

Project Part 2

Computational Visual Perception (CompVP)

Bernhard Egger, Andreas Kist, Patrick Krauß, Tim Weyrich

- 7,5 ECTS
 - 5+2,5 ECTS
 - You need both!
 - You can't get only 5 or only 2,5 ECTS

Overall project goal

- How can we perceive rich shape from a fully occluded face?
- Is it based on inverse physics?
- Are we doing a cheap shortcut?



3D Shape Perception Integrates Intuitive Physics and Analysis-by-Synthesis

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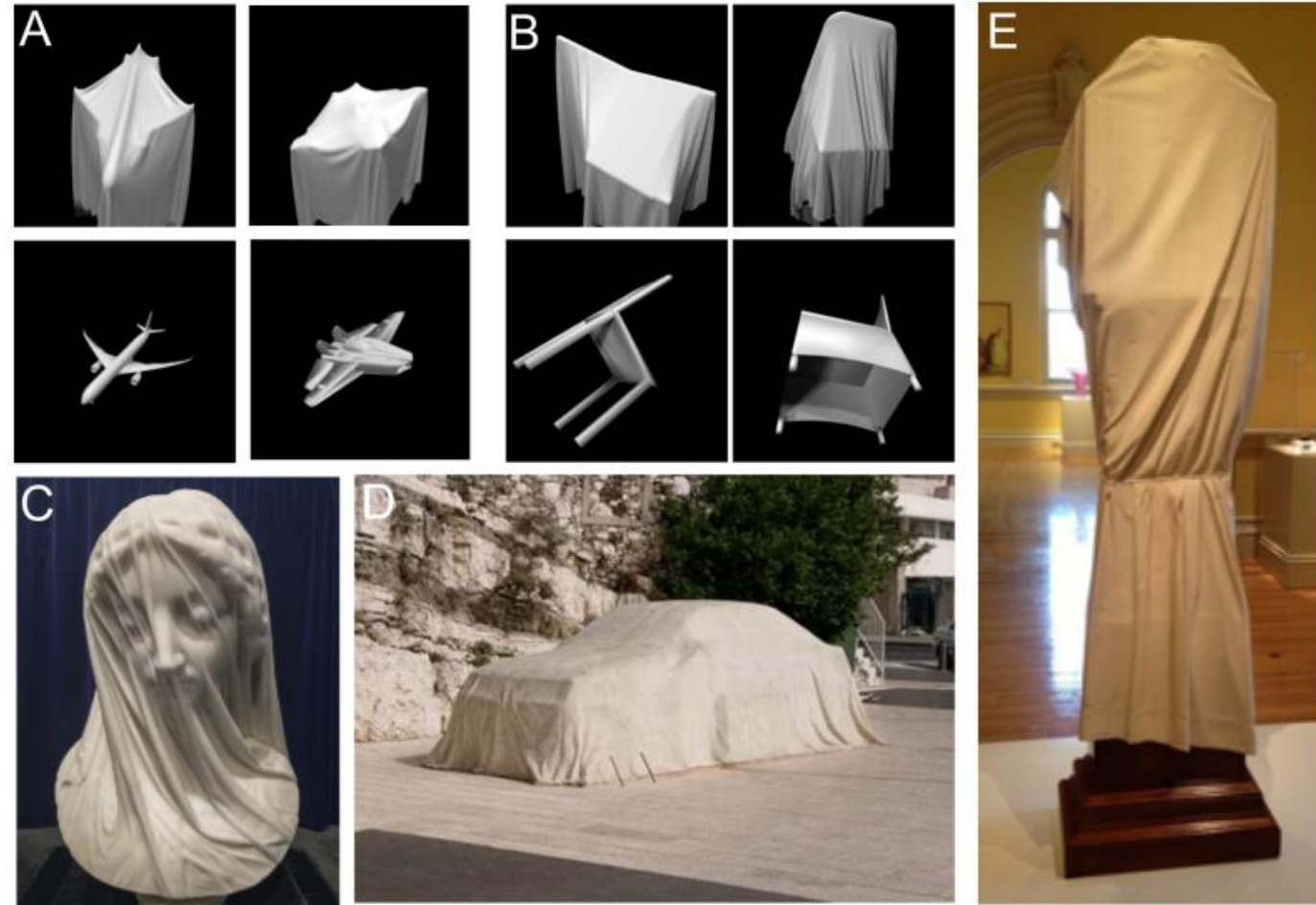
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The *Veiled Virgin* illustrates visual segmentation of shape by cause

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Three-dimensional (3D) shape perception is one of the most important functions of vision. It is crucial for many tasks, from object recognition to tool use, and yet how the brain represents shape remains poorly understood. Most theories focus on purely geometrical computations (e.g., estimating depths, curvatures, symmetries). Here, however, we find that shape perception also involves sophisticated inferences that parse shapes into features with distinct causal origins. Inspired by marble sculptures such as Strazza's *The Veiled Virgin* (1850), which vividly depict figures swathed in cloth, we created composite shapes by wrapping unfamiliar forms in textile, so that the observable surface relief was the result of complex interactions between the underlying object and overlying fabric. Making sense of such structures requires segmenting the shape based on their causes, to distinguish whether lumps and ridges are due to the shrouded object or to the ripples and folds of the overlying cloth. Three-dimensional scans of the objects with and without the textile provided

be able to identify that different three-dimensional (3D) shape features have distinct causal history, as has been suggested previously for two-dimensional (2D) shapes (8–16). We sought to measure and understand this phenomenon.

Results and Discussion

Experiment 1: High Intersubject Agreement about Causation in *The Veiled Virgin* Sculpture. We reasoned that if the visual system can segment shape features based on their causal origin, participants should be able to indicate the apparent causes of different structures in the sculpture. To test this, we presented 40 untrained observers with images of *The Veiled Virgin* on a tablet device and asked them to paint onto the picture to indicate geometrical features caused predominantly by the underlying face (“contact”) and those caused predominantly by the overlying textile (“fabric”). Participants could toggle back and forth between two separate screens, one for each of the two phe-



- Ultimately: test if Paper 2 is correct
 - Project Part 1: run physics simulation (close to Paper 1)
 - Project Part 2: calculate distances and render images (close to paper 2)
 - Project Part 3: Train a UNet on images from Part 1
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- Submission via Studon course:
“Tutorials to Computational Visual Perception”
 - Submission has to be in the exact format
 - Three strict project deadlines
 - November 23rd, December 18th , February 8th
 - By design more time for 3rd part as some of you might need/want to fight for a pass
-

- Pass/Fail for each of the 3 parts,
- You need to pass 2 out of 3 parts
- The best solutions for each part will be released ~ 1 week after the deadline, to enable others to continue with the best solution of another team

How to pass

- Scope of project ~ 150 hours per student
 - Teams of 1-3 students
 - Steps can be performed in new group
 - If you are looking for a new group, please stay after the class and talk to people who also stay
 - If you are looking for a new group and can only join virtually, please use the forum in “Tutorials to Computational Visual Perception” to team up
 - Finding a group is your responsibility
-

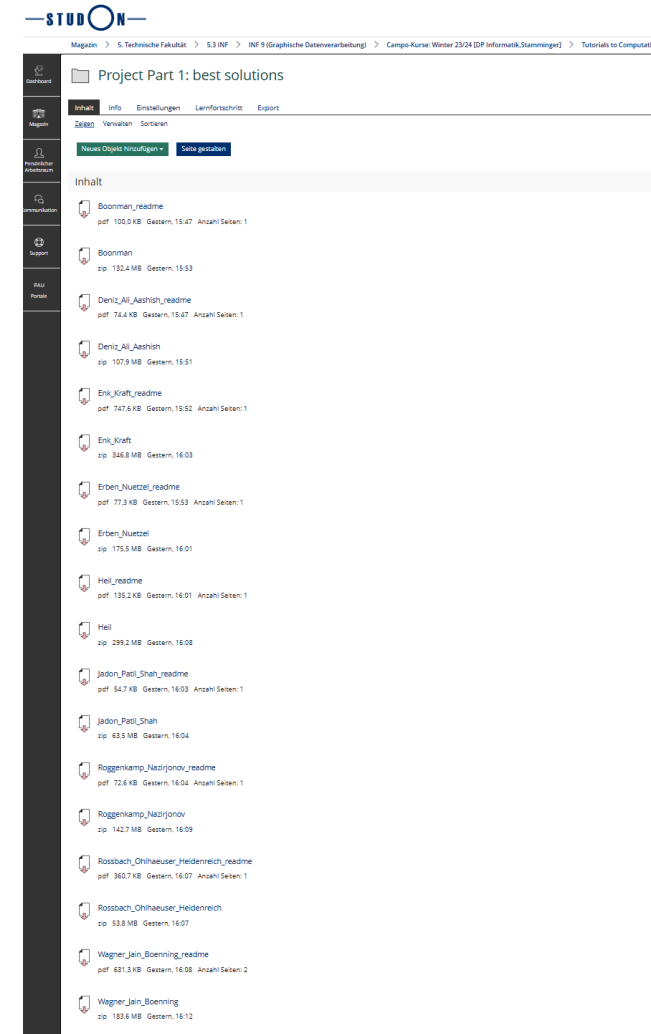
- Tasks:
 1. Choose between your solution, or your favorite solution by peers
 2. For each combination of object/cloth calculate distances and save them as vertex color
 3. Render 5000 images and 5000 distance images
 4. Render test objects
 5. Write a 1 page report to sell your solution
-

Part 2 Task 1

Choose your solution or a favorable solution
Make sure mesh has uniform gray texture



Renderings: Wagner Jain Boenning



For each Cloth mesh:

For each point on the cloth mesh:

Find closest point on object

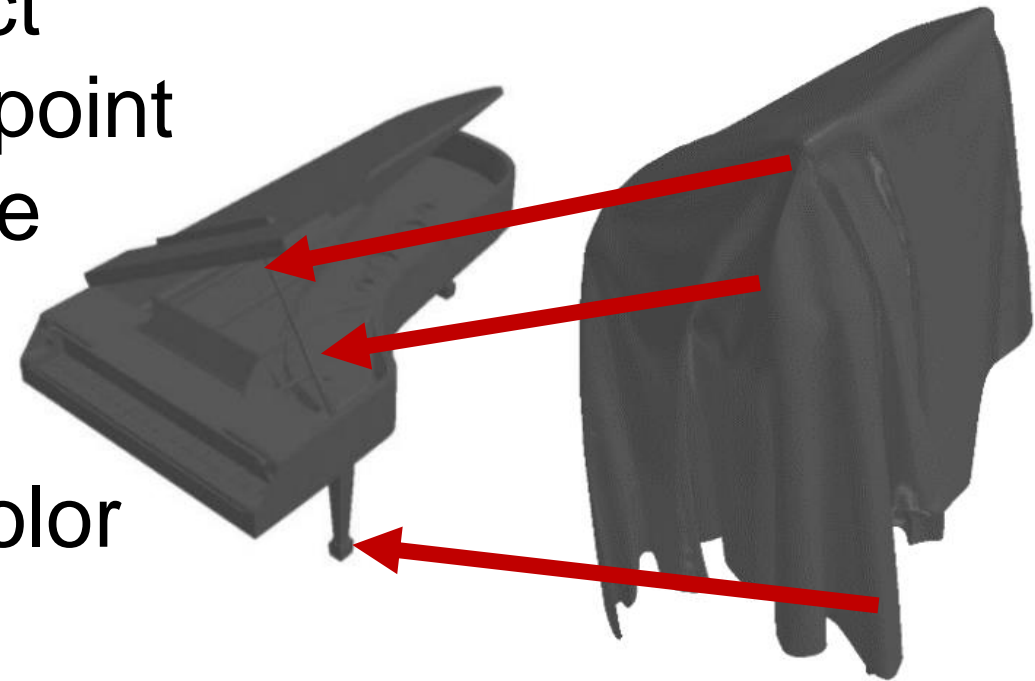
Calculate distance to that point

map distances to grayscale

map (0 to 0.1) to (1 to 0)

map (> 0.1) to 0

save color as per vertex color



Do with your favorite mesh-processing-library

Part 2 Task 3

Render 5000 images of cloth and corresponding distances

- choose a random viewpoint (upper hemisphere 0-45°)
- mesh should fill at least 50% of the height of the image
- for distances: render vertex color mesh from task 2 (render only albedo, e.g. with ambient light - **no shading!**)
- for images: choose a random (interesting) grayscale illumination per image (e.g. point light)

Perform e.g. with blender

All images 512x512 and grayscale

Image and distance image have to match



Part 2 Task 4

Render below linked 4 real test objects
Same settings as for images in Task 3
Pose $\pm 45^\circ$ frontal
10 images per object
Remove texture and use same gray
(no distance images)

<https://sketchfab.com/3d-models/veiled-vestal-raffaele-monti-d4714df6a4a84e2ead5cf99abd5592c4>

<https://www.myminifactory.com/object/3d-print-veiled-lady-at-the-minneapolis-institute-of-arts-usa-6091>

<https://www.myminifactory.com/object/3d-print-veiled-woman-at-the-louvre-paris-6479>

<https://www.myminifactory.com/object/3d-print-bust-of-a-veiled-woman-100907>



- Per project team 1 single zip file
- The zip file contains:
 - readme.pdf - a 1 page report, selling your solution to other project teams, there is no template
 - a folder called cloth
 - contains 5000 *.png rendering of your cloth
 - a folder called distances
 - contains 5000 *.png rendering of the distances
 - A folder called meshes
 - contains the first 5 meshes with calculated distances (vertex color)
 - A folder called test
 - subfolders 1-4
 - 10 *.png images each

- In Studon course :
“Tutorials to Computational Visual Perception”
- You will upload up to ~1GB
Plan in internet speed, upload at university

If you run into issues uploading, you send an md5 hash of your zip file **before** the deadline and you provide an alternative download link within 24h

- Correct file structure
 - readme.pdf contains useful information about the approach taken
 - 5000 cloth renderings
 - 5000 distance renderings
 - Color scheme is correct
 - Meshes contain distance as per vertex color
 - Illumination setting for cloth rendering is reasonable
 - No shading for distance renderings
 - Test images under same illumination and with same gray texture as other renderings
-
- Pass: not more than 2 of those points missing/wrong (binary)
 - Selected solution: all points fulfilled
-
- Plagiarism will have serious consequences

- Project Part 1: run physics simulation (perhaps blender, simple loops)
 - Project Part 2: calculate distances and render images (perhaps blender, you will need to code)
 - Project Part 3: Train a Unet on images from Part 1 (perhaps pytorch, you might get away with colab)
-

- You can ask questions in the forum
“Tutorials to Computational Visual Perception”
 - You come with concrete questions
 - I’ll open a thread in the forum, where you can respond till Tuesday each week if you want to meet
 - I’ll distribute time slots on Wednesday
 - No guarantee for any responses on the day of the deadline
-

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Massimo ✓
@Rainmaker1973

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The ghost sculptures in the castle of Vezio on Lake Como, Italy, are made with white chalk and re-crafted each summer by tourists who volunteer to be put in a particular position.

The tradition is linked to a legend.

In 1779, Anton Gioseffo della Torre di Rezzonico published a book, *Larius*, which is the other name of Lake Como.

In it, he mentioned that the castle was built thanks to the wishes of Theodelinda, the queen of the Lombards, the Germanic people who ruled this part of Italy for several hundred years from the VII century CE.

It is said that she spent the last years of her life in the area and wished to leave behind a church and oratory with a prominent bell tower as part of her legacy.

The legend says that her heart and soul are buried within the walls of the castle of Vezio and that her soul wanders its halls on moonless nights.

These plaster sculptures want to embody that legend that certainly adds to the beauty and mystery of the castle.



8:25 PM · Nov 18, 2023 · 396.8K Views



Armin Amiri ✓ @abedian_amiri · Nov 18



Gallos is an 8-foot-tall (2.4 m) bronze sculpture by Rubin Eynon located at Tintagel Castle, a medieval fortification located on the peninsula of Tintagel Island adjacent to the village of Tintagel (Trevena), North Cornwall, in the United Kingdom. It is a representation of a...

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The sculpture in 2016



Don't start late

PROCRASTINATION



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