3DCG Illustrations [Week 12]

Non-Research Tips for Information Science Researchers

情報科学研究補助技法

Yuki Koyama | httsp://koyama.xyz/ | https://non-research-tips.github.io/

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- 2017:
  Ph.D. from **UTokyo** (Computer Science)
- 2017—Current:
  Researcher (Senior Researcher; 2022–) at **AIST (産業技術総合研究所)**
- 2021—Current:
  Technical Adviser at **Graphinica, Inc.** (an anime production company using 3DCG)
- 2022—Current:
  Part-Time Lecturer at **UTokyo** (Computer Graphics)

Motivation: Why 3DCG?

In general, good illustrations ...

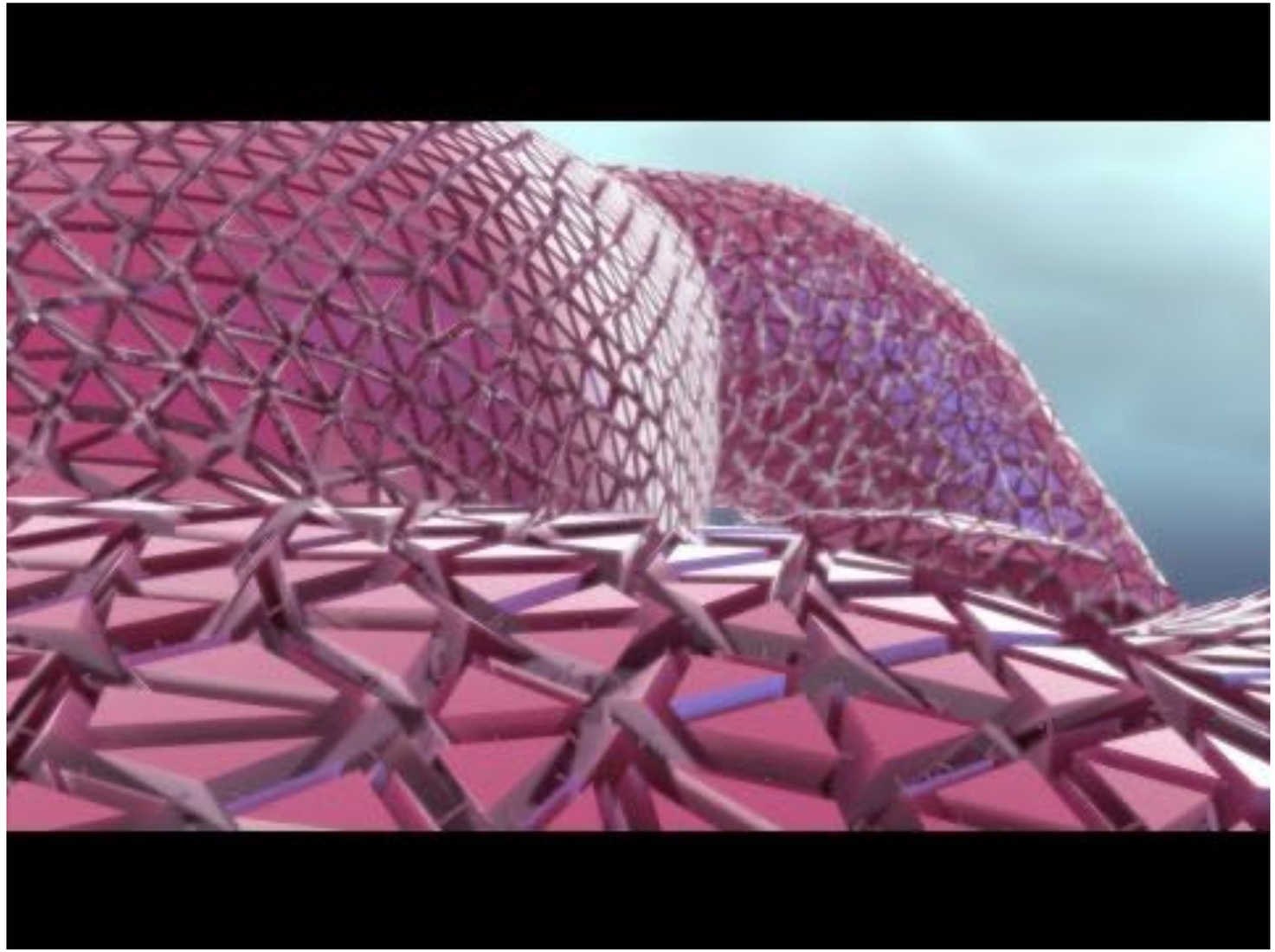
1. help audience better understand your research 💡 , and
2. increase presentation appeal 💖 (→ buzz).

3DCG is (sometimes) an effective technique for these purposes.

THE PREMIER CONFERENCE & EXHIBITION ON
COMPUTER GRAPHICS & INTERACTIVE TECHNIQUES

1. Better Understanding 💡

- Processed faster by the brain, **making it easier for audiences to grasp information**
- Provides visual representations that **make complex ideas and data more accessible**



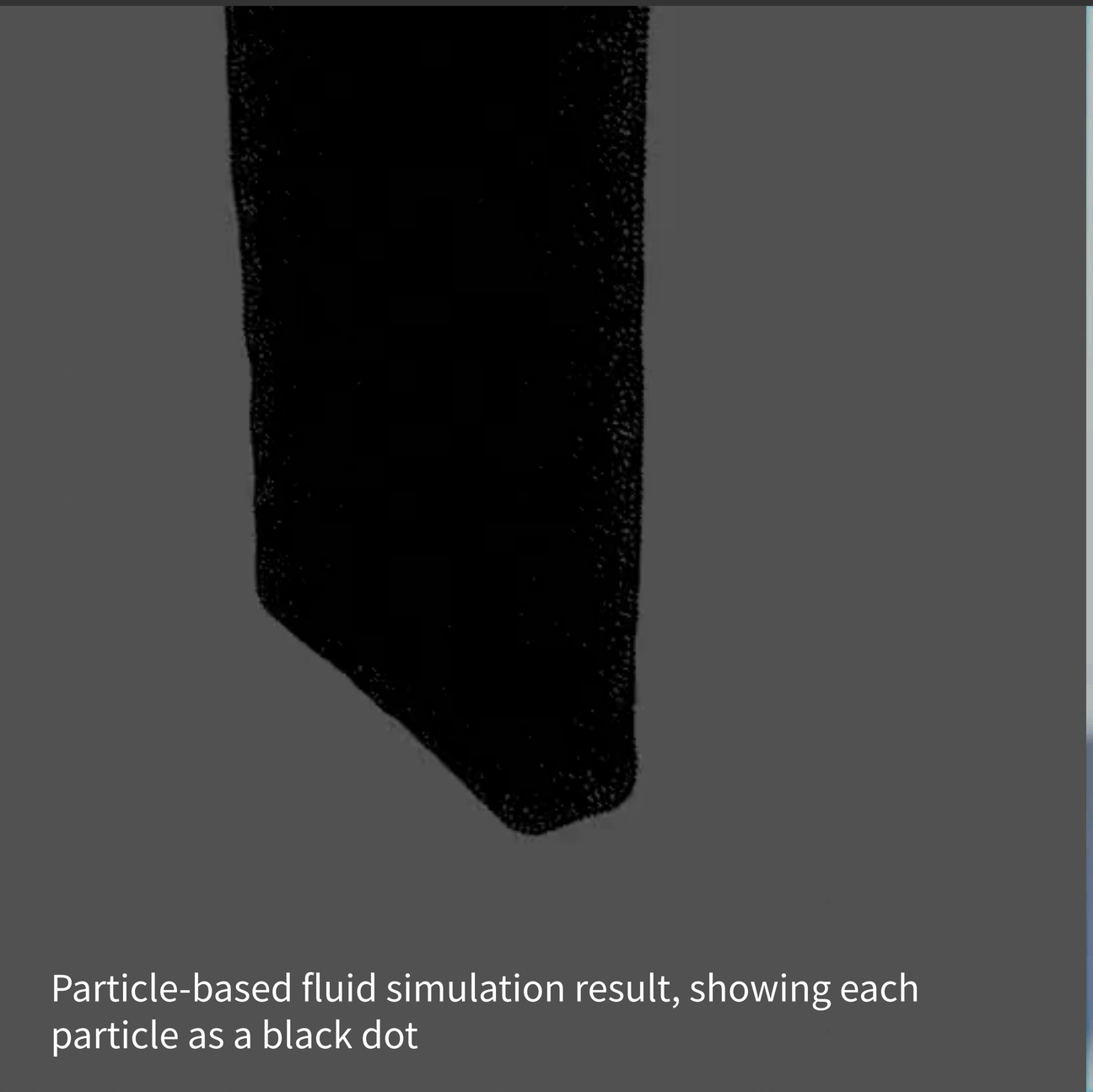
https://www.youtube.com/watch?v=2LPboySOSvo

2. Presentation Appeal

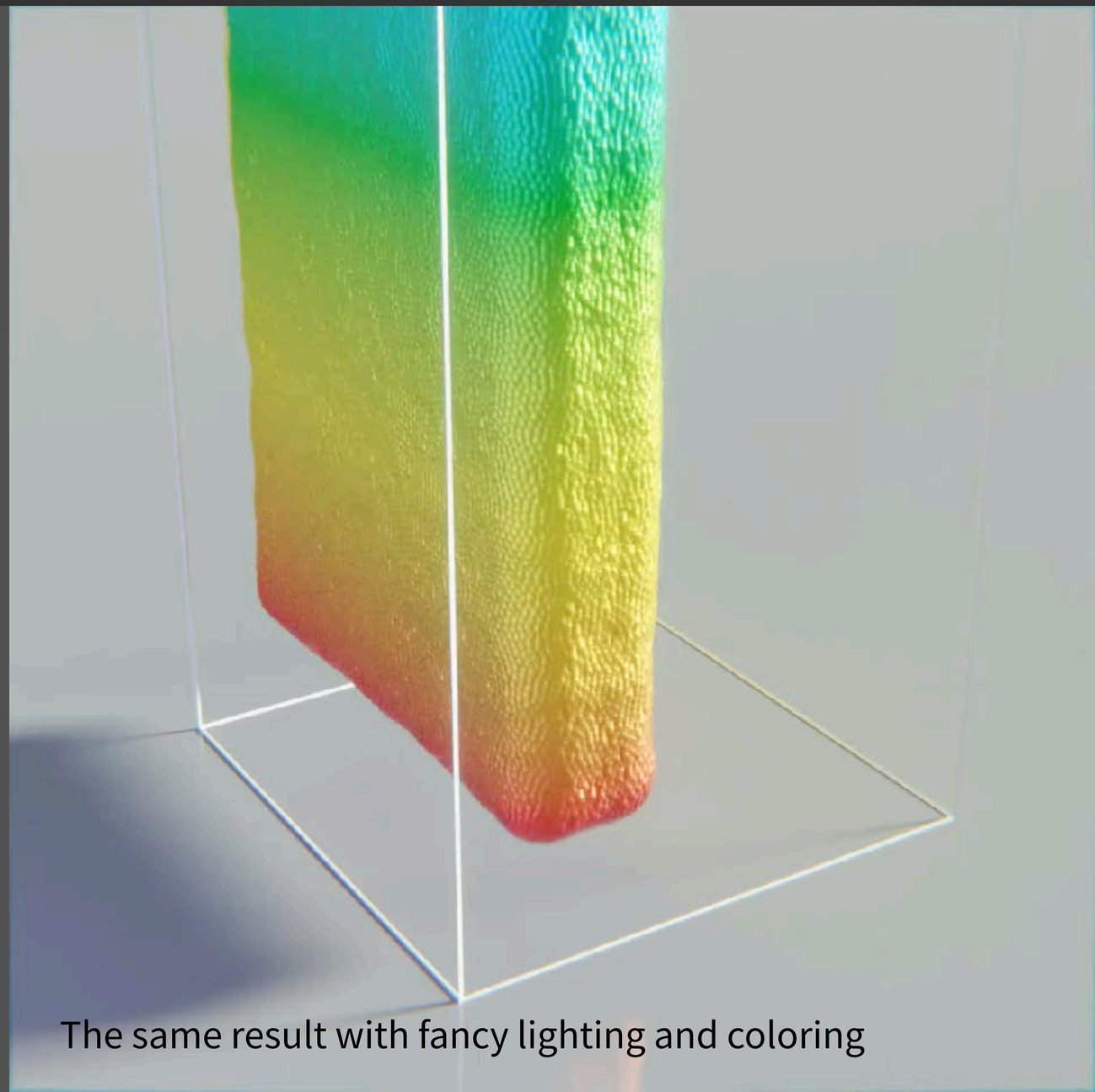
- Make presentations more memorable, leading to **better communication**
- Capture the audience's **attention**

https://www.youtube.com/watch?v=VBZ2sDxvZQE

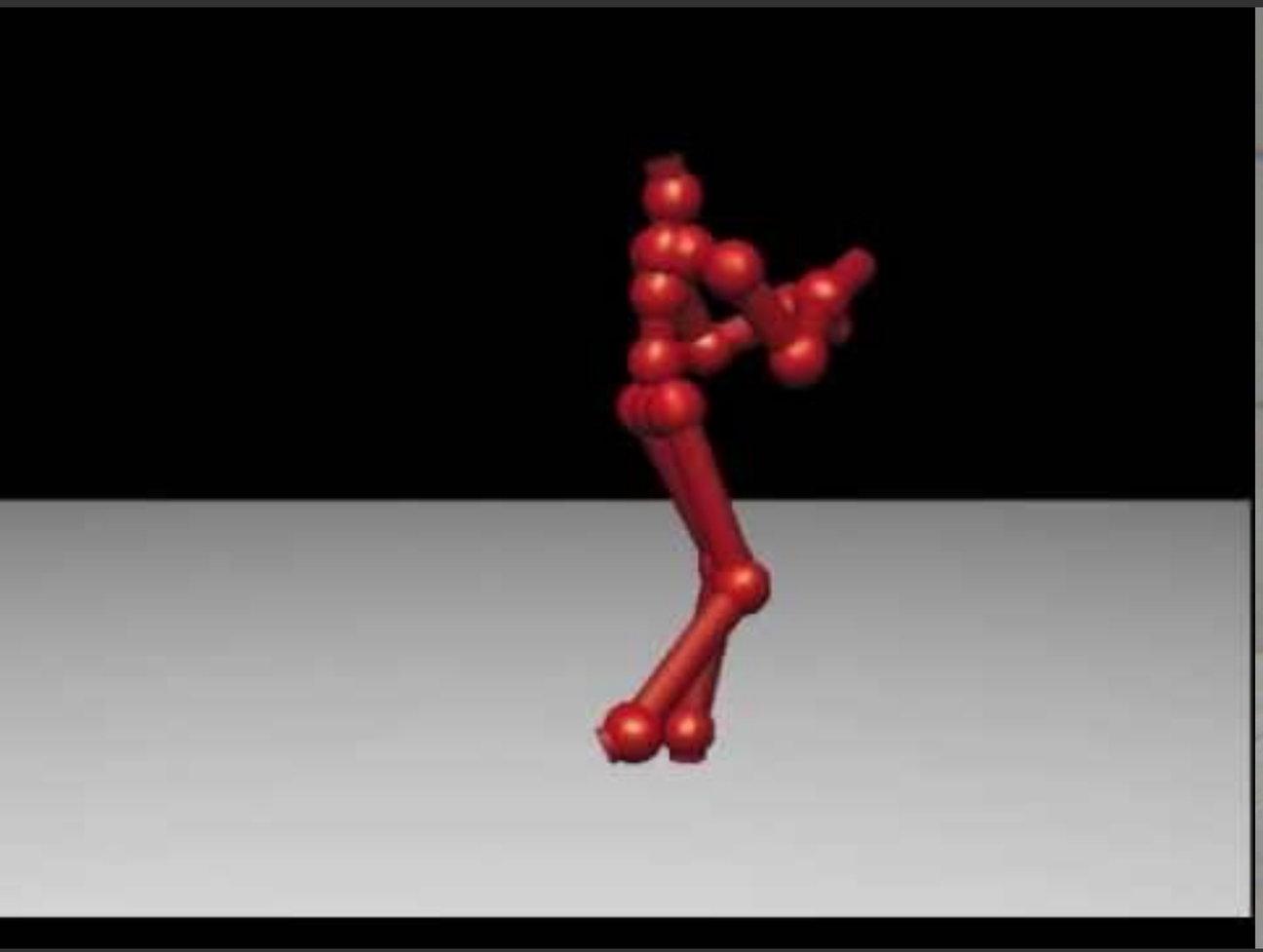
Which is better?

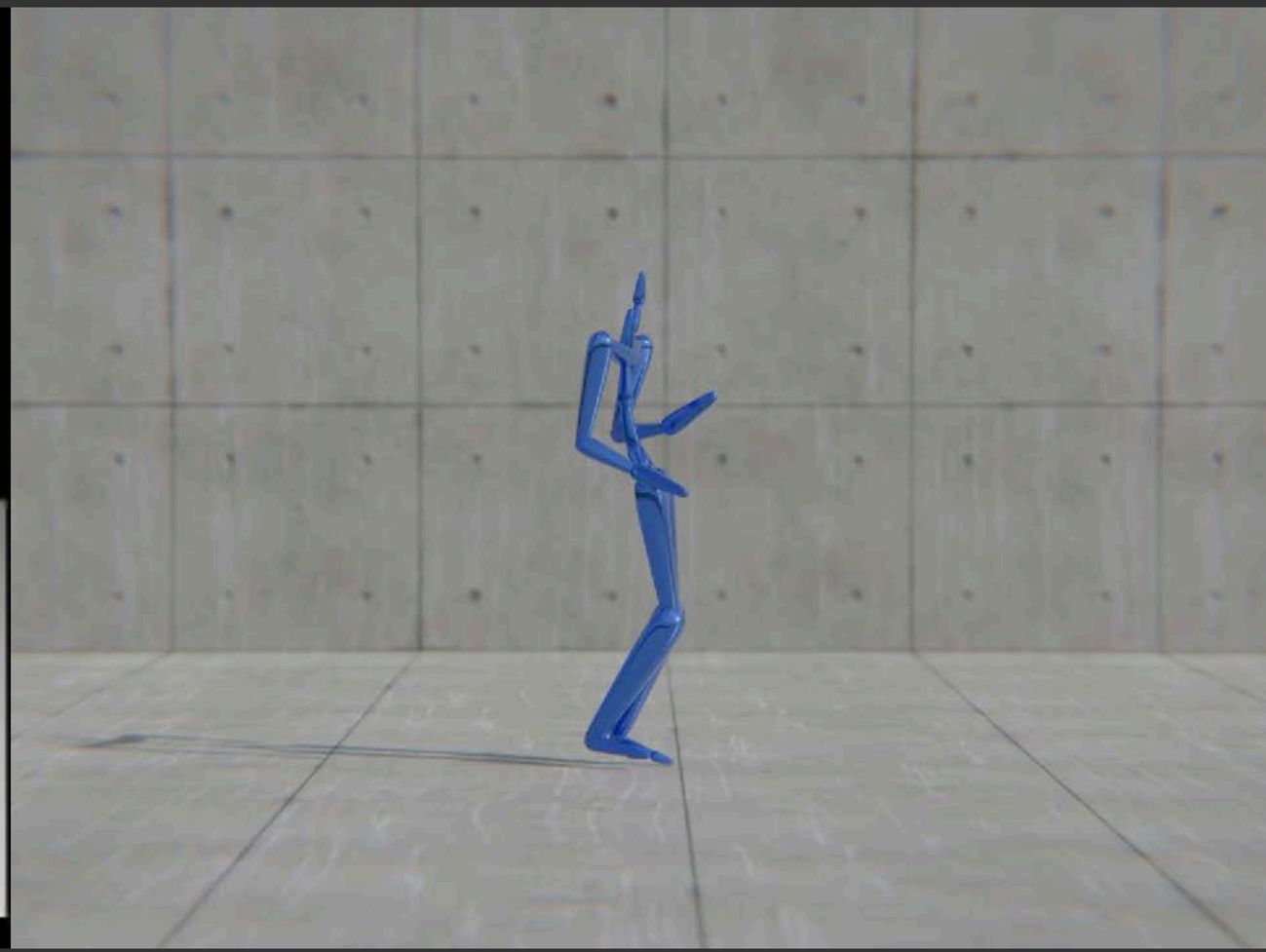


Particle-based fluid simulation result, showing each particle as a black dot



The same result with fancy lighting and coloring





Which do you want to retweet?

Scenarios: When to Use 3DCG?

Illustrating Complex Concepts

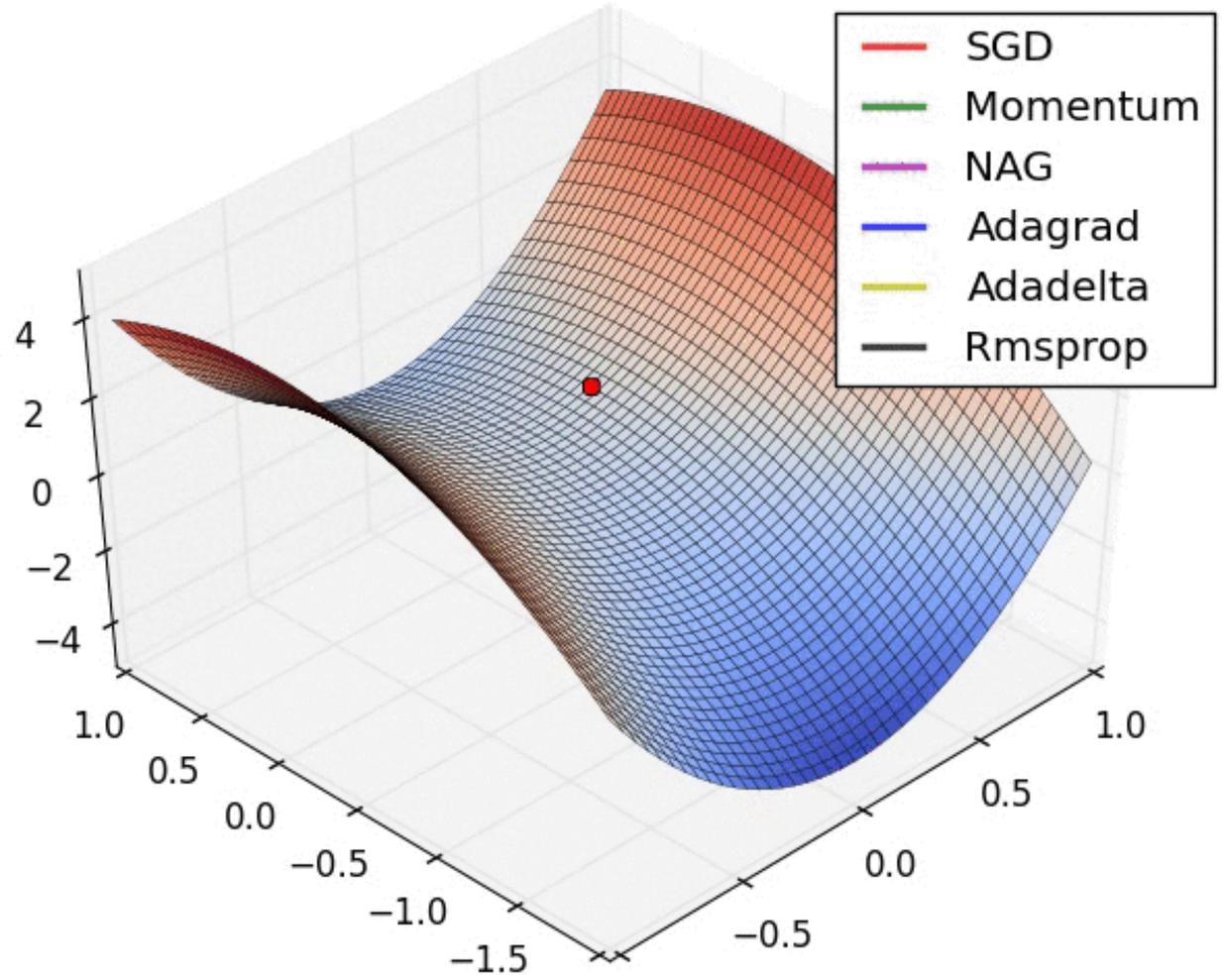
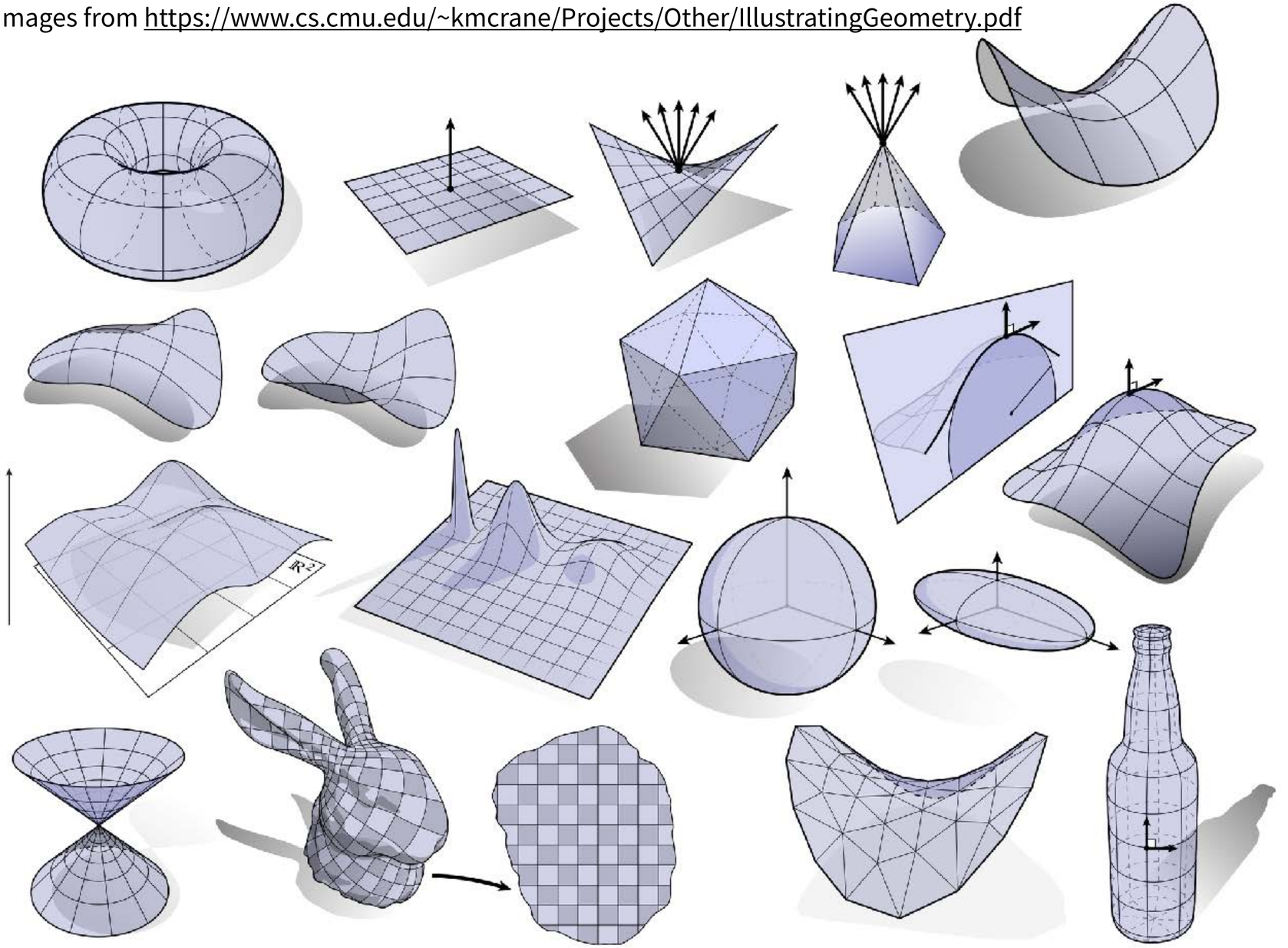


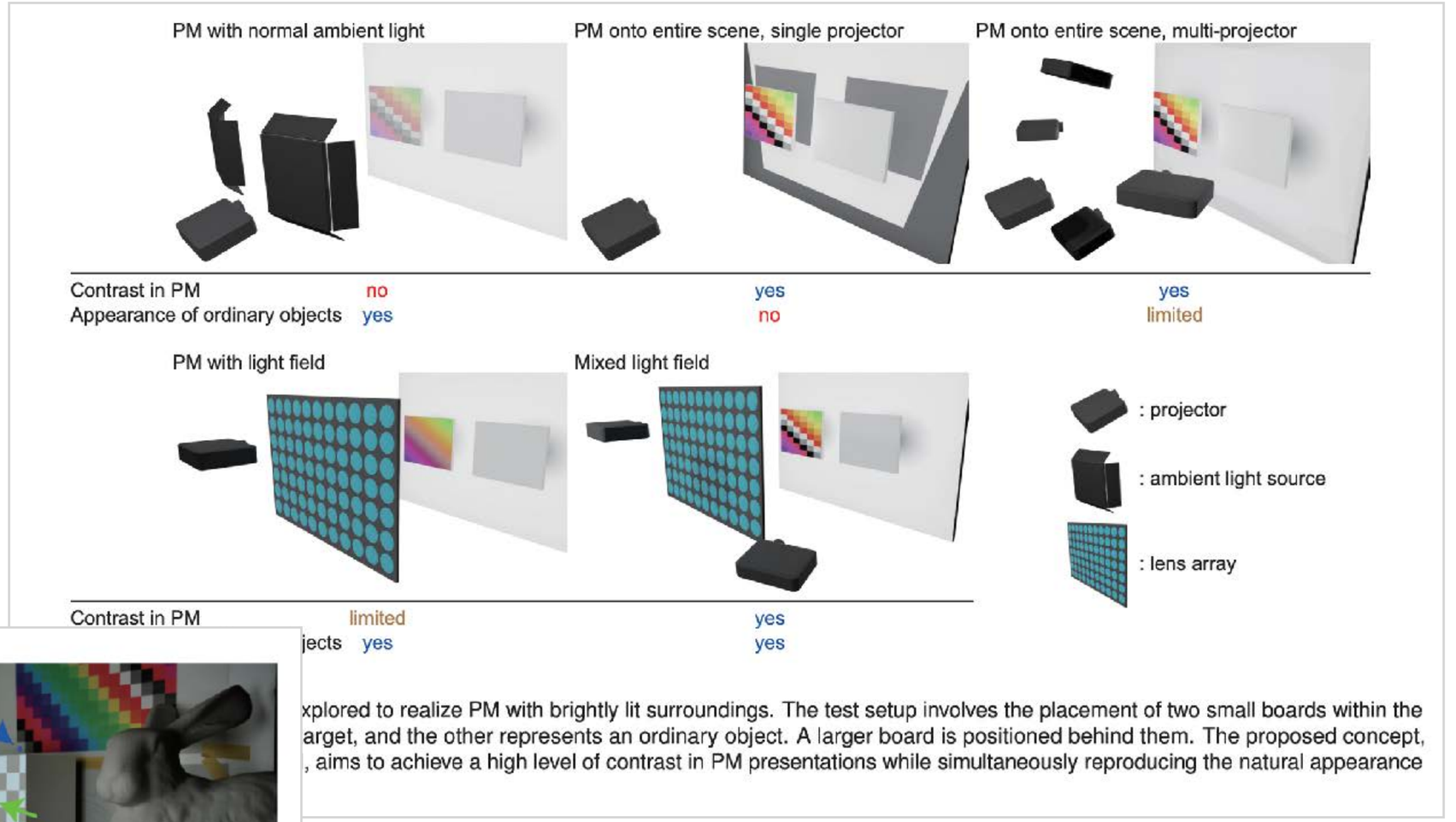
Image from https://www.ruder.io/optimizing-gradient-descent/

Illustrating Complex Concepts

Images from https://www.cs.cmu.edu/~kmcrane/Projects/Other/IllustratingGeometry.pdf



Illustrating Complex Experimental Settings



xplored to realize PM with brightly lit surroundings. The test setup involves the placement of two small boards within the arget, and the other represents an ordinary object. A larger board is positioned behind them. The proposed concept, , aims to achieve a high level of contrast in PM presentations while simultaneously reproducing the natural appearance

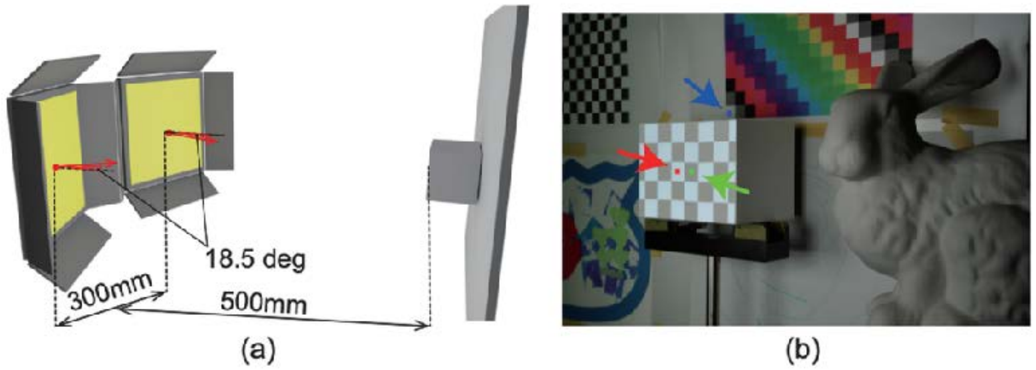


Fig. 12: (a) Arrangement of panel lights in the scene. (b) Measured point for the irradiance and contrast evaluations. *White*, *black*, and *background* values were measured at the red, green, and blue points, respectively.

Images from https://ieeexplore.ieee.org/document/10461983

Mechanical Assemblies: Step-by-Step Assemble

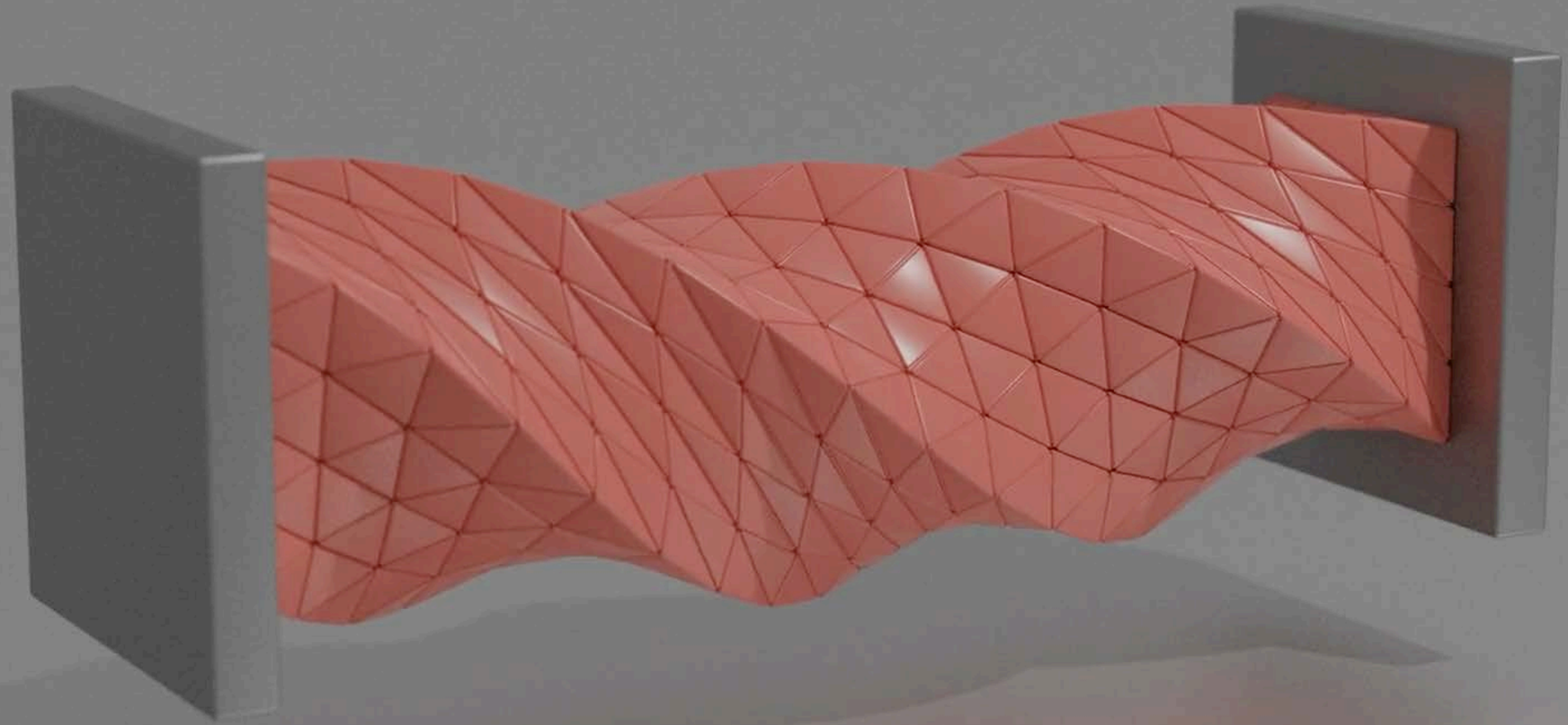
1:01—1:34 https://www.youtube.com/watch?v=Cd09lh2cXnc

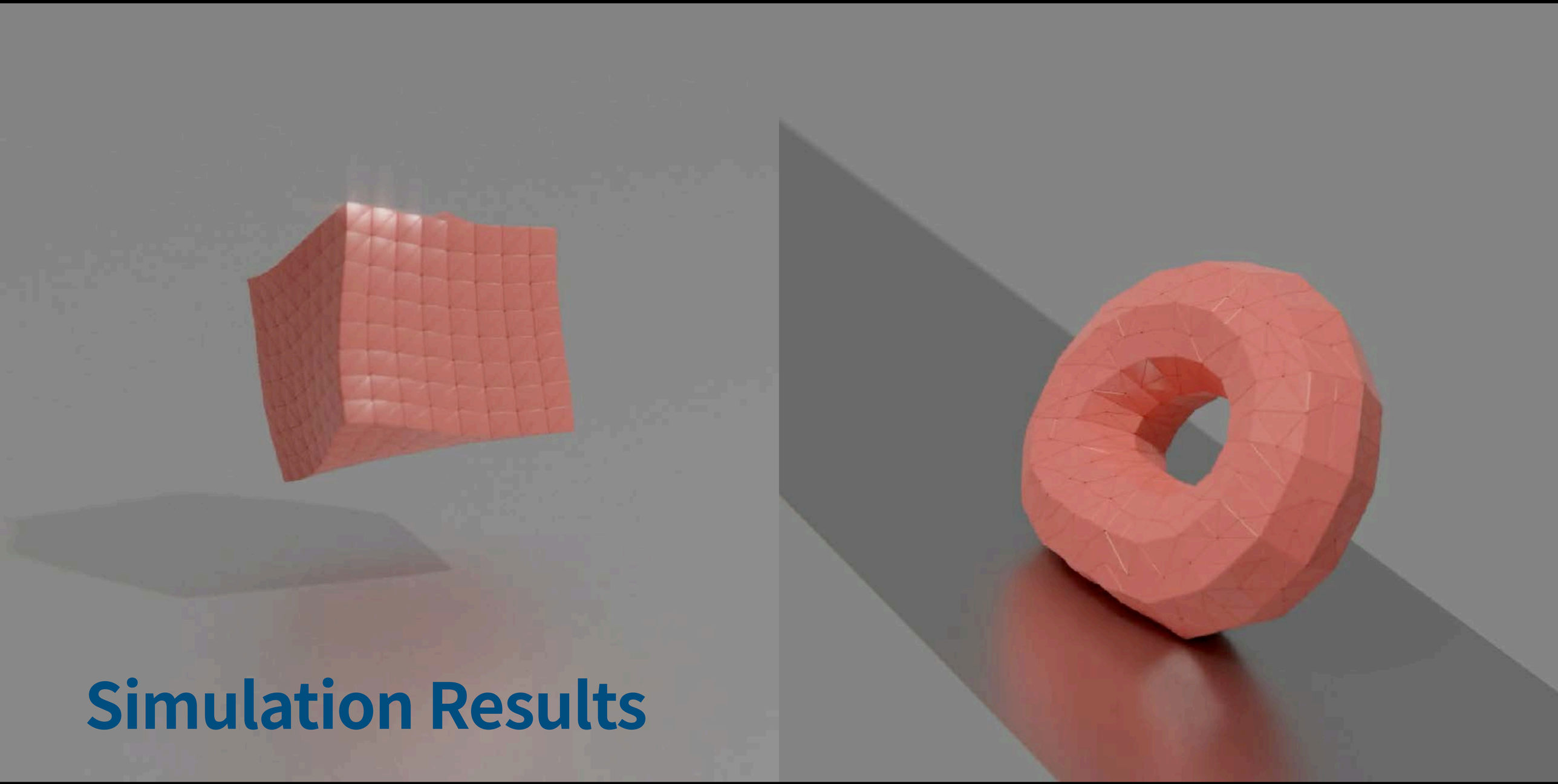
Mechanical Assemblies: Exploded View Animation

- Help understanding of the assembly, and
- Simply attractive

The 3D model was provided by George Kayesi for tutorial purposes
https://www.youtube.com/watch?v=IC0-9b0Rv2g

Simulation Results

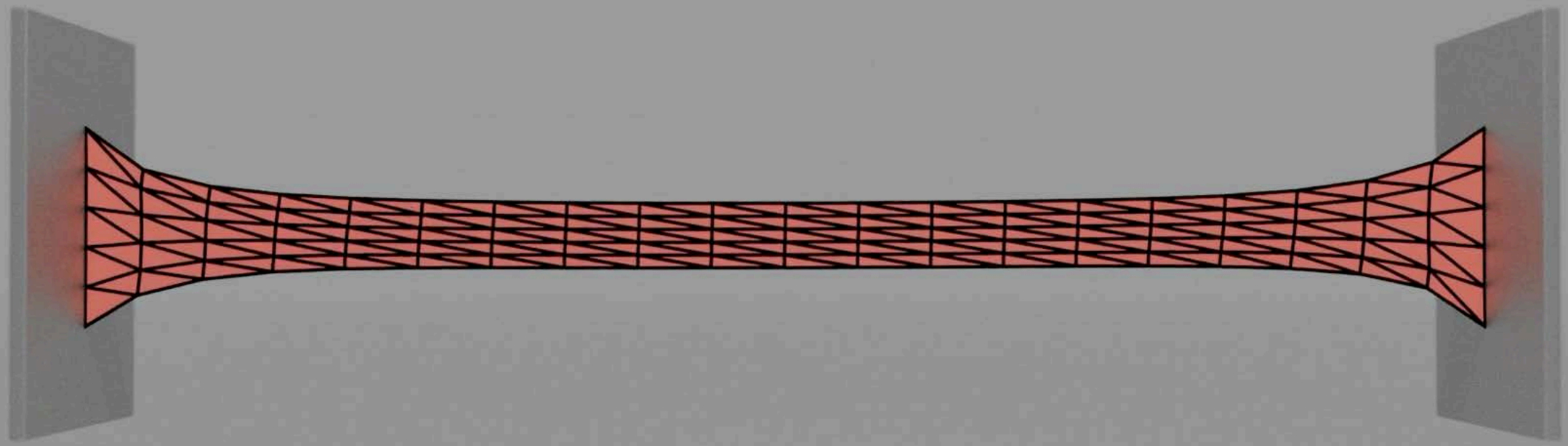




Simulation Results

Simulation Results

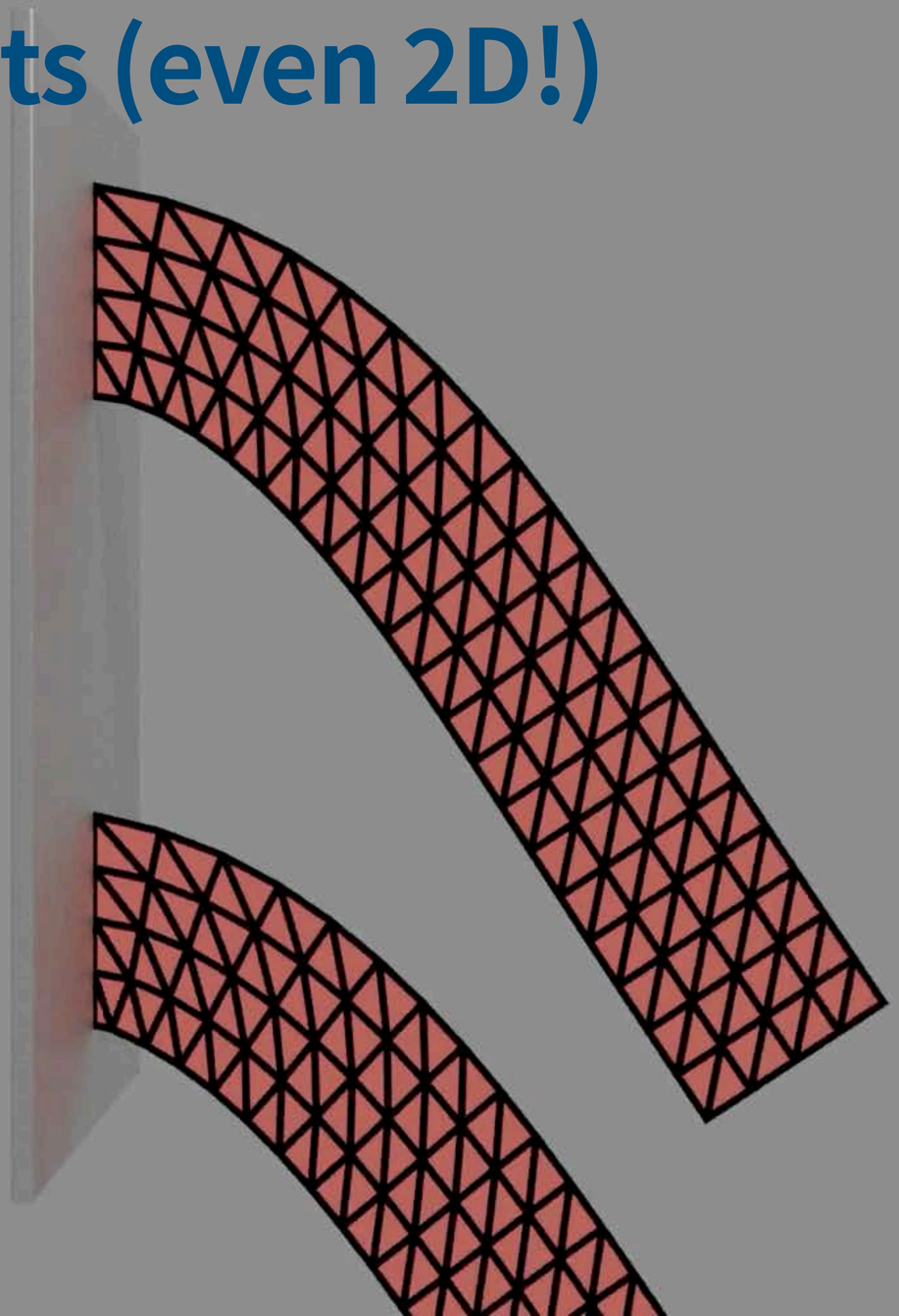
Simulation Results (even 2D!)



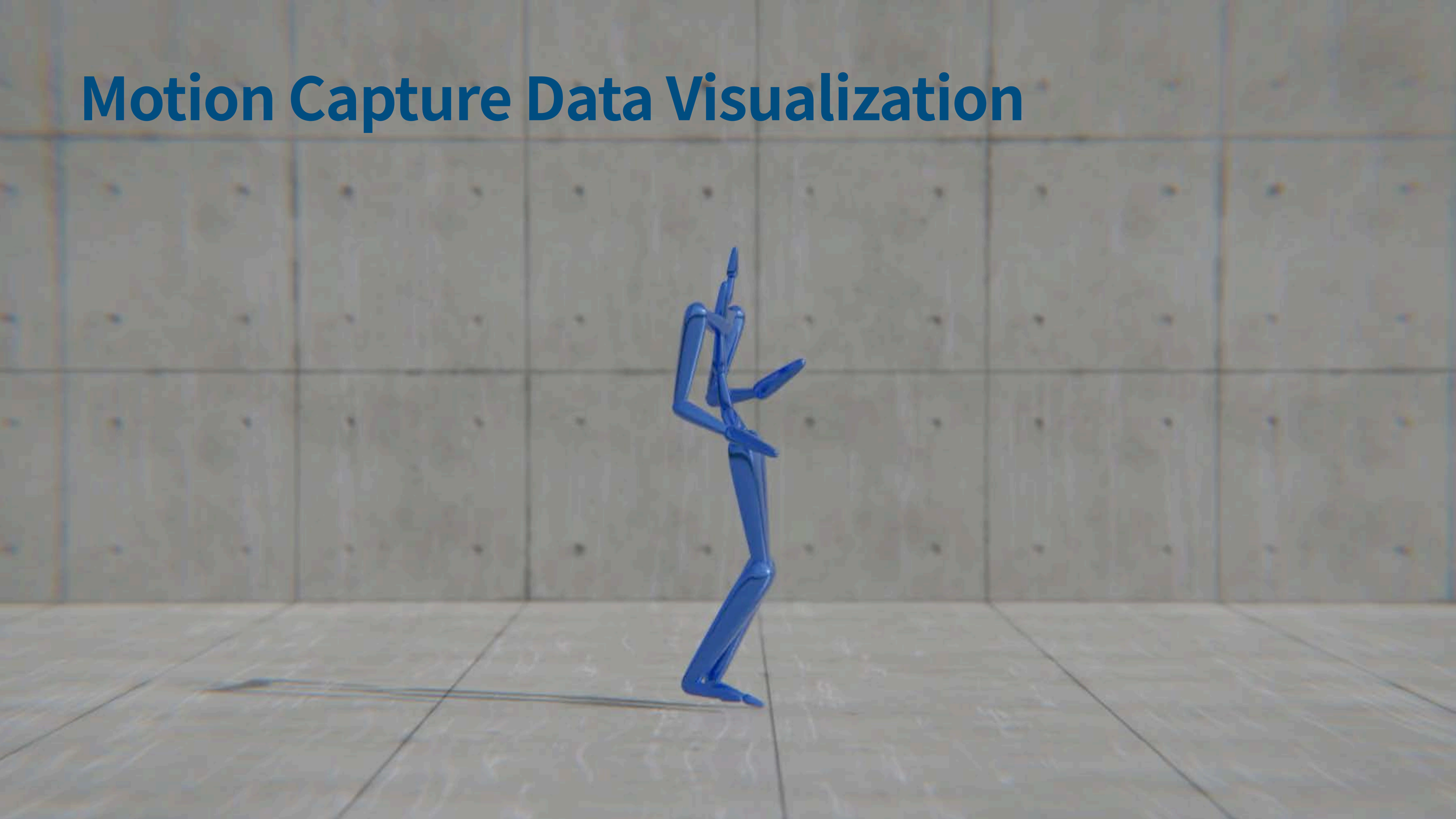
Simulation Results (even 2D!)

Co-Rotational

St. Venant-Kirchhoff



Motion Capture Data Visualization



3DCG Software

Blender

- Comprehensive 3DCG software
- **Free** and open source (GPL)
- Programmer-friendly (next slide)

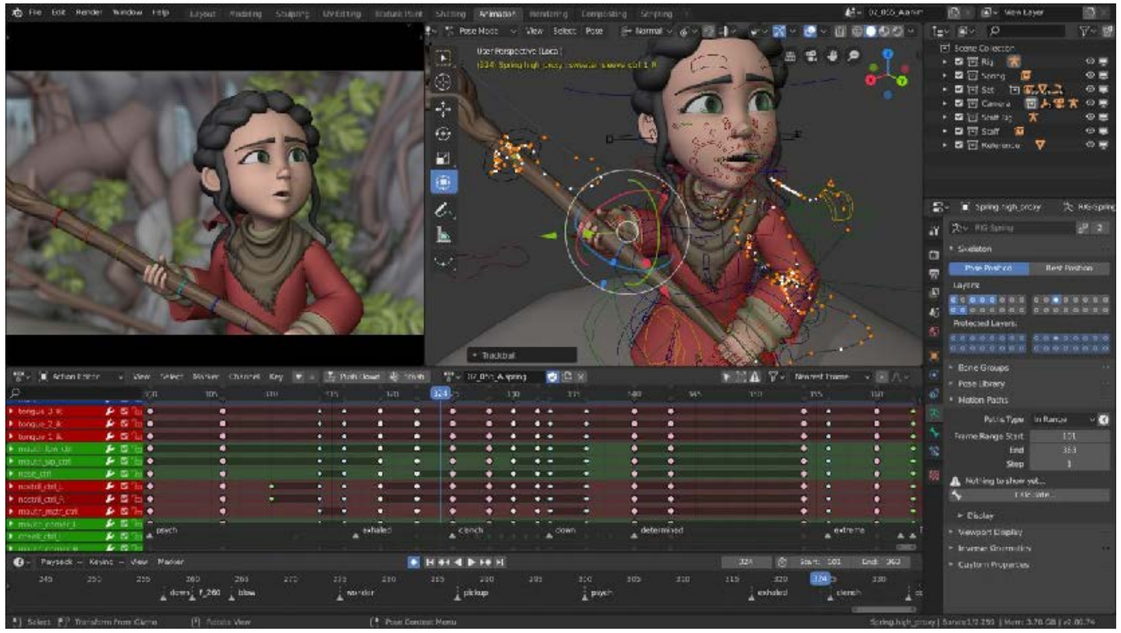


Image from https://www.blender.org/

Blender is … Programmer-Friendly! 🤝

- **Easy to install using command line (see the right)**
- Able to run on (display-less) computing servers (e.g., ABCI)
- Everything can be manipulated and automated via **Python APIs**

Other Software (Not Free)

- **3DCG animation and VFX**
  - Maya
  - 3ds Max
  - Houdini
  - …
- **Game engine**
  - Unreal Engine
  - Unity
- **CAD**
  - Rhinoceros
  - AutoCAD
  - Solidworks
  - …

3DCG Tips for Researchers

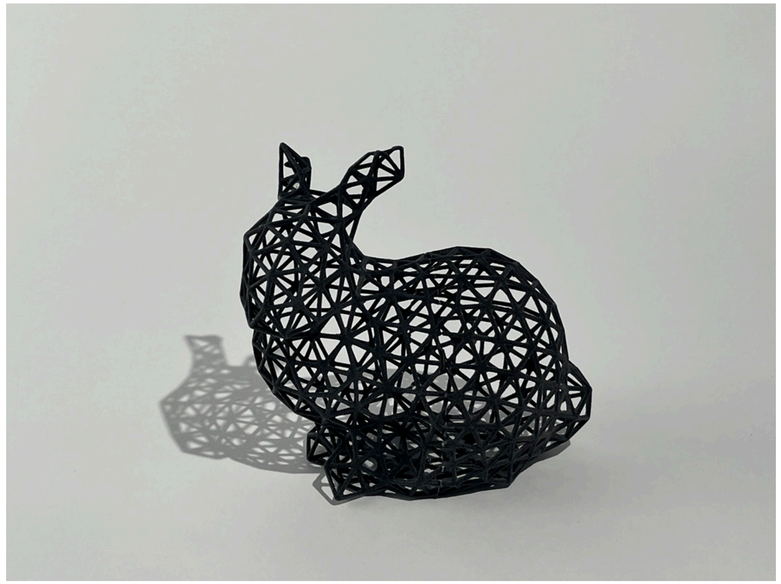
How to Create Good Illustrations?

Lighting Tips | Detailed in the following slides

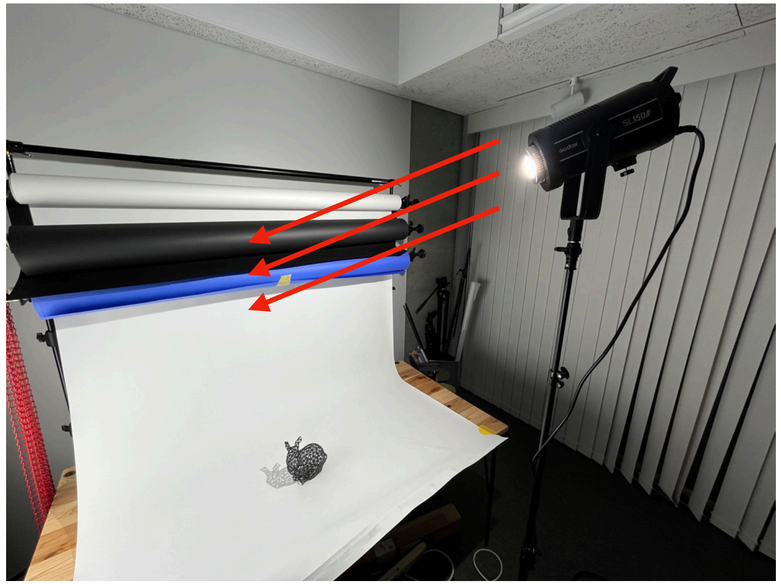
- Use soft shadow (avoid hard shadow)
- Use cyclorama (infinity curve) background
- Environmental light is easy and useful

Do you remember? — Week5 [Figures] by Koya Narumi

Avoid a non-diffused light



Strong shadow → Bad

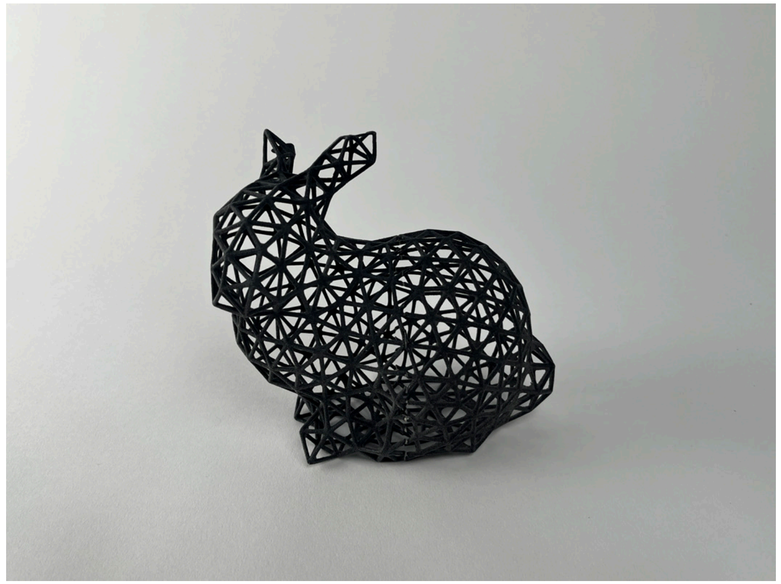


Non-diffused light → Bad

Don’t use a strong, non-diffused light like a summer beach.

Do you remember? — Week5 [Figures] by Koya Narumi

Use a diffused light



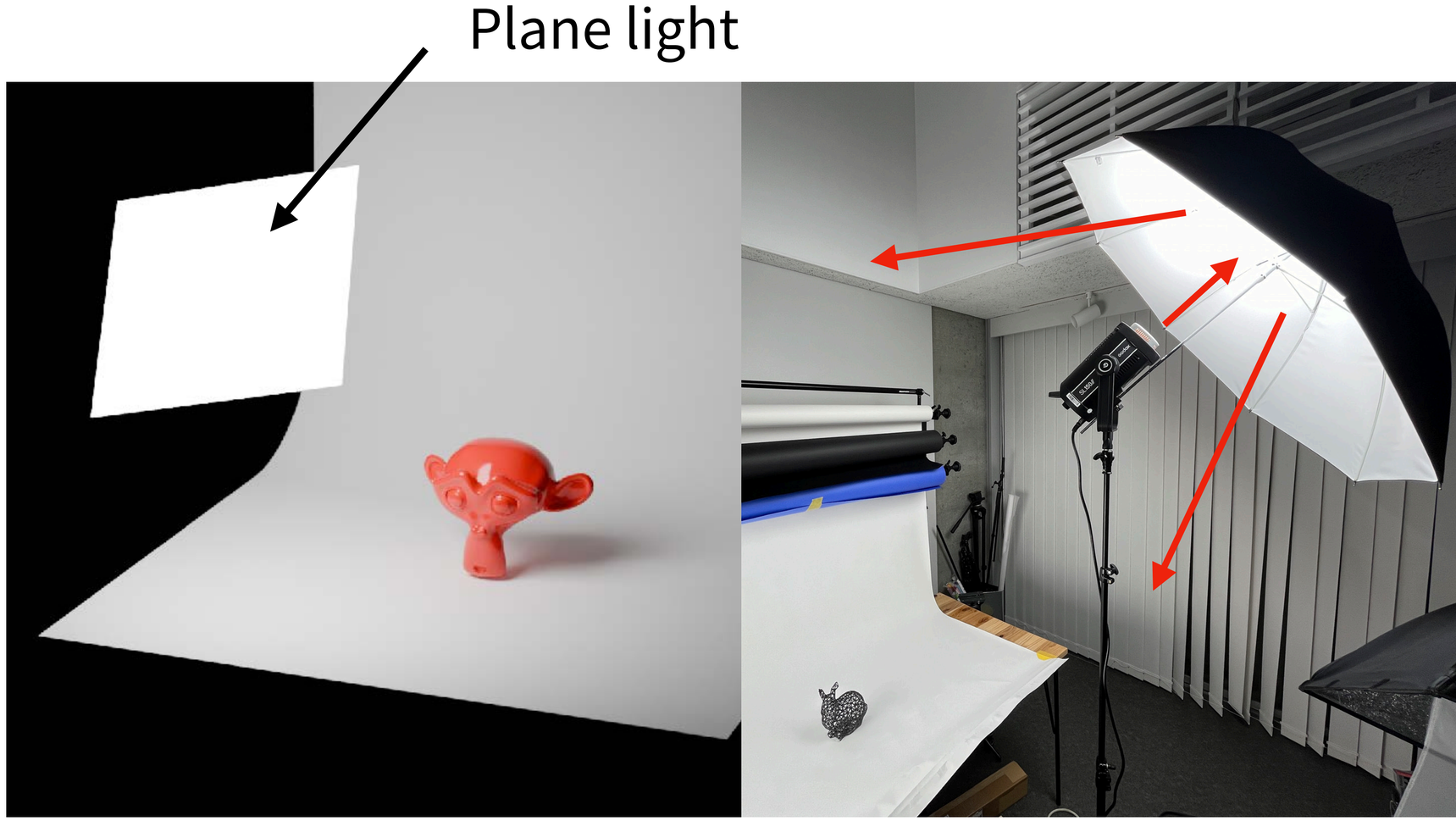
Soft shadow → Good

Diffused light → Good

The diffused light like a cloudy sky **is much better.**

Lighting: Soft Shadow

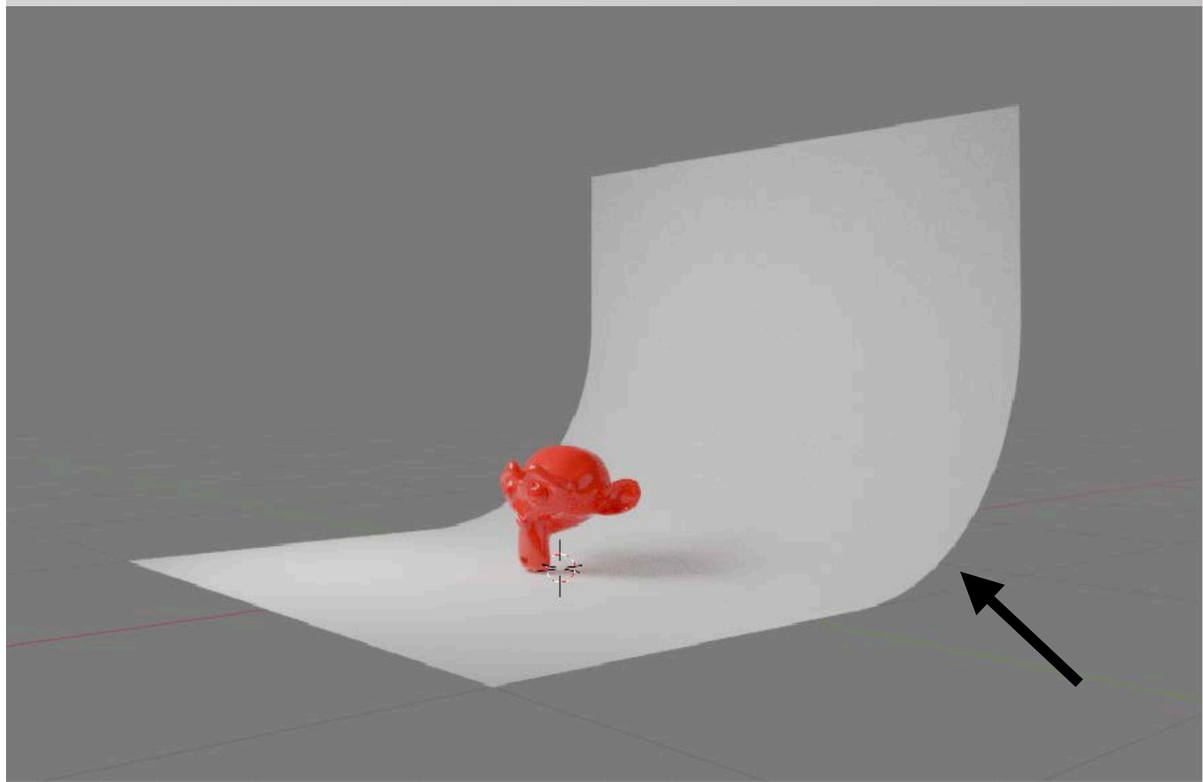
- 3DCG can easily create soft shadows by using **plane lights**
- No need of expensive equipments as in real-world photography🥰



No need to buy this

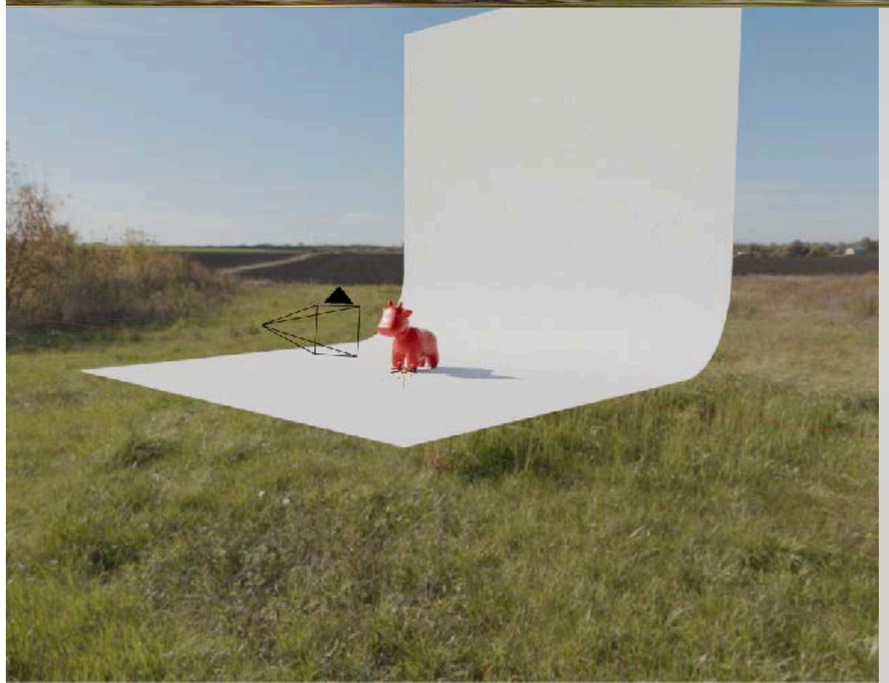
Lighting: Cyclorama (Infinity Curve) Background

- Curved background to create **the illusion of an infinite space**
- Used in photography
- Also useful in 3DCG

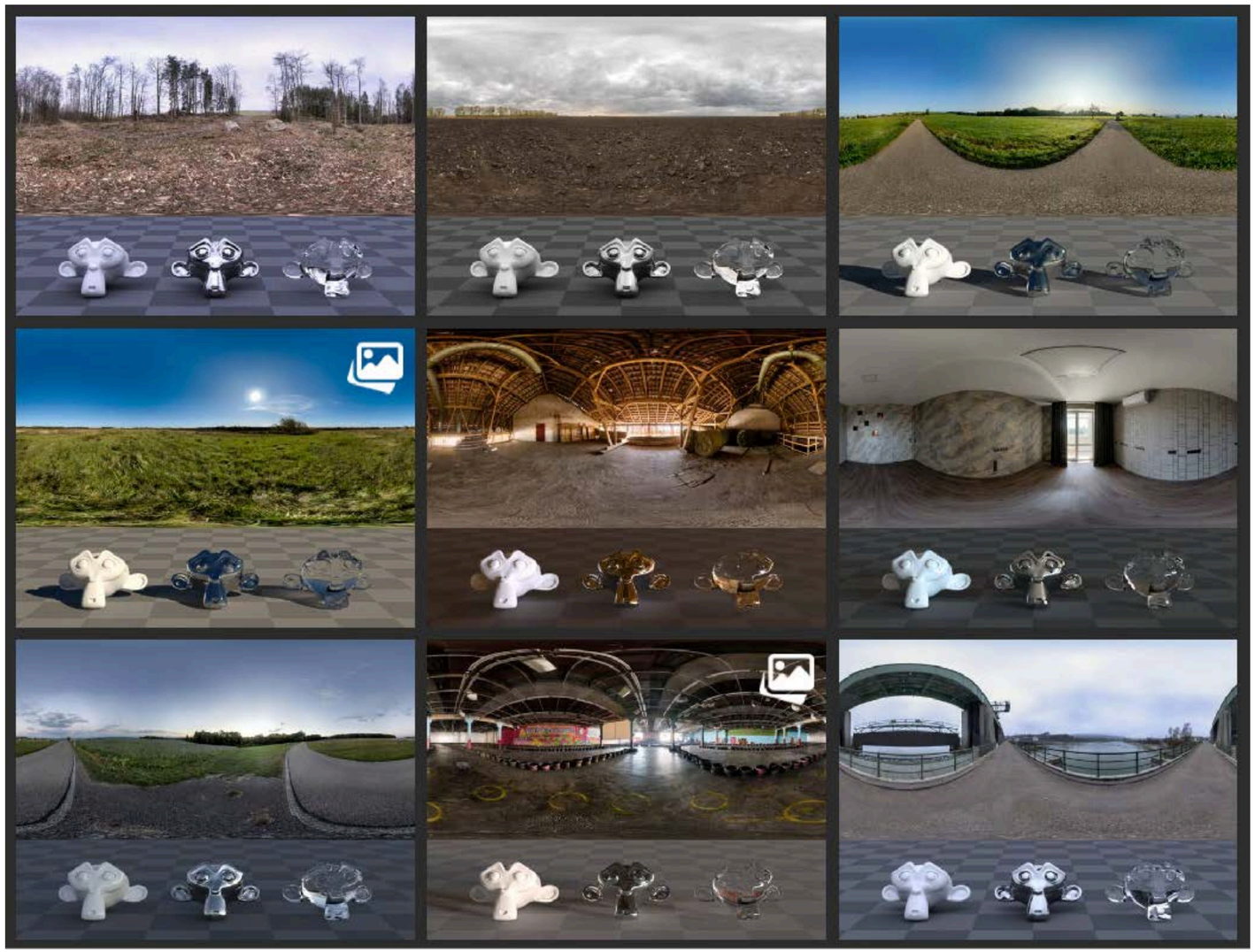


Lighting: Environmental Map

- … is a texture that represents the surrounding environment of a 3D scene
- Highly useful for creating realistic lighting **(very easy🥹)**



Lighting: Where to Find HDR Images?



https://hdri-haven.com/

Lighting: File Format for Environmental Maps

- **High Dynamic Range (HDR) image format (.hdr)** is used

- **Typical formats: unsigned int (8 bit/channel)** — $[0,255]$
  - 😢 Cannot represent very bright (> 255) light sources (overexposure)
- **HDR format: float (32 bit/channel)** — $[0,\infty)$
  - 😀 Can represent more-than-1.0 values! 💪

Materials Tips

- **Reflection** helps better shape perception 💡
- But be careful ⚠ Reflection increases **visual clutter**

with reflection

without reflection

Materials Tips

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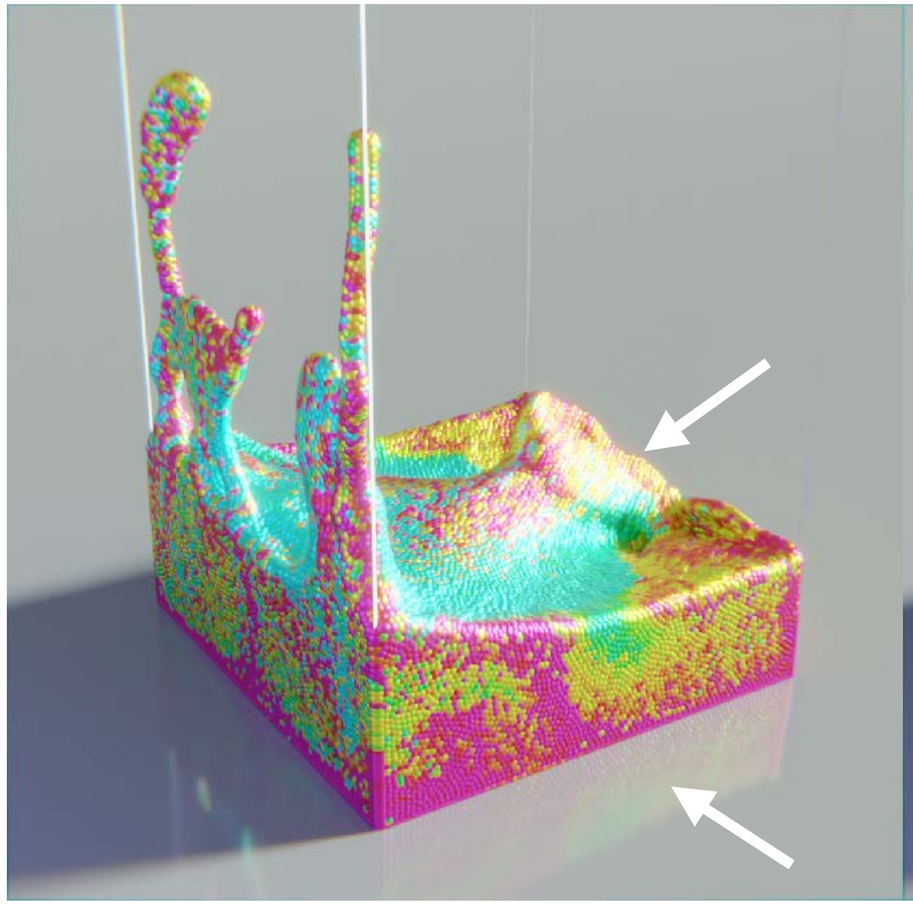
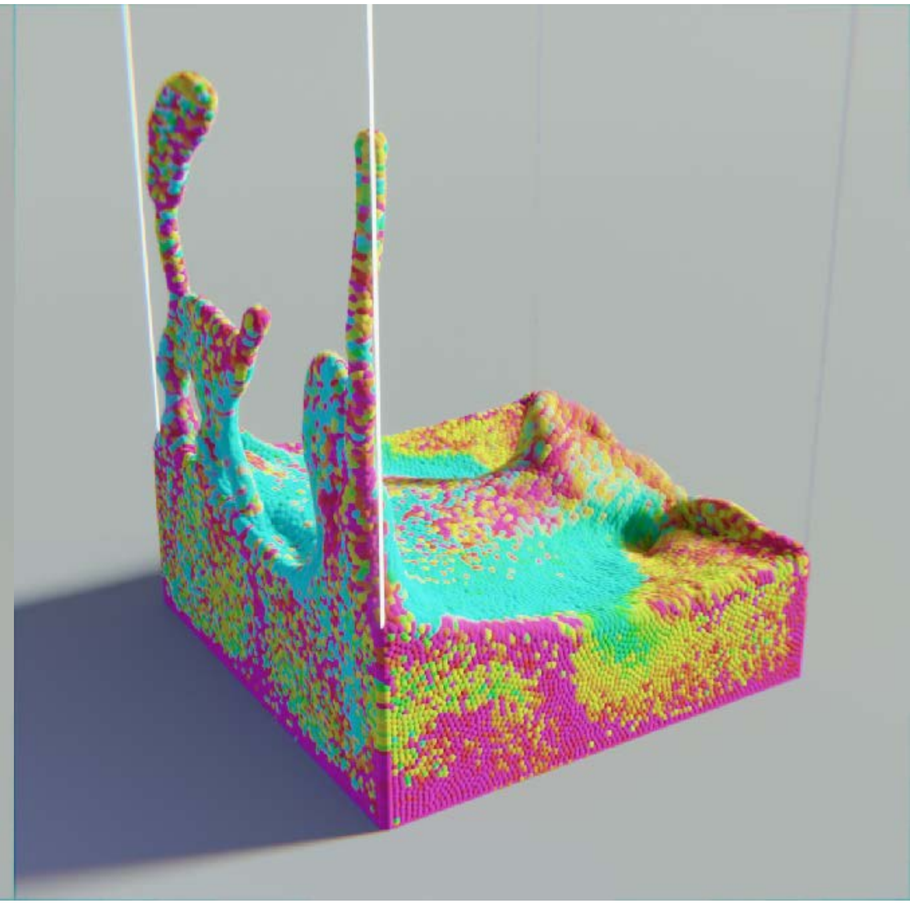
- But be careful ⚠ Reflection increases **visual clutter**



with reflection

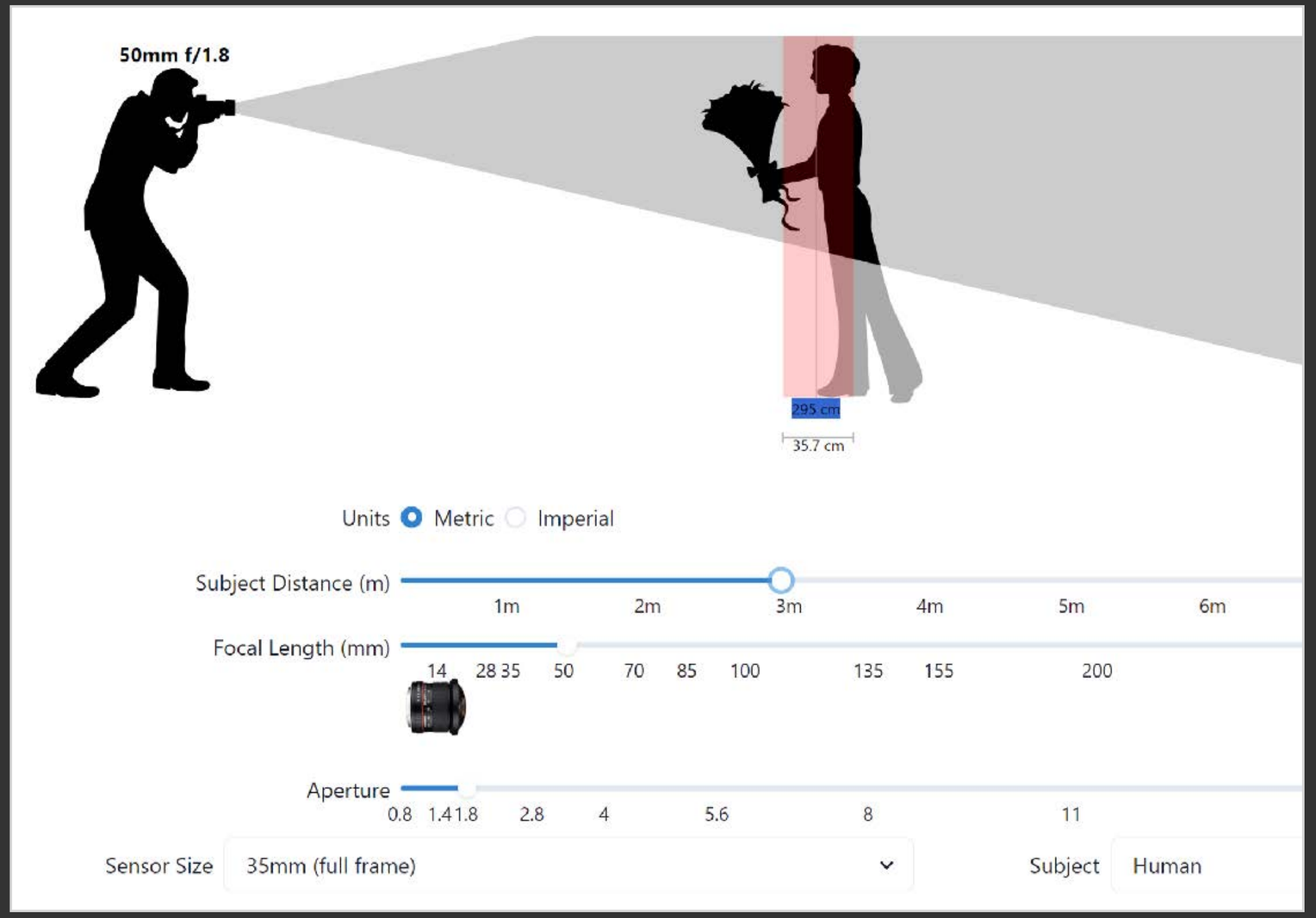


without reflection

Camera Tips: Depth Blur

- Use **depth blur** for …
  - Guiding viewers' attention 💡
  - Creating emotional expressions 🥹
- But avoid using depth blur in most technical illustrations ⚠️

Depth of Field (in real world)



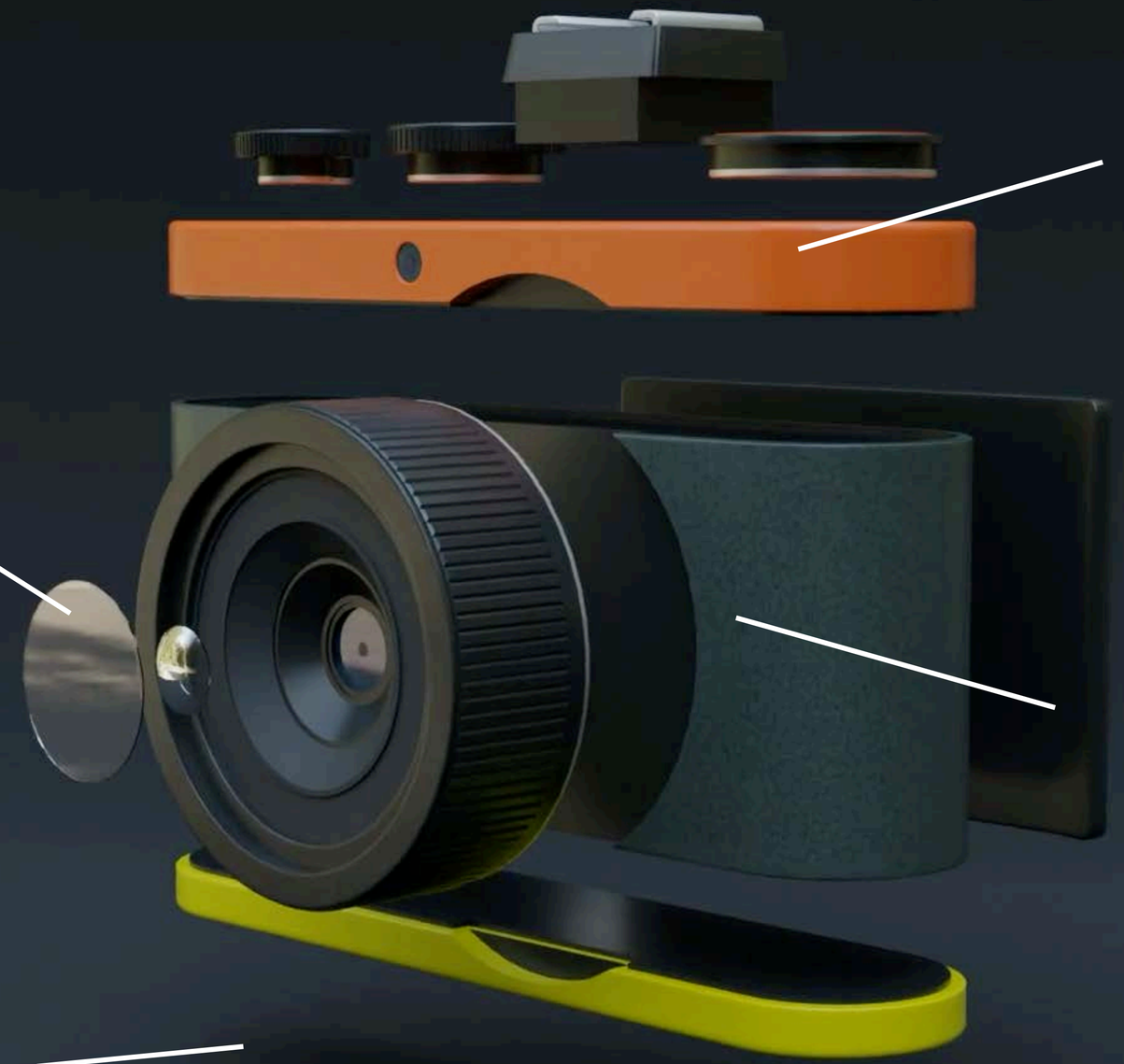
https://jherr.github.io/depth-of-field/

Scripting Tips

- **Everything that you can do with GUI can be done via Python API**
  - Automation is easy
  - Once scripting is done, it runs even on computing servers (e.g., ABCI)
- **It is easy to integrate Blender into your data processing pipeline**
  - E.g., Checkpoint visualization during the training of 3D-related ML models (3D shape generation, point cloud segmentation, human motion generation, etc.)
  - E.g., Visualization of fluid simulation results from various viewpoints (which is useful to check and validate the simulation behavior)

Demonstration

The 3D model was provided by George Kayesi for tutorial purposes
https://www.youtube.com/watch?v=IC0-9b0Rv2g



Exploded view animation

(1) helps understanding of the assembly, and

(2) is attractive

Environmental map is used to create fancy reflection

Slight rotation helps shape perception

Cyclorama (infinity curve) background

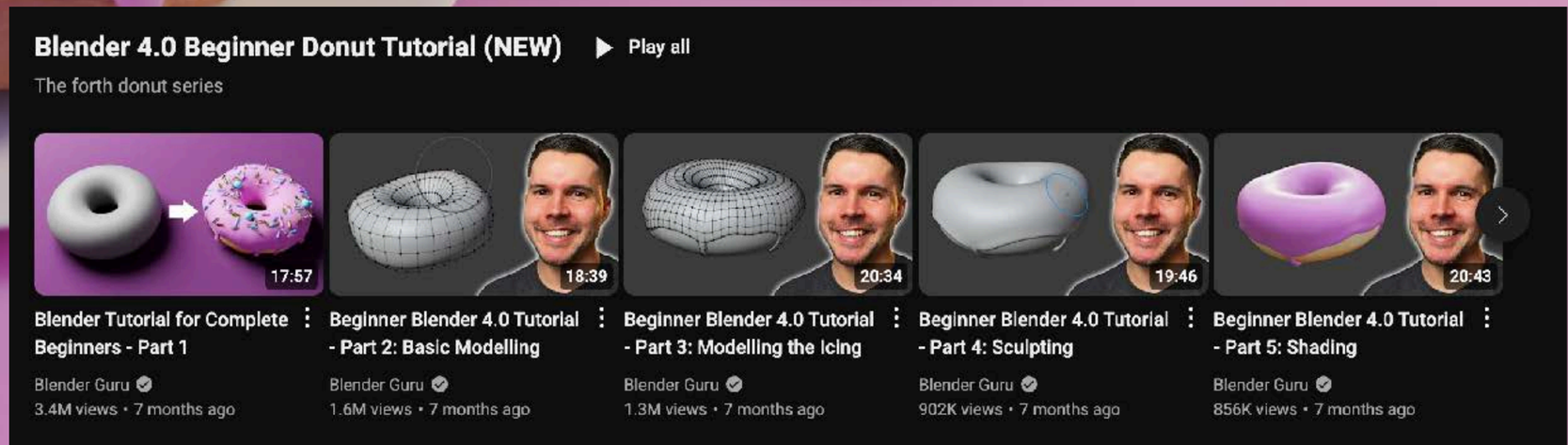
Soft shadow is often preferred

Mastering 3DCG: Where to Start?

Resources

The "Donut" Tutorial

https://www.youtube.com/@blenderguru



Resources

- Exploded View Animation of Objects in Blender (Tutorial)
  - https://www.youtube.com/watch?v=IC0-9b0Rv2g
- Illustrating Geometry (Keenan Crane)
  - https://www.cs.cmu.edu/~kmcrane/Projects/Other/IllustratingGeometry.pdf
- Multi-scale Multi-physics Heart Simulator UT-Heart
  - https://www.youtube.com/watch?v=2LPboySOSvo
- Blender Python scripting examples
  - https://github.com/yuki-koyama/blender-cli-rendering

Summary

In general, good illustrations ...

1. help audience better understand your research 💡 , and
2. increase presentation appeal 💖 (→ buzz 🧨).

3DCG is (sometimes) an effective technique for these purposes.