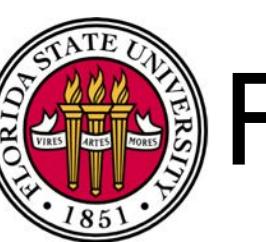


01 - Introduction

Acknowledgements: Daniele Panozzo

CAP 4730 - Computer Graphics - Spring 19 – Xifeng Gao



Florida State University

Staff

Lecturer

Xifeng Gao



Assistant

Arthur Xenophon Karapateas



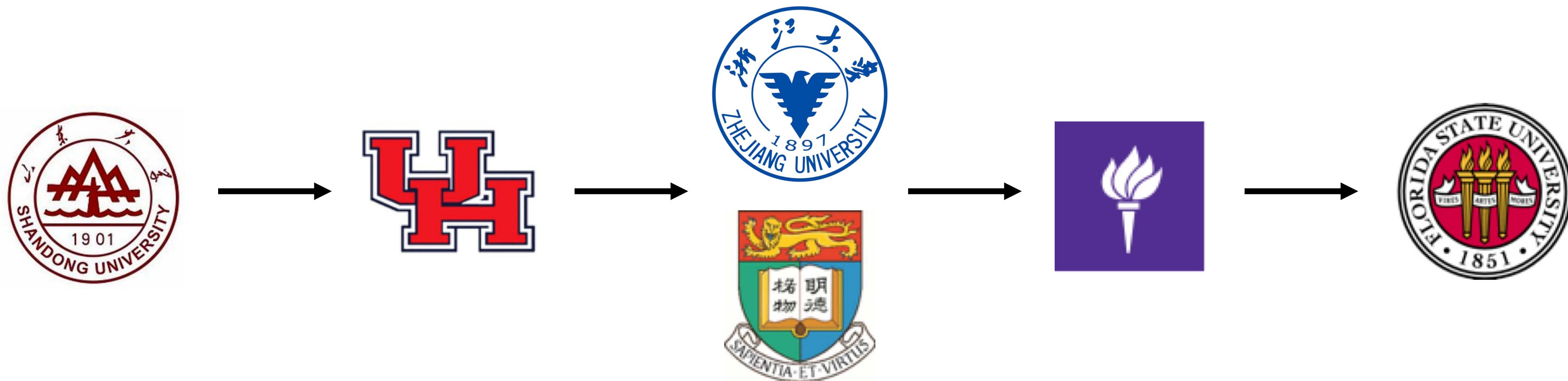
<https://gaoxifeng.github.io/>
gao@cs.fsu.edu

axk13@my.fsu.edu



Florida State University

Who Am I?



Florida State University

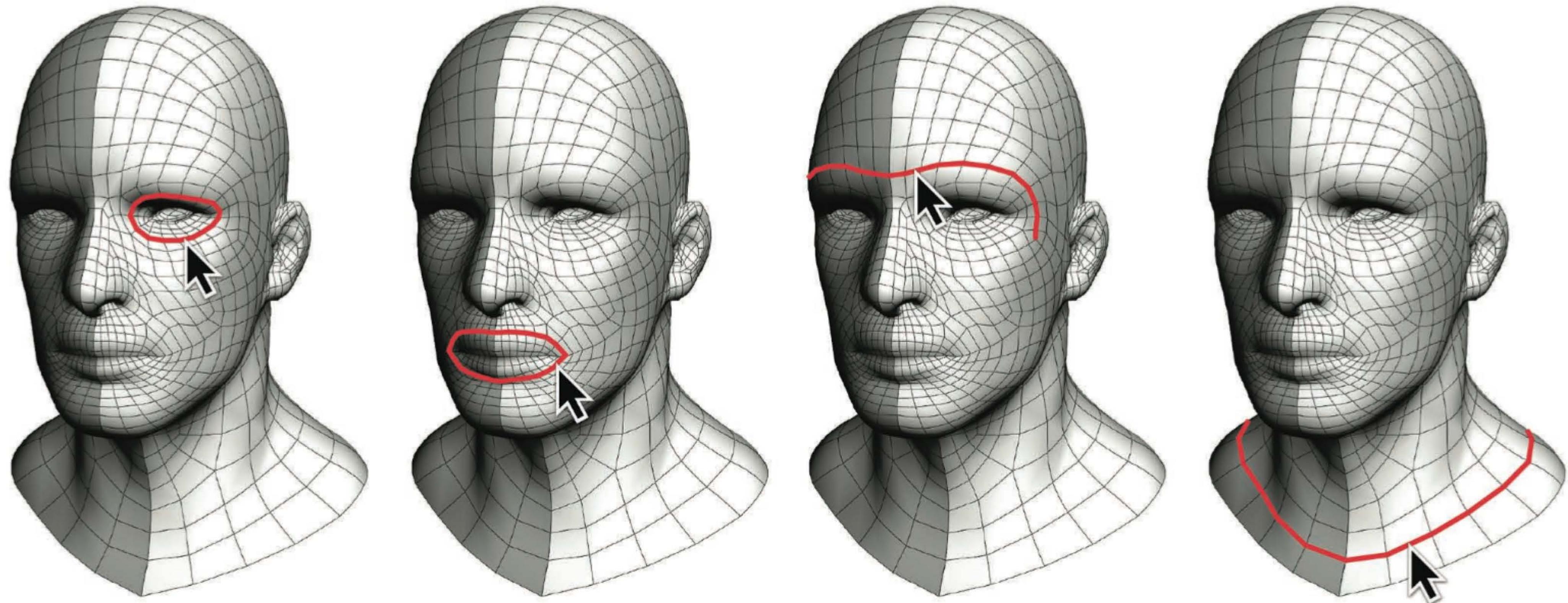
What is Computer Graphics?

- In a broad sense is the use of a computer to create and manipulate images and shapes
 - It involves a combination of hardware (input, processing, output) and software
 - It can be 2D or 3D
 - It is used in most electronic devices



Florida State University

Graphic Areas



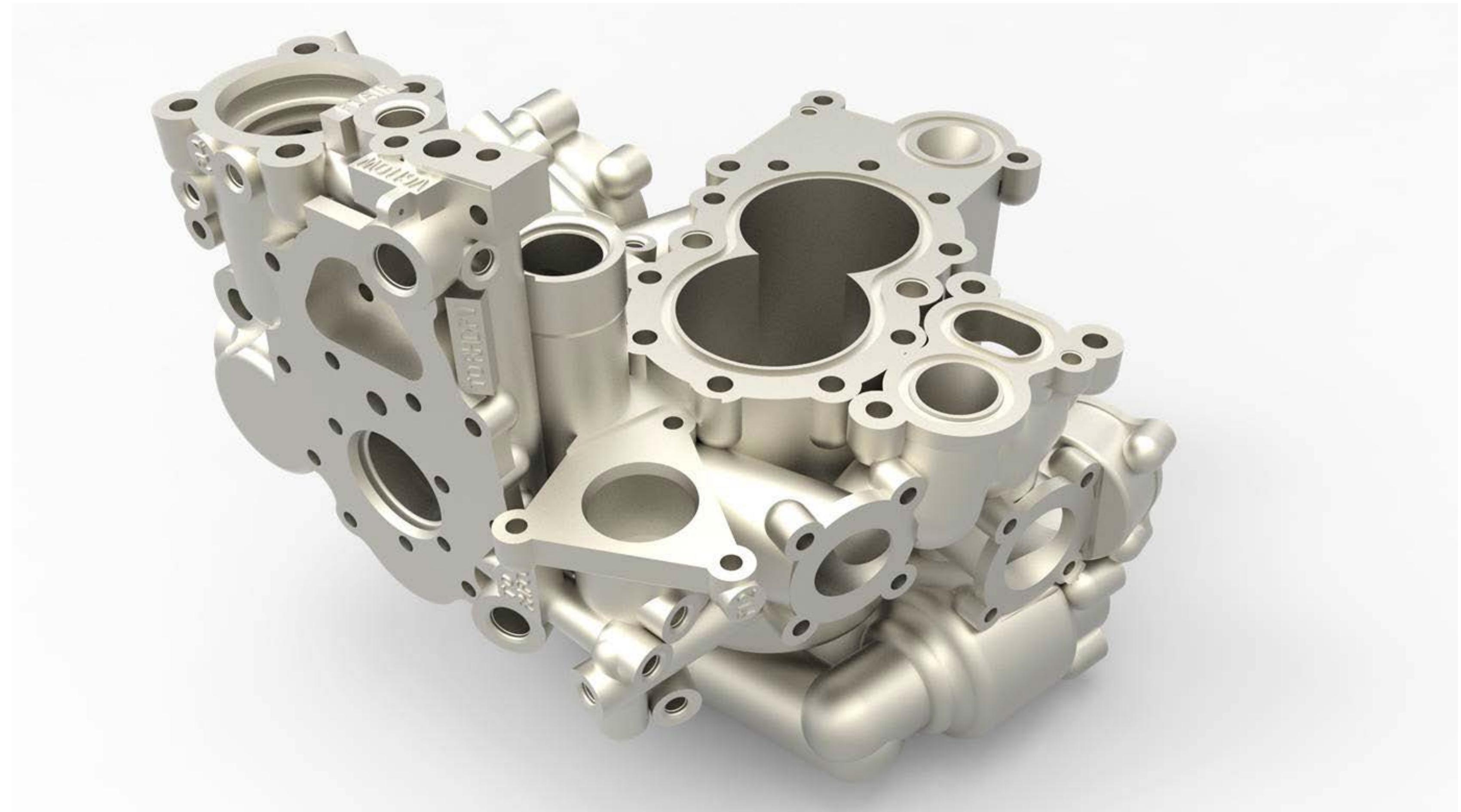
Modeling

<https://www.youtube.com/watch?v=Udno6EA5IXY>



Florida State University

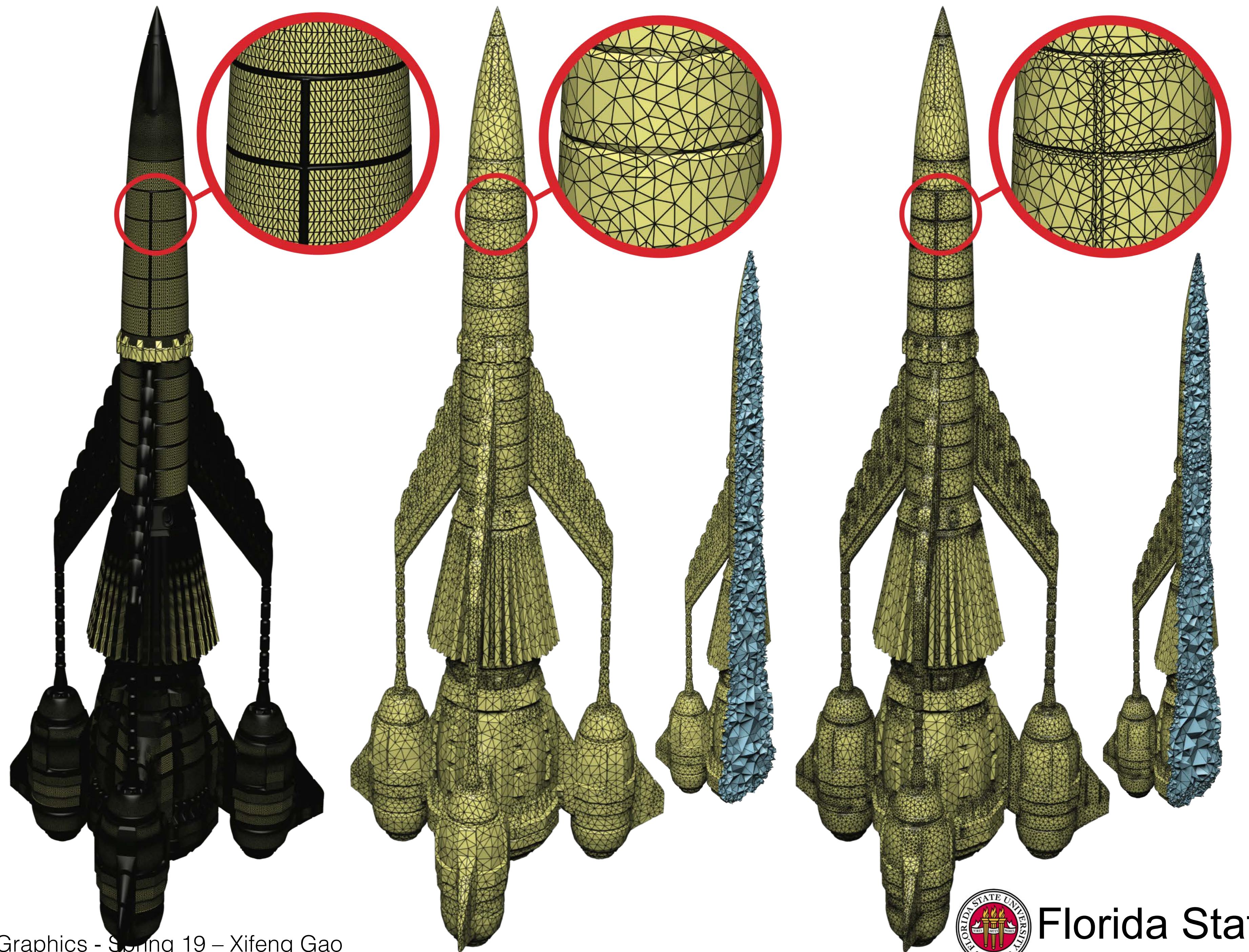
Modeling



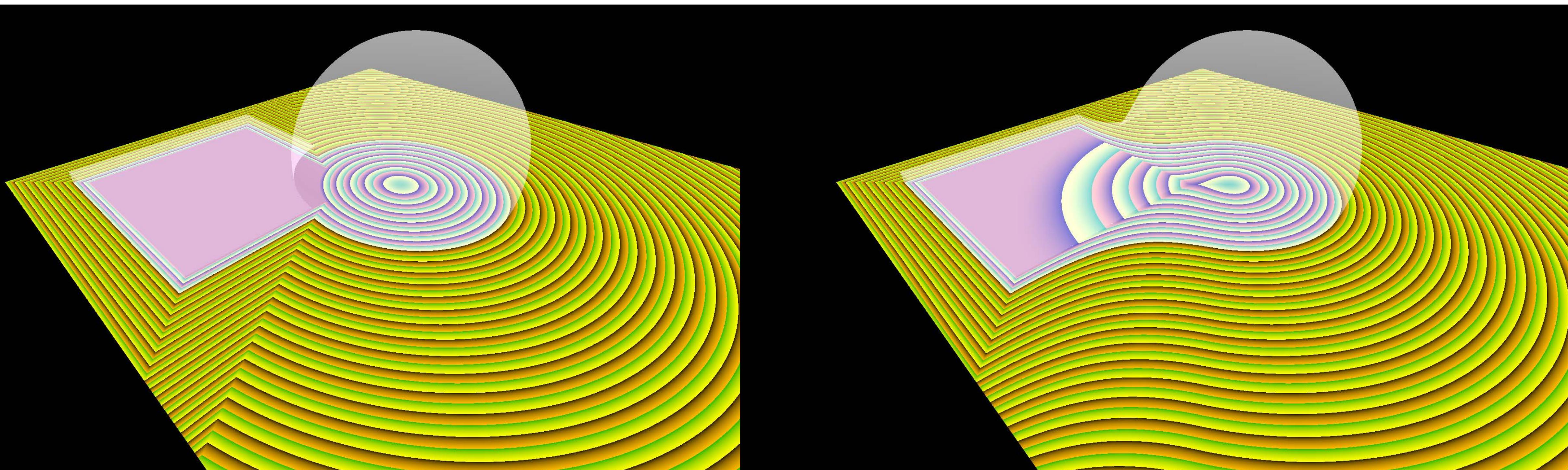
Delcam Plc. [CC BY-SA 3.0 (<http://creativecommons.org/licenses/by-sa/3.0>) or GFDL (<http://www.gnu.org/copyleft/fdl.html>)], via Wikimedia Commons



Florida State University



Modeling With Implicit functions



Alex Evans at SIGGRAPH 2015

https://www.mediamolecule.com/blog/article/siggraph_2015



Graphic Areas



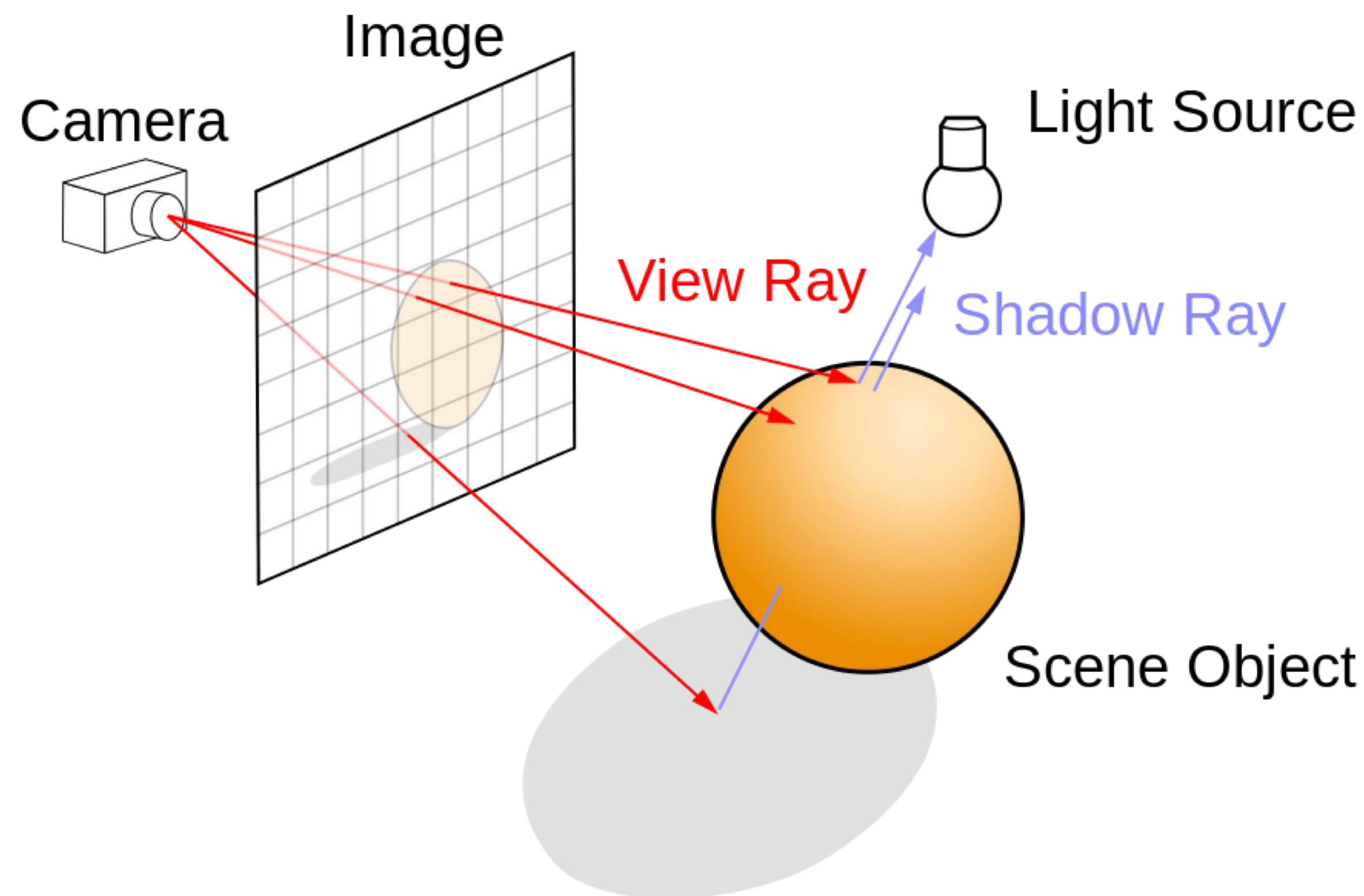
Rendering



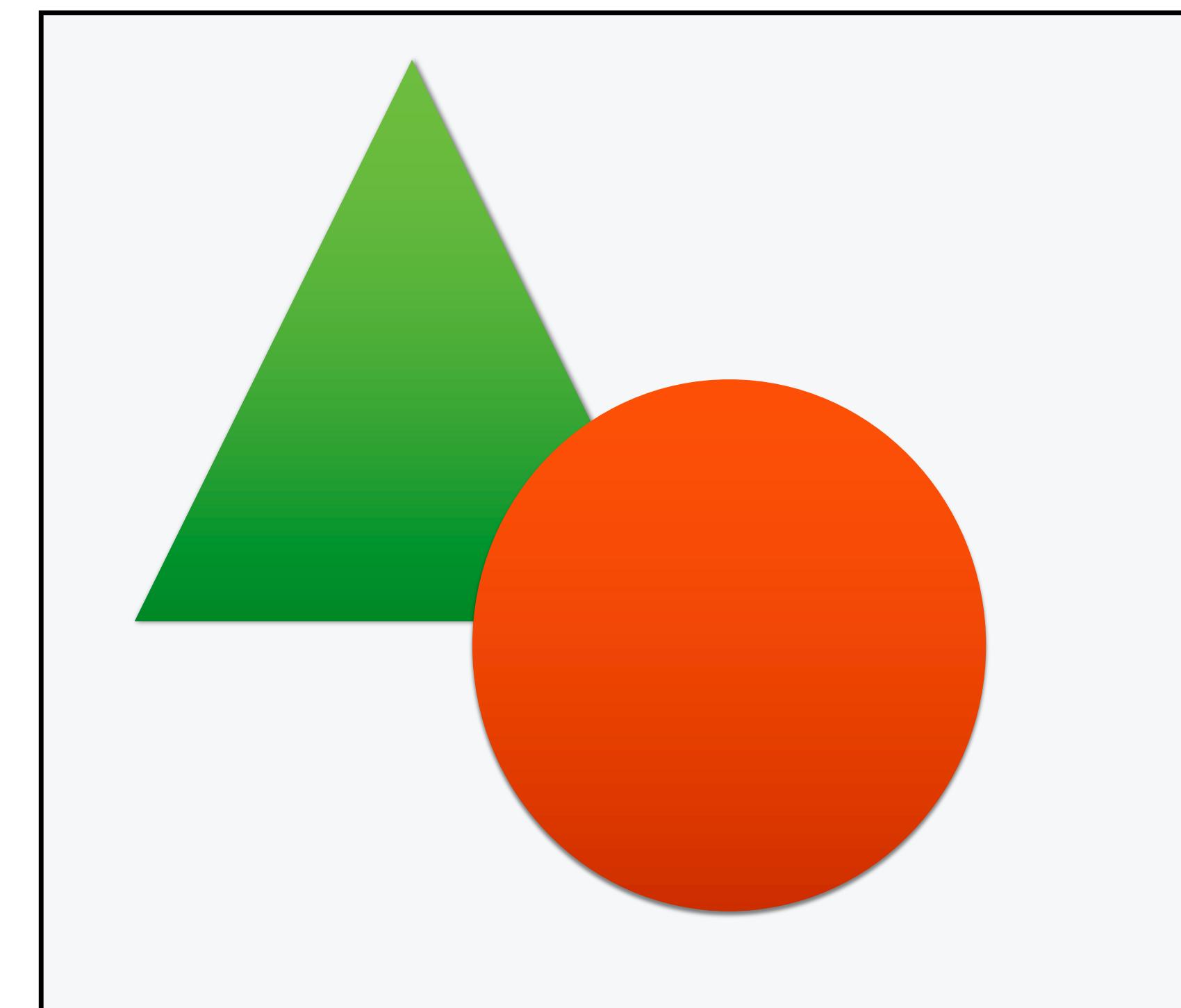
Florida State University

Two major approaches

Per-pixel - “Raytracing”

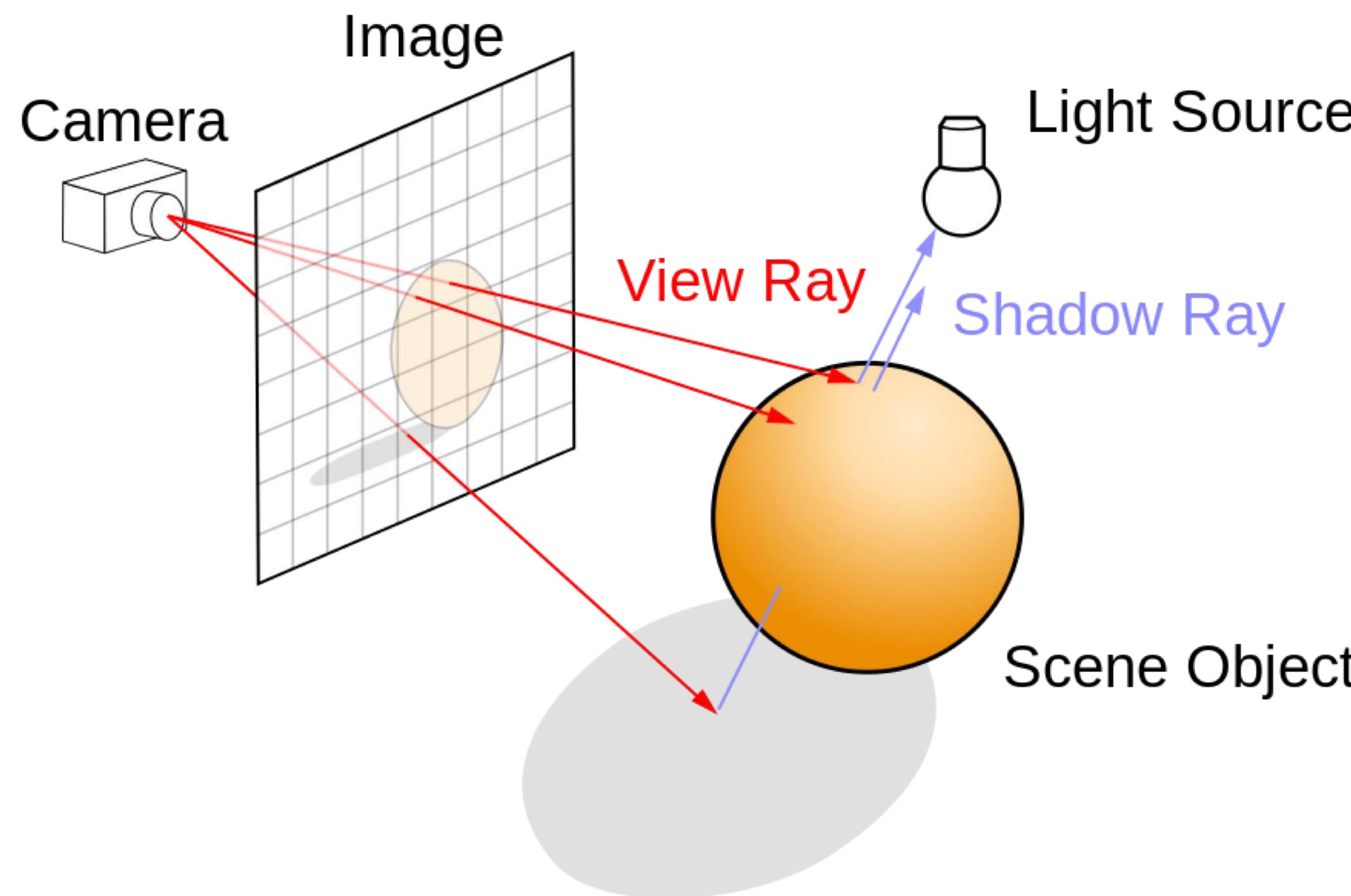


Per-object - “Rasterization”



By Henrik - Own work, GFDL, <https://commons.wikimedia.org/w/index.php?curid=3869326>

Per-pixel



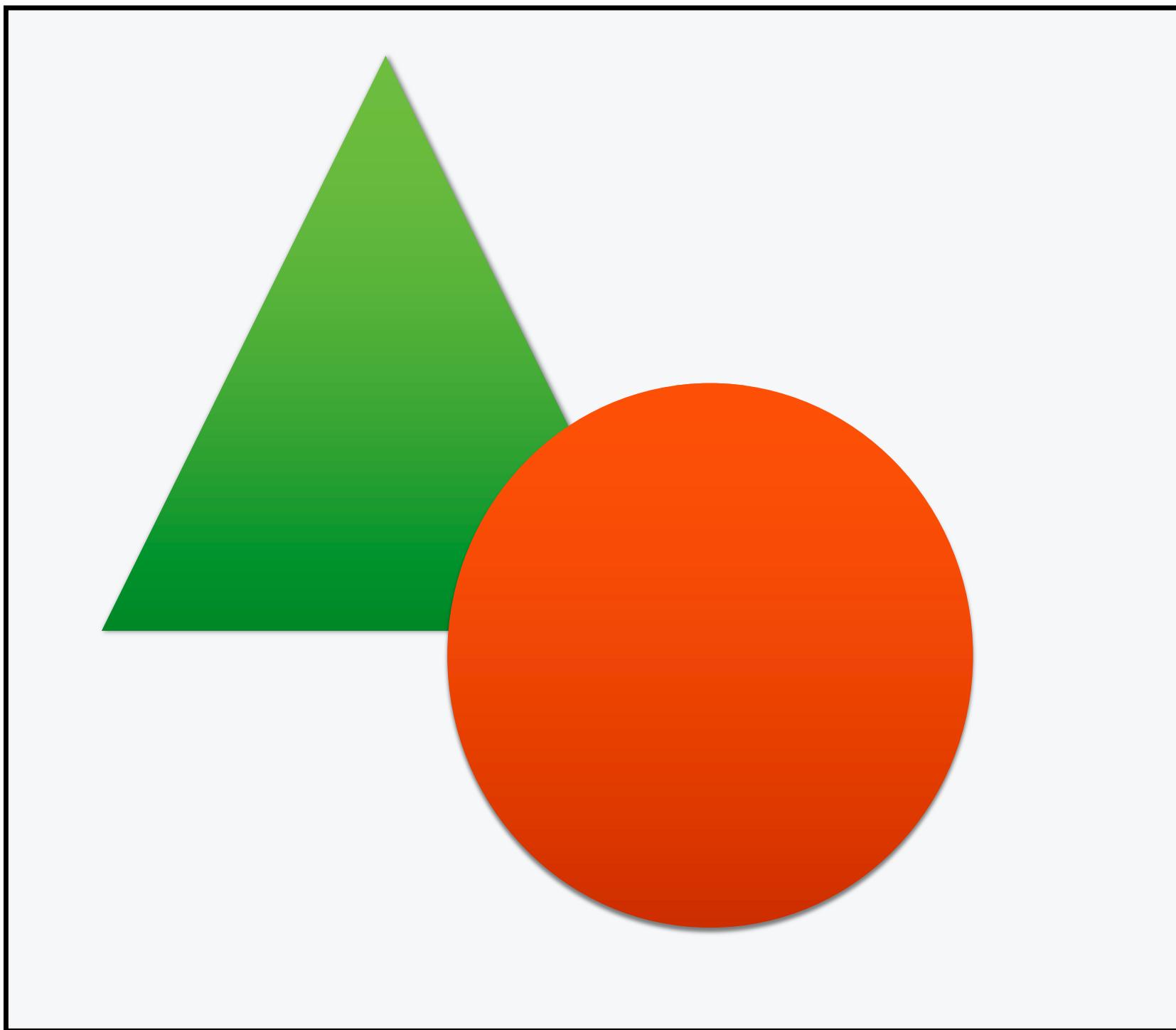
- Easy to parallelize but hard to map to hardware
- Expensive!
- It can be extended to model many physical phenomena such as internal scattering, diffraction, reflections, etc.
- Used to obtain high quality images

By Henrik - Own work, GFDL, <https://commons.wikimedia.org/w/index.php?curid=3869326>



Florida State University

Per-object

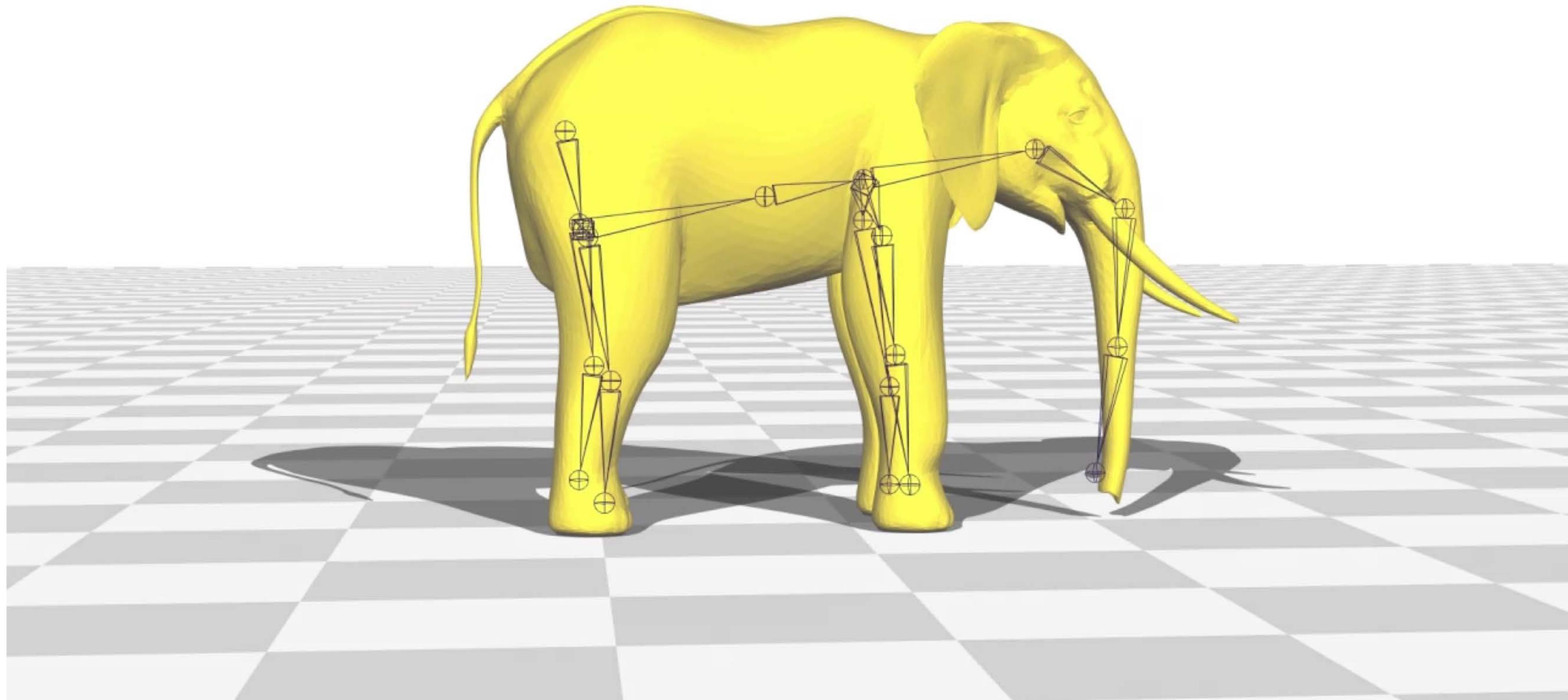


- Easy to map to hardware
- While it cannot model directly complex effects, we can approximate them
- Used in interactive applications (mostly)



Florida State University

Graphic Areas

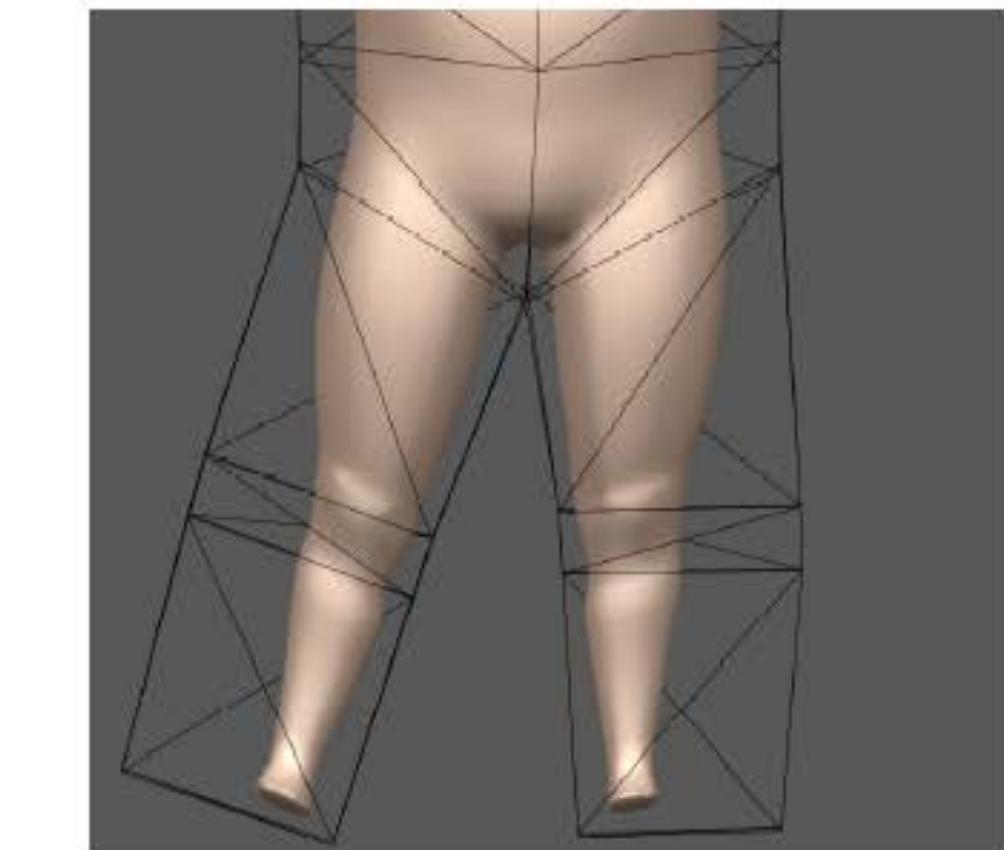
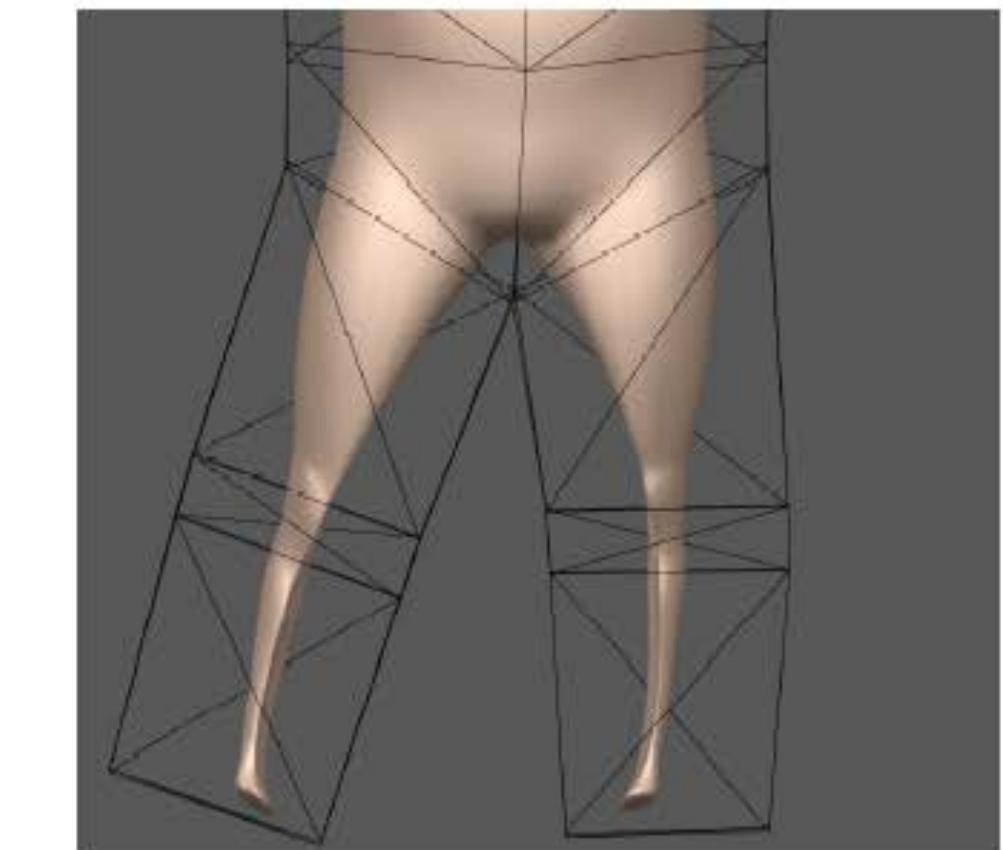
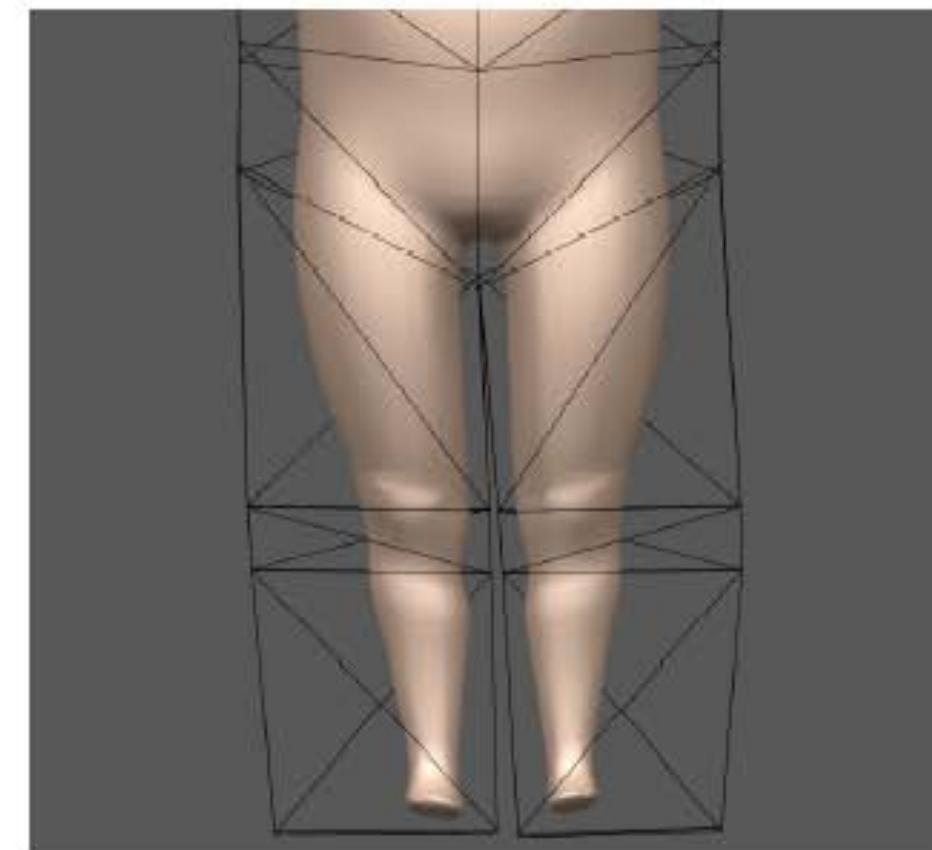
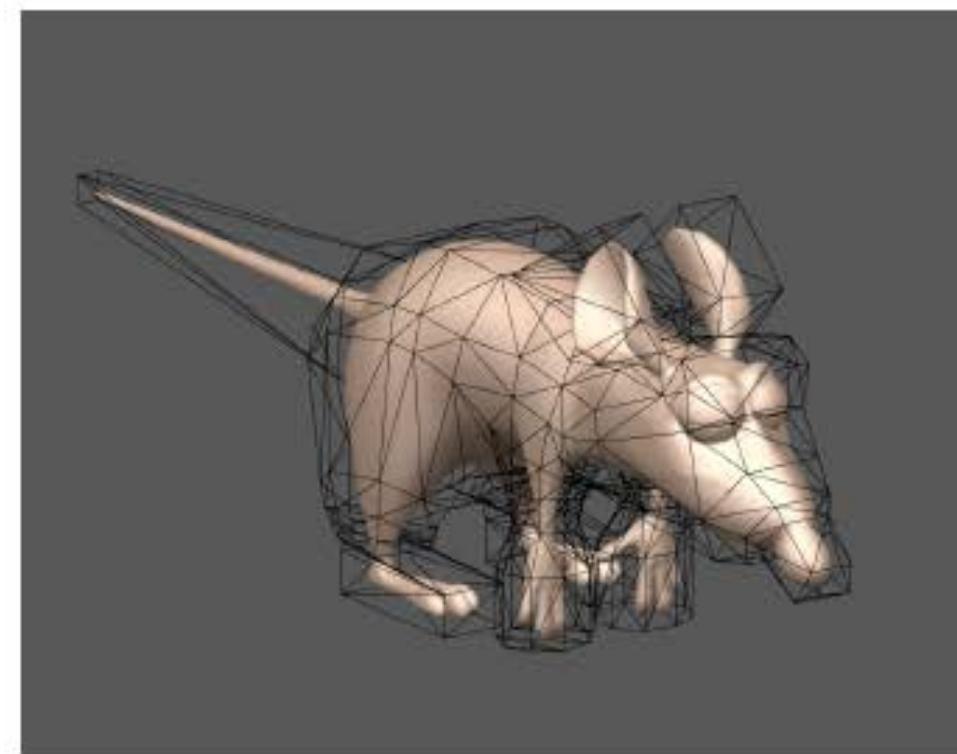


Animation



Florida State University

Animation



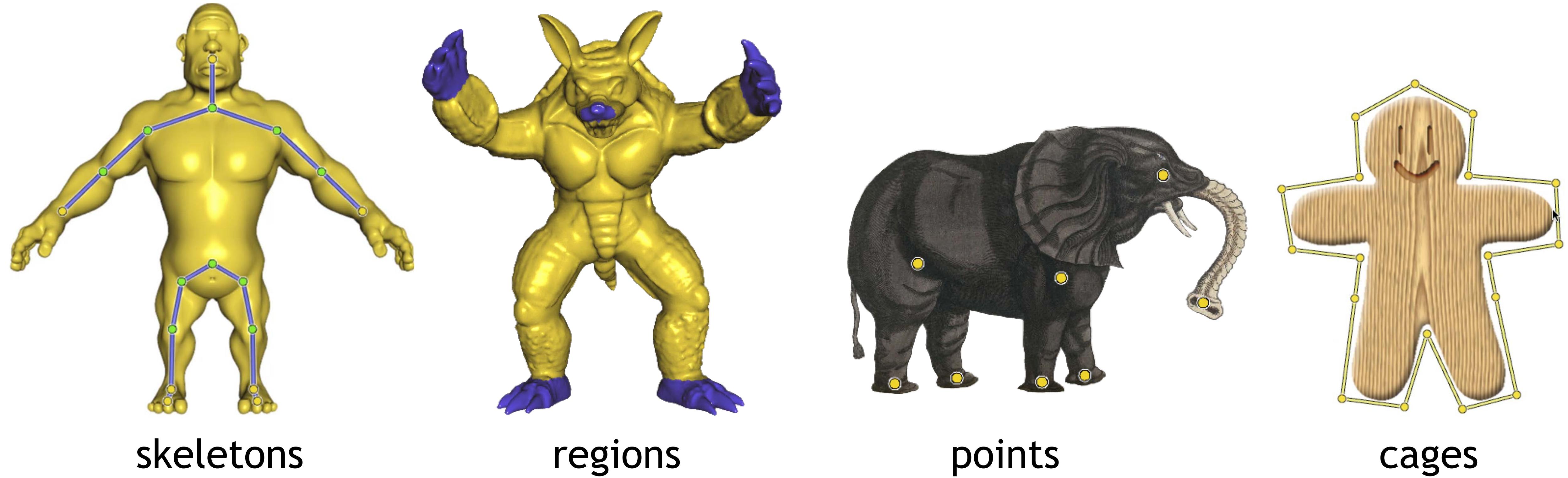
MVC

HC



Florida State University

different handle types



Graphic Areas



Copyright: Andrew Guyton

User Interaction



Florida State University

Graphic Areas



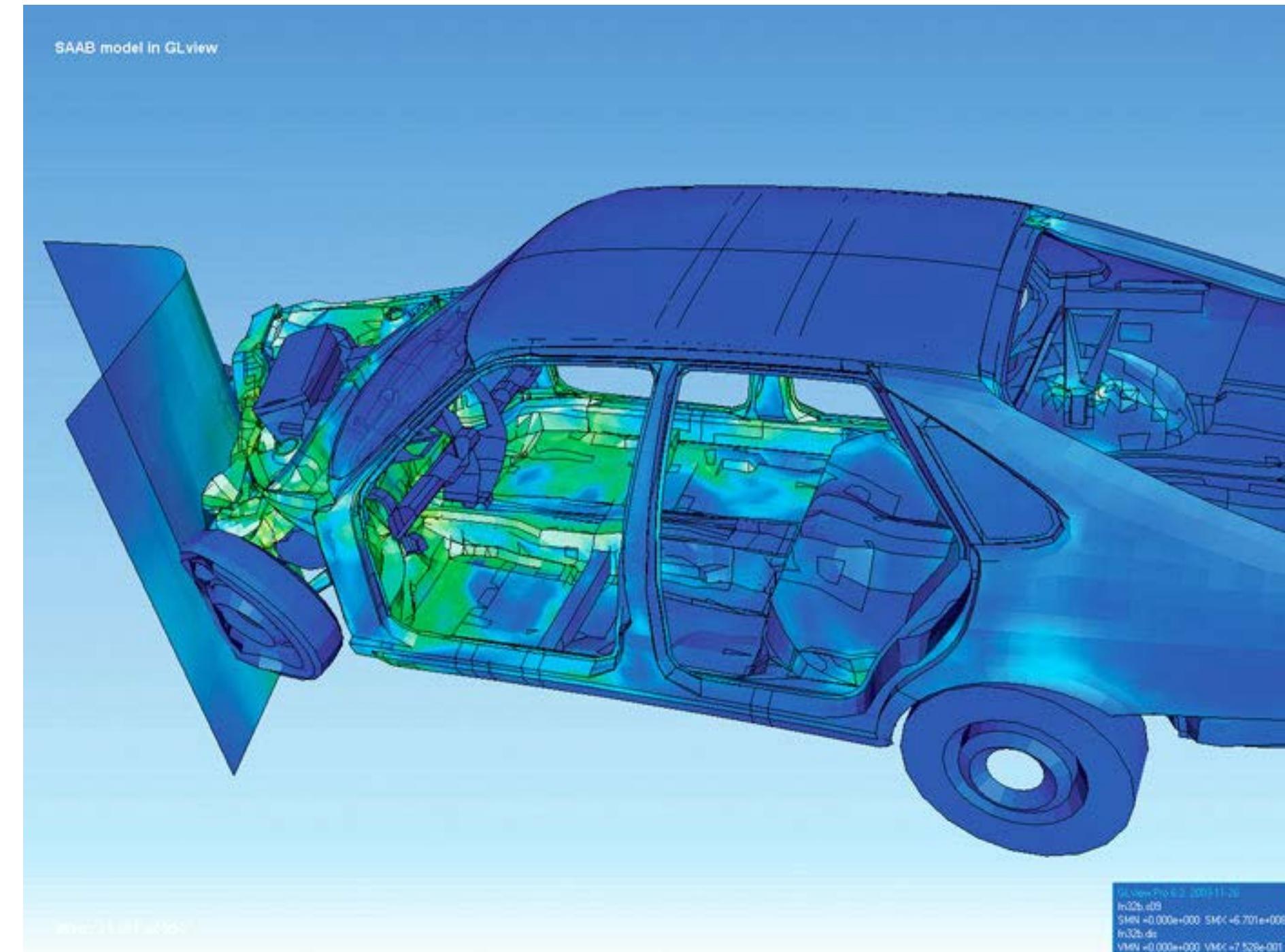
Copyright: Maurizio Pesce

Virtual Reality



Florida State University

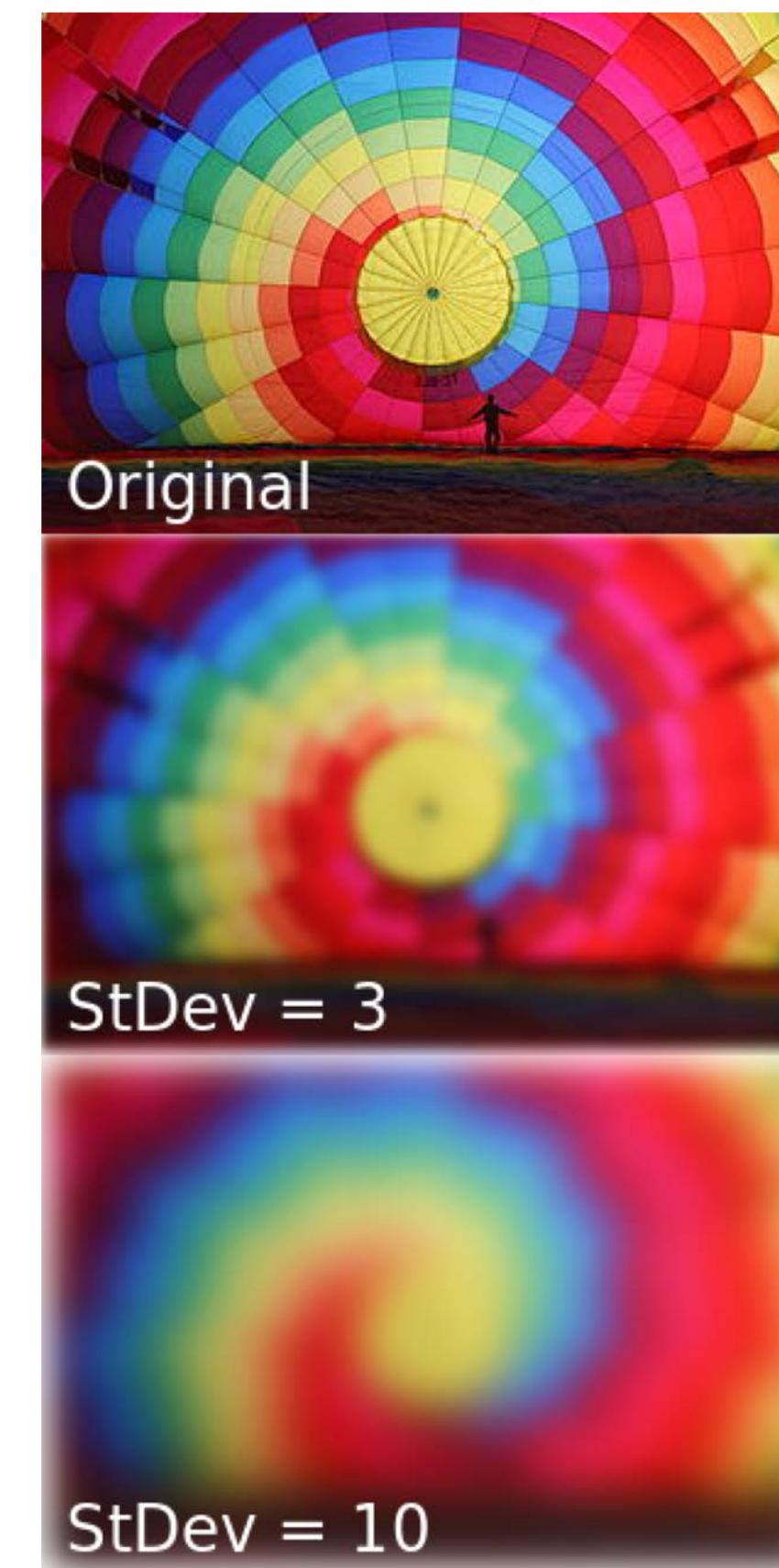
Graphic Areas



Visualization



Graphic Areas



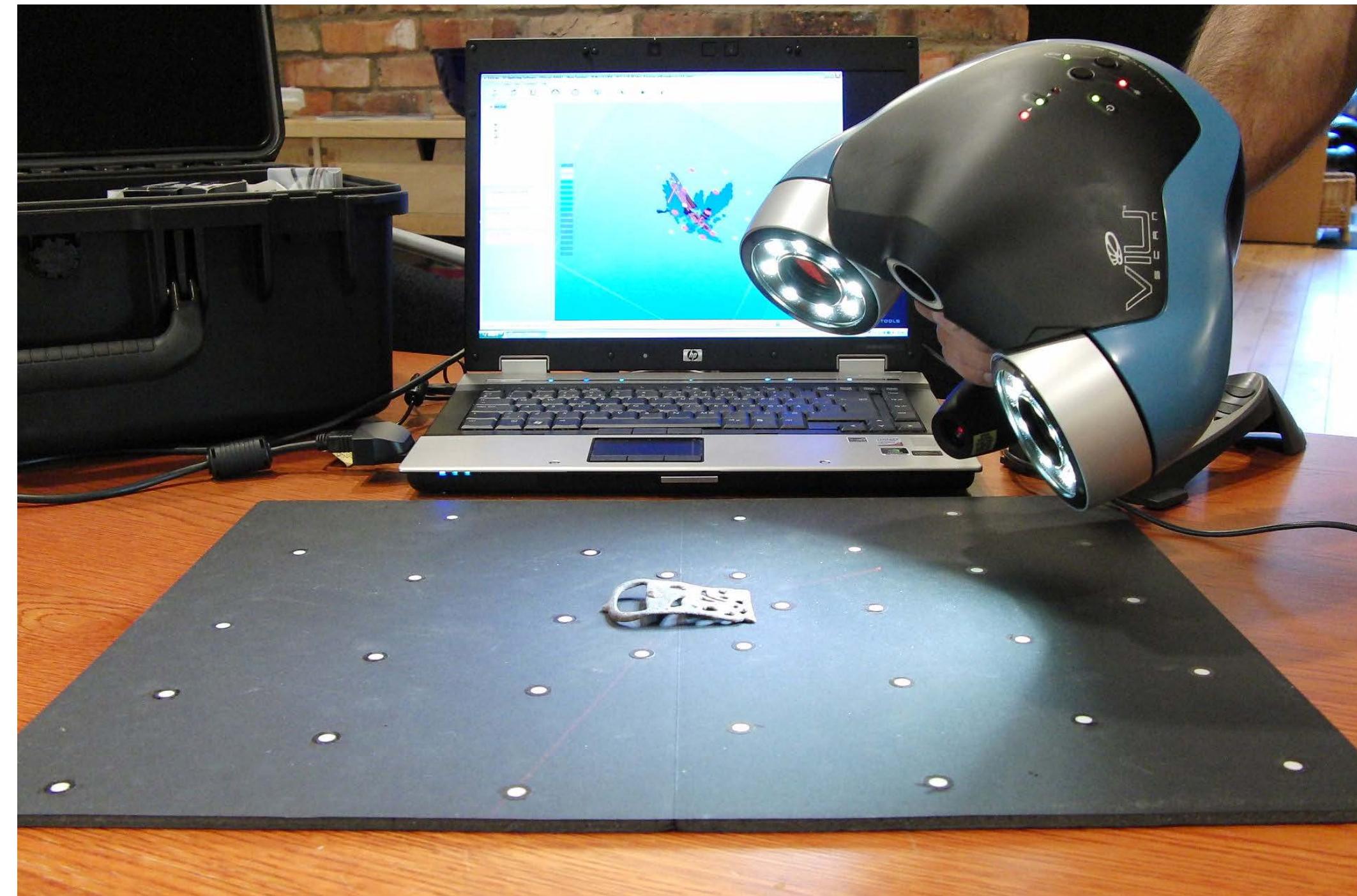
By IkamusumeFan - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=41790217>

Image Processing



Florida State University

Graphic Areas



By Creative Tools from Halmstad, Sweden - CreativeTools.se - VIUscan - Laser-scanned - ZPrinter - 3D printed -
Viking Belt Buckle 24, CC BY 2.0, <https://commons.wikimedia.org/w/index.php?curid=12419129>

<http://www.agisoft.com>

Geometry Acquisition



Florida State University

Applications

Video Games



Copyright: Nintendo

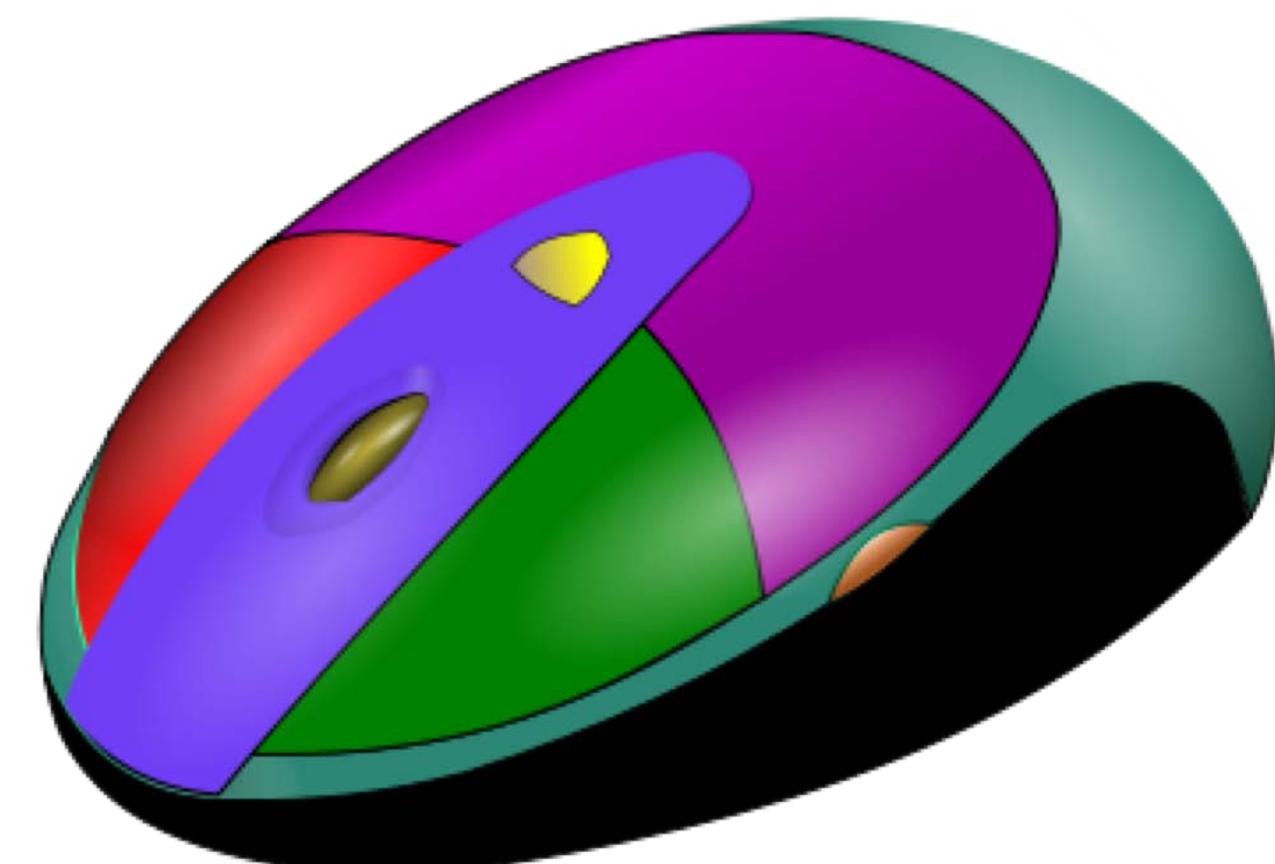
Cartoons/Visual Effects/Films



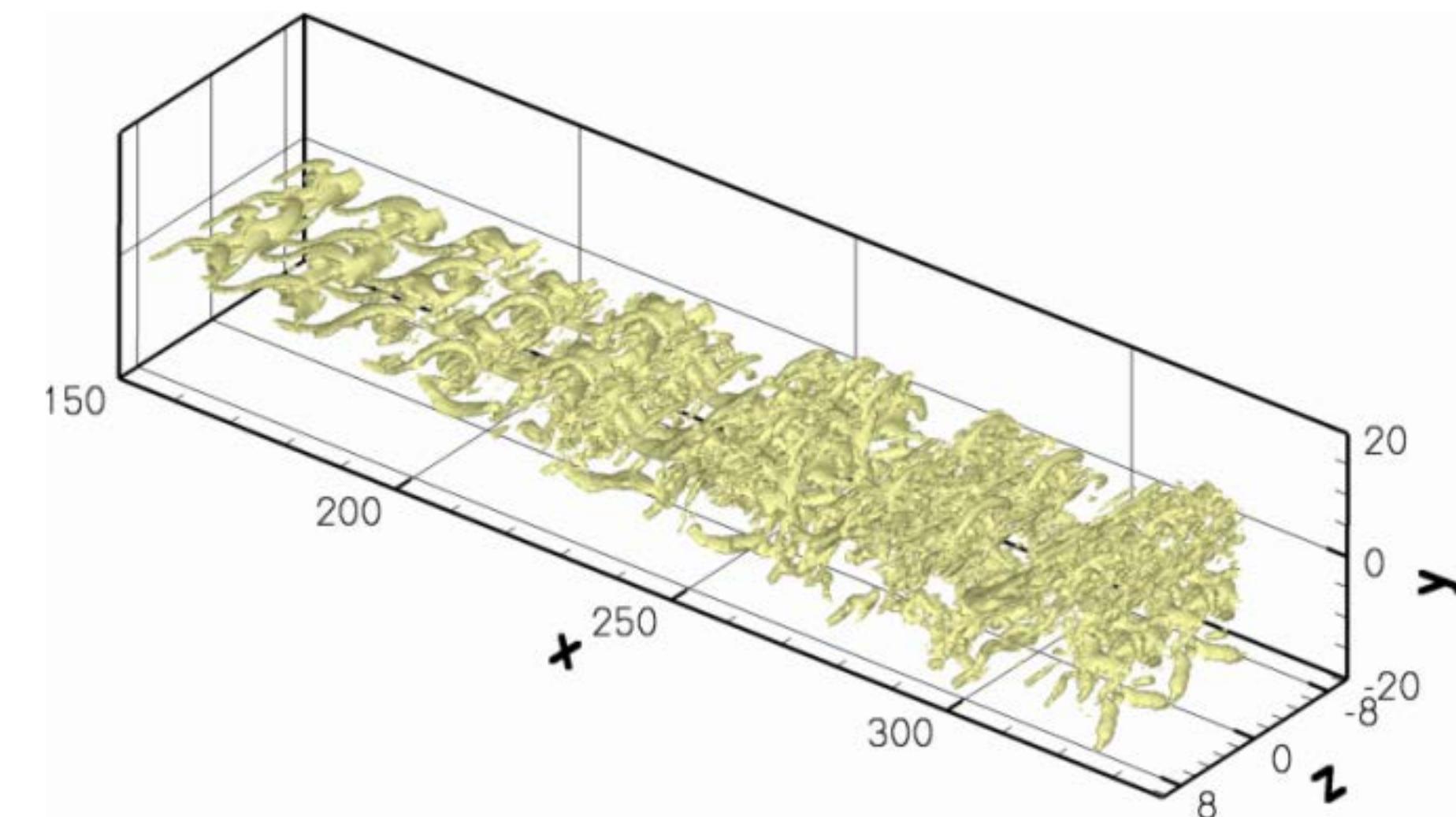
Copyright: Blender Foundation

Applications

CAD/CAM



Simulation



By Andreas Babucke - self made with EAS3, original upload at
http://de.wikipedia.org/wiki/Bild:Lambda2_scherschicht.png, CC BY 3.0 de,
<https://commons.wikimedia.org/w/index.php?curid=2999003>



Florida State University

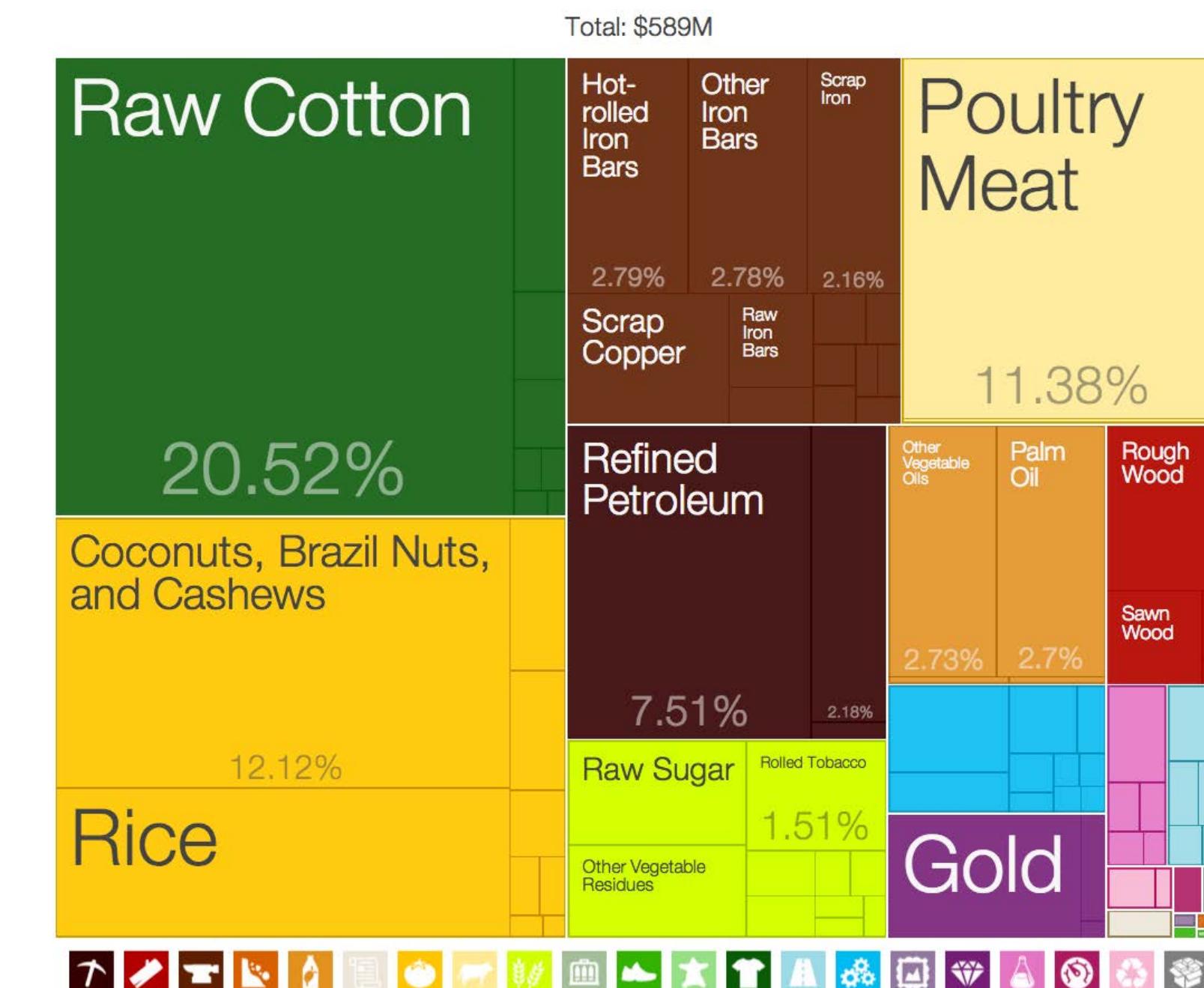
Applications

Medical Imaging



By Etan J. Tal - Own work, CC BY 3.0,
<https://commons.wikimedia.org/w/index.php?curid=12743250>

Visualization



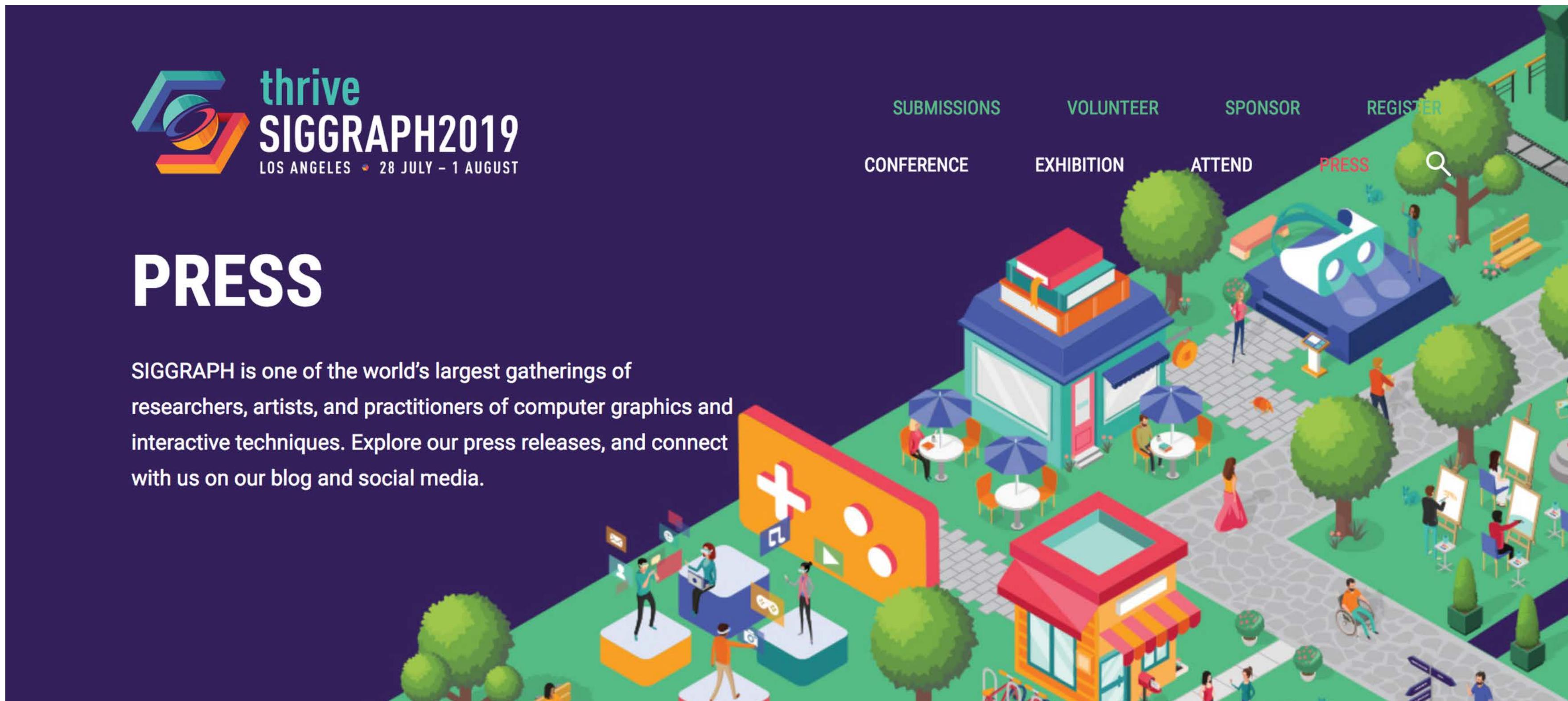
By Mcstol - Own work, CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=18553353>



Florida State University

SIGGRAPH

ACM's Special Interest Group on Computer Graphics and Interactive Techniques



The graphic features the SIGGRAPH 2019 logo at the top left, which includes the word "thrive" in a teal sans-serif font above "SIGGRAPH2019" in a larger white font, with "LOS ANGELES" and "28 JULY - 1 AUGUST" below it. To the right of the logo is a navigation bar with links: SUBMISSIONS, VOLUNTEER, SPONSOR, and REGISTER (in teal); CONFERENCE, EXHIBITION, ATTEND, and PRESS (in white); and a magnifying glass icon. The main area is a colorful isometric illustration of a city street with buildings, trees, people, and a large VR headset on a pedestal.

PRESS

SIGGRAPH is one of the world's largest gatherings of researchers, artists, and practitioners of computer graphics and interactive techniques. Explore our press releases, and connect with us on our blog and social media.



SIGGRAPH

ACM's Special Interest Group on Computer Graphics and Interactive Techniques

Experience PROGRAMS

SIGGRAPH 2019 will immerse you in an array of educational and hands-on opportunities, and open the door to breakthrough technologies that will keep you on your game.

The grid contains 20 items, each with an icon and a label:

- ADAPTIVE TECHNOLOGY
- ART GALLERY
- ART PAPERS
- BIRDS OF A FEATHER
- BUSINESS SYMPOSIUM
- COMPUTER ANIMATION FESTIVAL
- COURSES
- CREATIVE DEVELOPMENT
- EDUCATOR'S FORUM
- COMPUTER ANIMATION FESTIVAL ELECTRONIC THEATER
- EMERGING TECHNOLOGIES
- GAMES
- INTERNATIONAL CENTER
- PANELS
- POSTERS
- COMPUTER ANIMATION FESTIVAL PRODUCTION SESSIONS
- REAL-TIME LIVE!
- ACM SIGGRAPH FRONTIERS TALKS
- STUDENT VOLUNTEERS
- STUDIO
- TALKS
- TECHNICAL PAPERS
- VIRTUAL, AUGMENTED AND MIXED REALITY
- COMPUTER ANIMATION FESTIVAL VR THEATER



Florida State University

Course Goals

- Study the fundamental mathematical concepts used in image and geometry synthesis algorithms
- Implement a basic rendering system based on ray tracing
- Implement two interactive applications based on object-order rendering (rasterization), one in 2D and one in 3D
- Apply these techniques in a final coding project



Florida State University

Final Coding Project

- Individual project, I will publish the rules later but you are essentially free to do whatever you want, as long as it requires computer graphics
- The project will be presented in a fast-forward session at the end of semester (3-5 minutes per project)



Florida State University

Prerequisites

- Linear Algebra
 - We will quickly review the concepts that you need, if you are not familiar with basis, points, vectors, matrices and linear systems, please review it on the textbook (Chapter 2, 5)
- C++
 - We will review the basic concepts of C++ next week, comparing them with Java. Keep this reference at hand <http://www.cppreference.com>
 - Why C++?
- Git
 - It will be used to distribute course materials and to deliver homework



Florida State University

Organization

- Communication through the course repository/website:
<https://github.com/FSU-ComputerGraphics/CAP4730-Spring19>
- Lectures: Tuesday/Thursday 9:30am – 10:45am, 103 Love Building
- Office hours:
 - Xifeng Gao: Tuesday 3pm – 5pm
 - Arthur Xenophon Karapateas: Wednesday 2pm – 4pm



Florida State University

Lectures

- I will upload the slides on the course website before the class, so that you can directly annotate them
- For every class, I will always add references in the end to the textbook and/or external resources
- At the end of every lecture, I will quickly introduce the topic of the next lecture and give you pointers — you are encouraged to take a look at the material **before** I present it in class



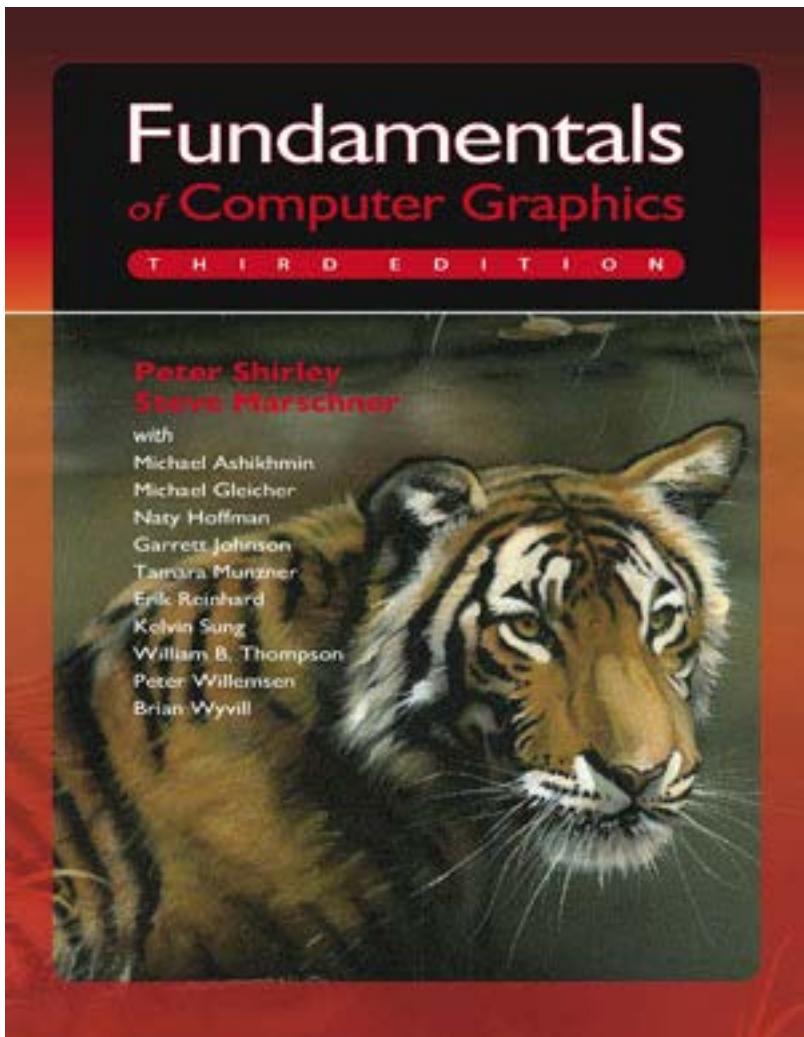
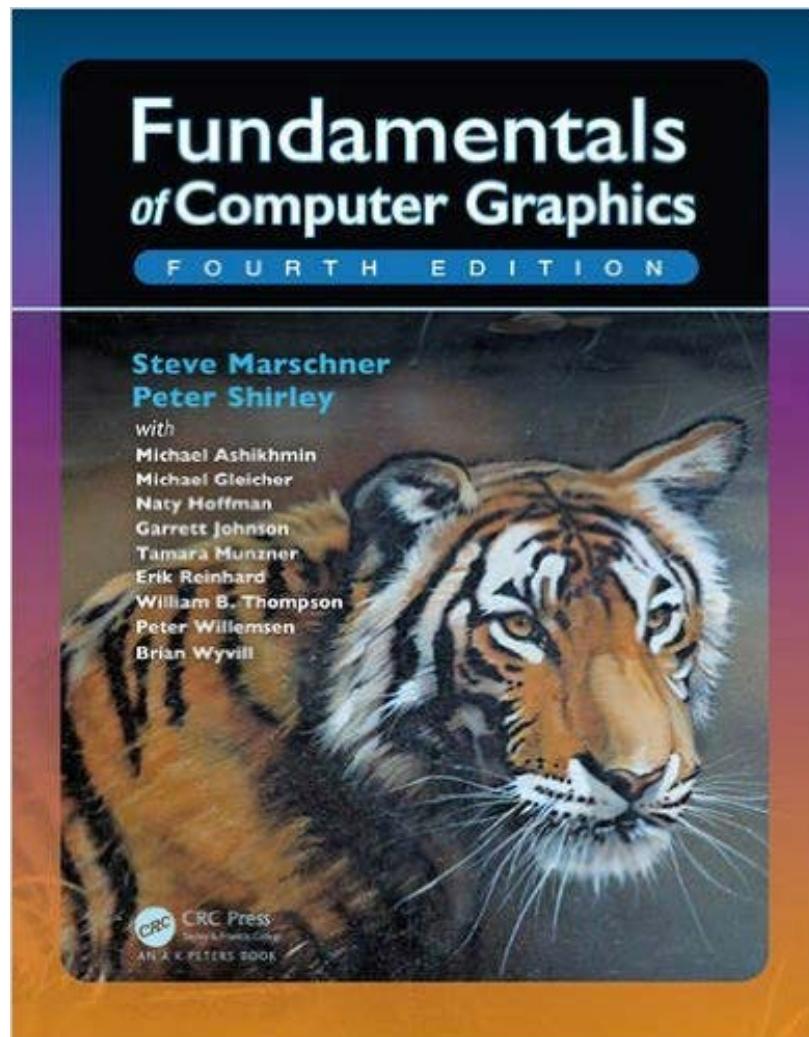
Florida State University

Lectures

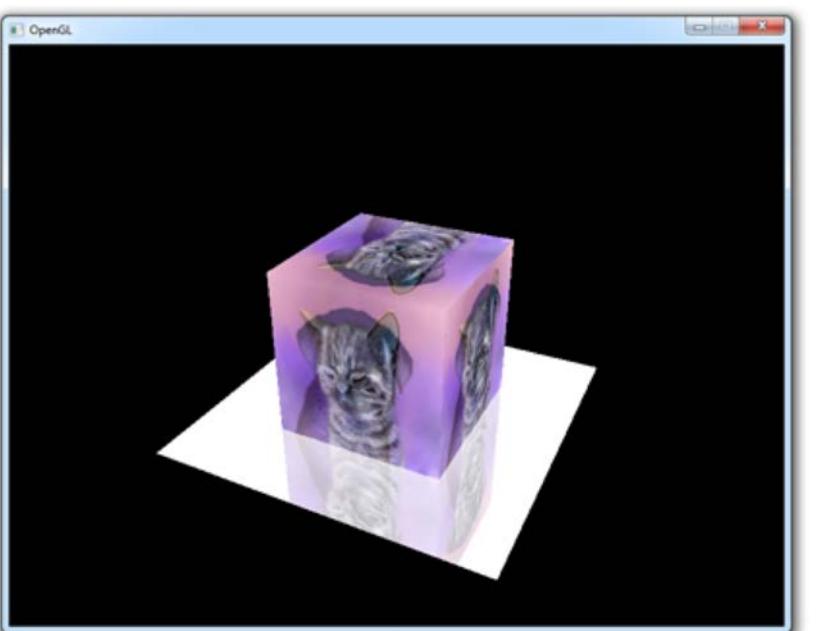
- Please interrupt me at any time to ask questions



Material



Fundamentals of Computer Graphics, Fourth Edition
4th Edition by [Steve Marschner, Peter Shirley](#)



<https://open.gl>



<https://www.wikipedia.org>



Florida State University

Grading

Assignment	Topic	Grade
1	Ray Tracing	20
2	Raster 2D	20
3	Raster 3D	20
4	Final Project	35

Total Exercises: 95%

- Attendance: 5 (randomly check)
- You **must** get at least 20 in the final project to pass the class
- There will be optional tasks, that will allow you to recover points lost in the assignments



Florida State University

Policy

- You are encouraged to consult with your classmates/friends but collaboration in the assignments is **NOT allowed**
- You are **not allowed** to copy code online or use external libraries (except those provided in the class) for the first 3 assignments
- We will use plagiarism tools to validate all homework
- I am horrible with names but I would still like to make an effort, please help me :)



Florida State University

References

Fundamentals of Computer Graphics, Fourth Edition
4th Edition by [Steve Marschner, Peter Shirley](#)

Chapters 1

