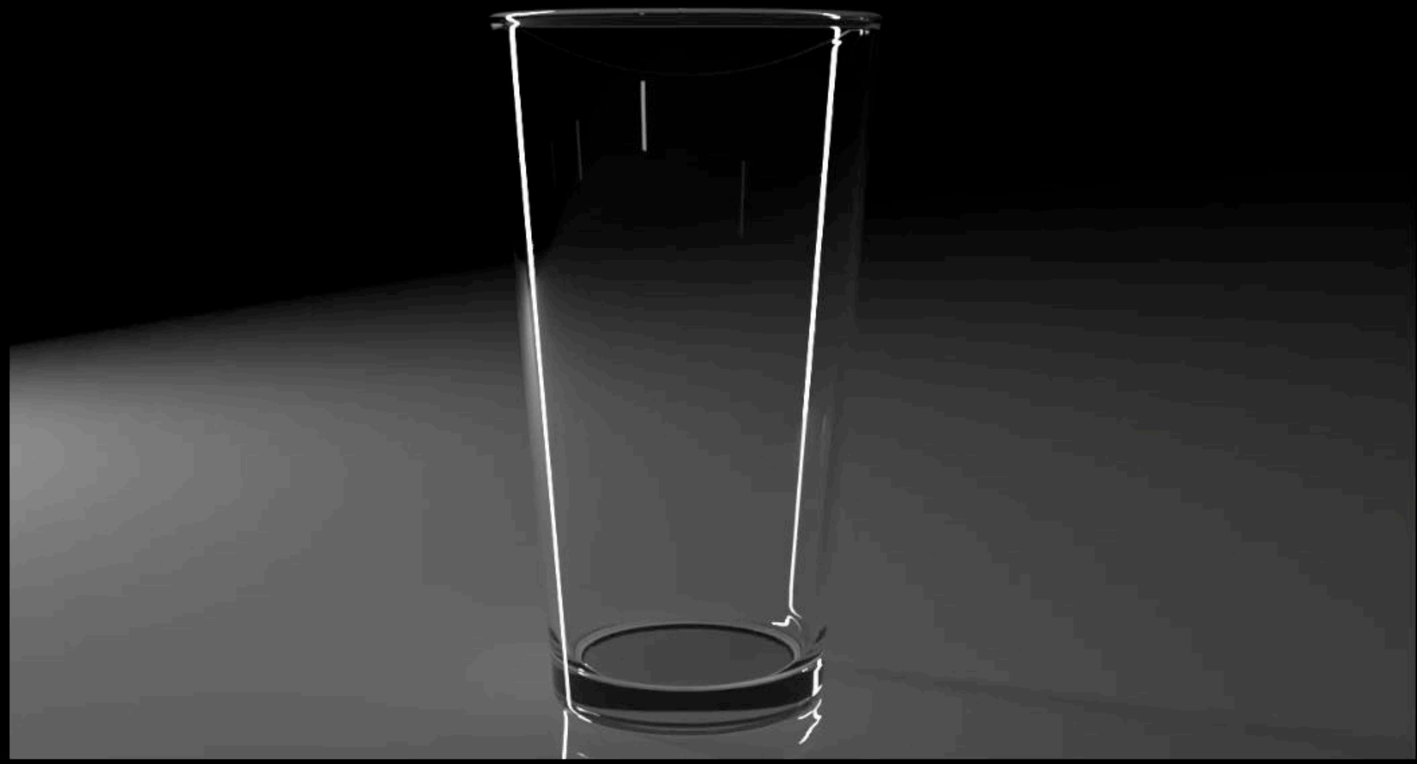
A framework for automatically synthesizing bubble-based water sounds for fluid animations.

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.

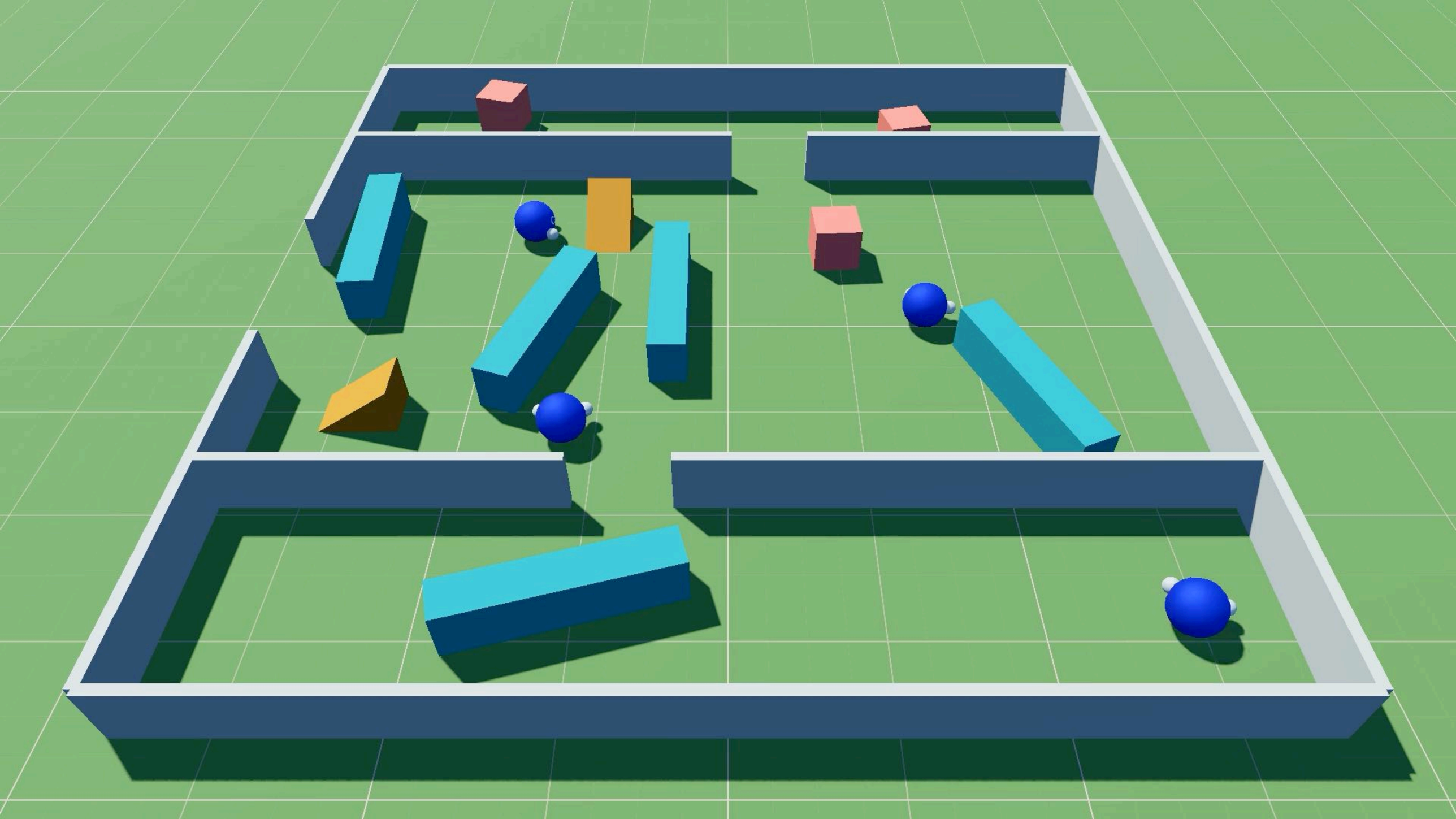


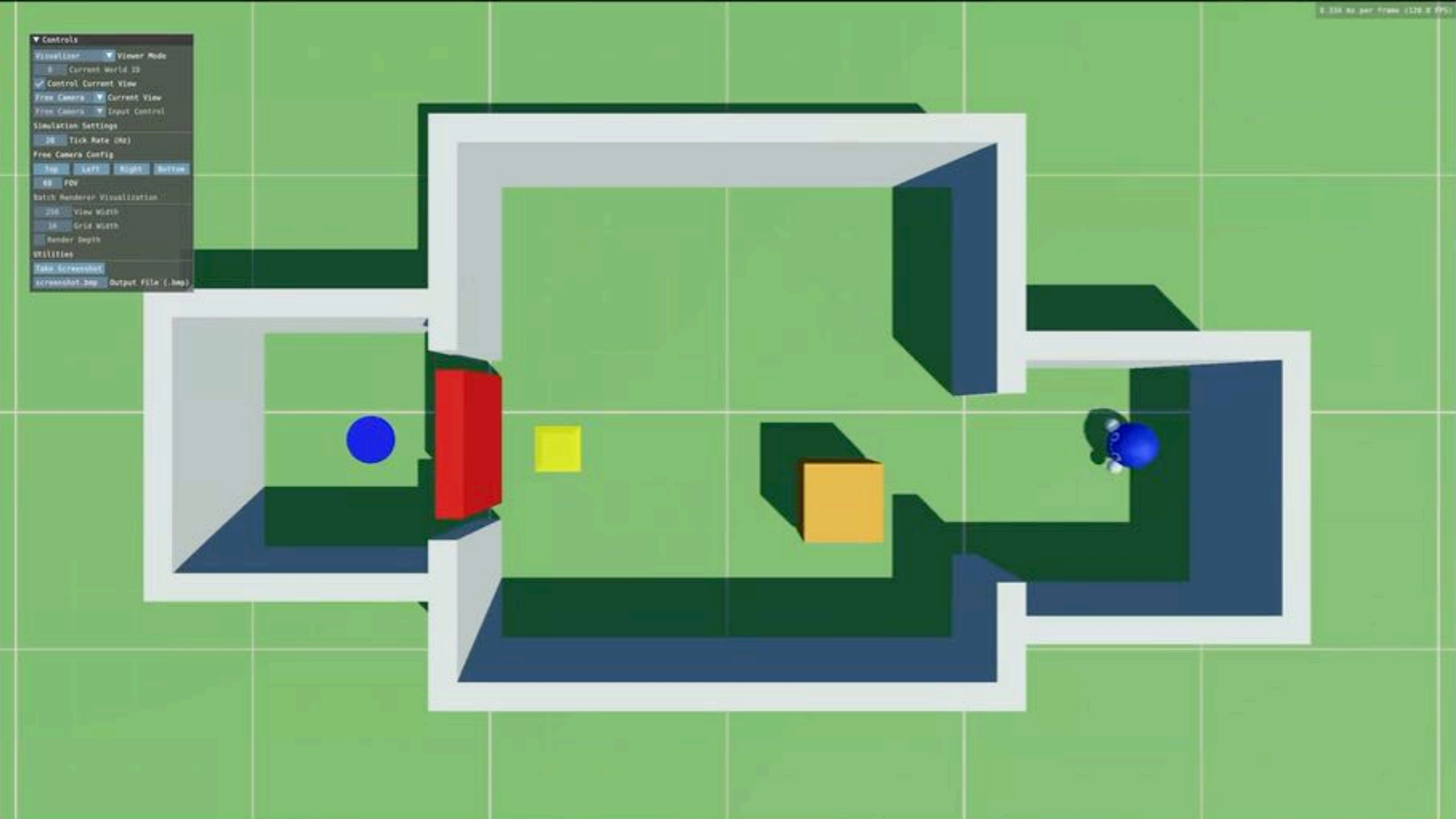


(The following sounds were generated by our method)

Jiajun Wu

Kayvon Fatahalian (me)



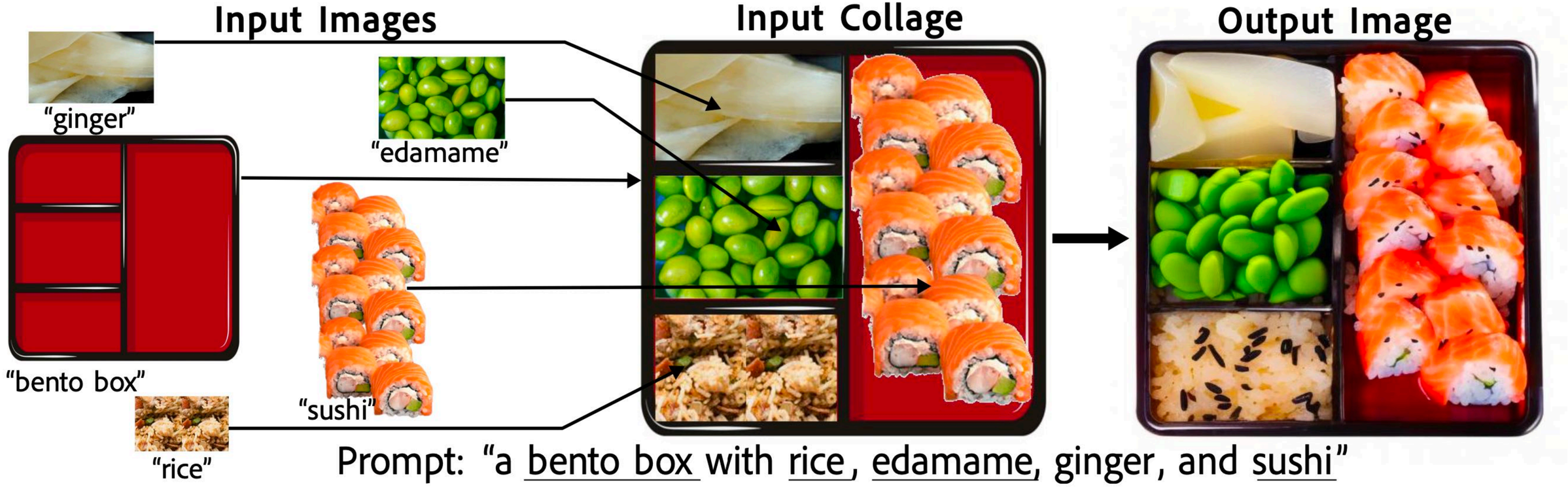

Controls
Visualizer
Viewer Mode
0
Current World ID
Control Current View
Free Camera
Current View
Free Camera
Input Control
Simulation Settings
20
Tick Rate (Hz)
Free Camera Config
Top
Left
Right
Bottom
60
FOV
Batch Renderer Visualization
256
View Width
10
Grid Width
Render Depth
Utilities
Take Screenshot
screenshot.bmp
Output File (.bmp)

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



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.

Information here is provided with the permission of the ACM

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.

ACM Digital Library: ACM Transactions on Graphics (TOG) Volume 42, Issue 4 (July 2023) Proceedings of ACM SIGGRAPH 2023

ACM Digital Library (DOI) Link for the paper **Paper Abstract** **Author Preprint** **Paper Video**

Paper Presentation **Paper Images** **Paper Data** **Demo Program or Source Code** **Related Links**

Changelog

A Material World

A Sparse Non-parametric BRDF Model
Tanaboon Tongbuasirilai, Jonas Unger (Linkoping University), Christine Guillemot (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
Mengqi (Mandy) Xia (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 d'Eon, Benedikt Bitterli, Andrea Weidlich, 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
Junqiu 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!