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# 3D Vision

CORONA EDITION

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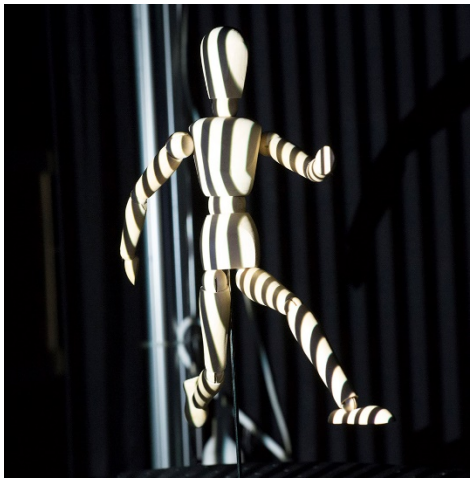
Look for remarks in this color

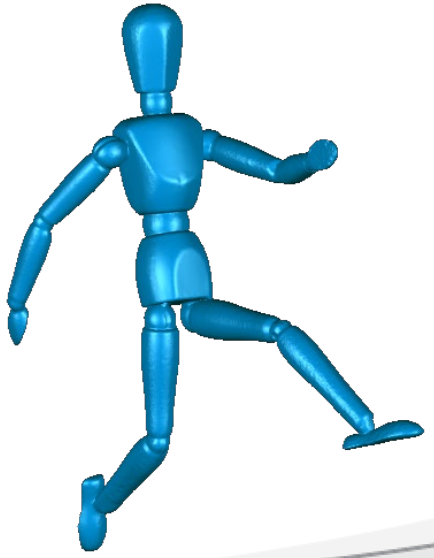
# Course overview

- Tasks:
  - Scan an object (of your choice) with our Structured Light Scanner (Aicon Primescan)
  - Create a Structure from Motion model of the **same** object by taking photos and processing them with a suitable software
  - Compare the results
- Team size:
  - 2-3 students
  - **1 Object per student**

# 3D Scanning (postponed indefinitely)

- Structured Light scanner
  - In our lab
- 1 object **per student**
  - Bring your own object
- Tasks
  - Scan objects in lab (under supervision)
  - Noise removal, registration and merging
    - → Waterproof 3D Model
  - Evaluation





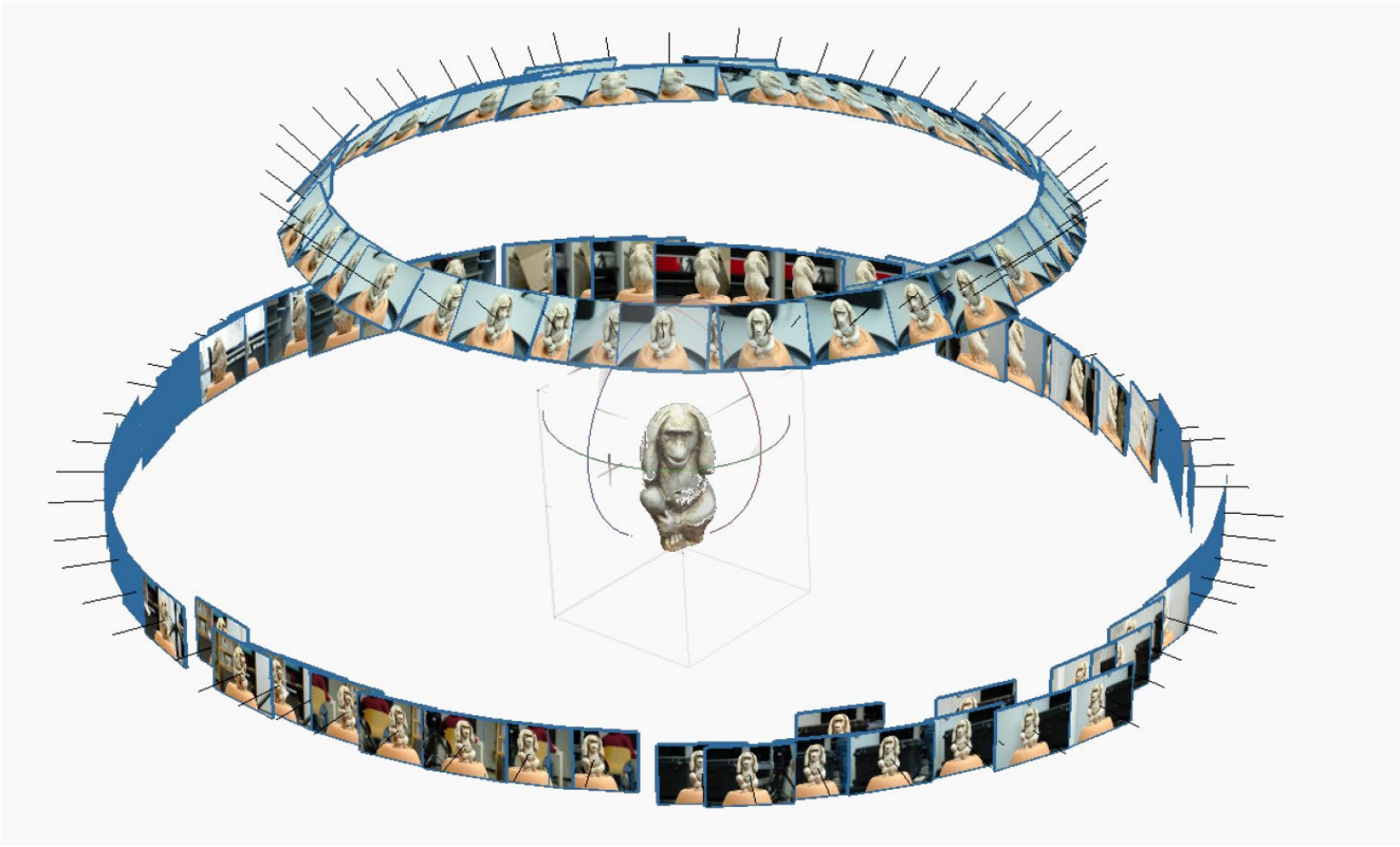
# Structure from Motion (the perfect quarantine activity! ☺)

- Take *suitable* pictures (see next slide)
- Create 3D model with SfM software, e.g:
  - VisualSFM: open source, very basic
  - Agisoft Metashape (formerly *Photoscan*): commercial, lots of nice features, 30 days full trial available
  - ..but you can also try something else. (look here for example: https://m.all3dp.com/1/best-photogrammetry-software/)
- Export model and refine it in Geomagic (noise removal etc)
- Waterproof 3D model only required for Grade 1 ;)
- Evaluation: compare result to scanned object

# Tips for taking pictures

- If possible, use a proper camera (DSLR, mirrorless) rather than a phone (image sensors is where size does matter!)
- Your object must be sharp in every photo! Double check!
  - Use a **small aperture** (e.g. f20) for high Depth of Field
  - Use a **tripod** (small aperture→long exposure)
- Move around the object at constant height and distance in ~10°-steps; do several rounds from different heights.
- Make raw images and convert them to **lossless format** (TIFF/PNG) (Unfortunately, VisualSfM only supports jpg..)
- If your object has little texture, put it onto something textured (e.g. newspaper), that helps with finding the camera parameters
- **Put a ruler/grid in the scene!** So you can correctly **scale** your object afterwards.
- Watch this video, for photogrammetry basics and practical tips:
  - https://www.youtube.com/watch?v=D7Torjkfec4

# Example



# The Object: make a wise choice!

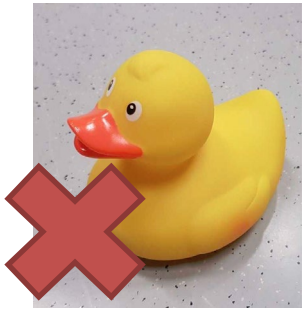
- Choose an object which you can access througout the whole term
- Size: apple – pinapple ☺
- Ideally waterproof (for volume measurement)
- Rigid, matte surface, moderately textured, medium complexity
- …more detailled dos‘s and dont‘s on the next slides

# Don‘ts

Shiny
even specular plastic can be problematic

Transparent/translucent

High contrast texture
→ bad for structured light scanner

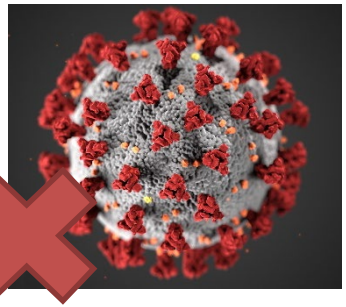


High contrast texture
→ bad for SfM (no unique feature points)

Too complex
lots of work

Too simple / symmetric
a) boring
b) problematic ambiguities

deformable

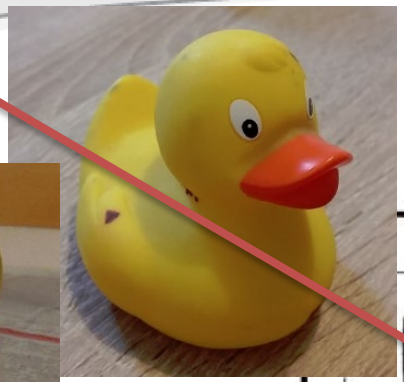


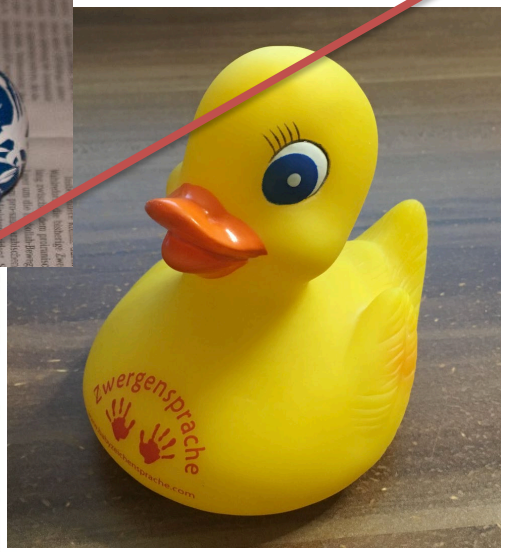
Viruses
(smaller than apples)

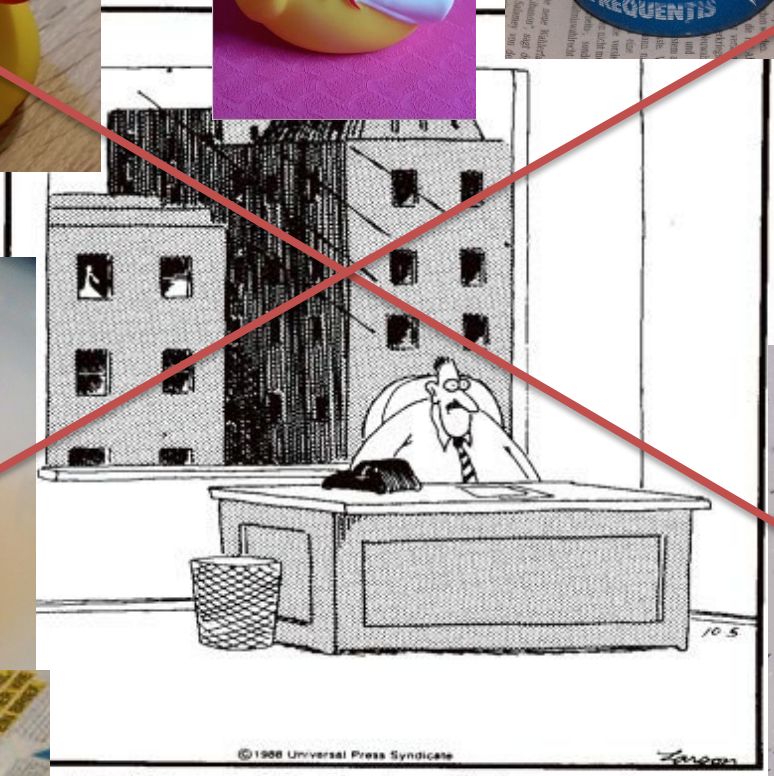
# Dos

„natural“ materials usually work best

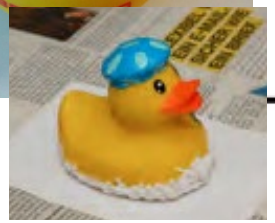
Ducks were very popular in previous semesters.. Please don‘t..

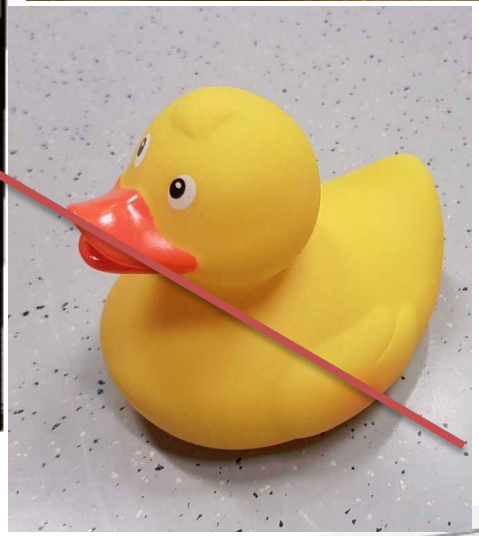





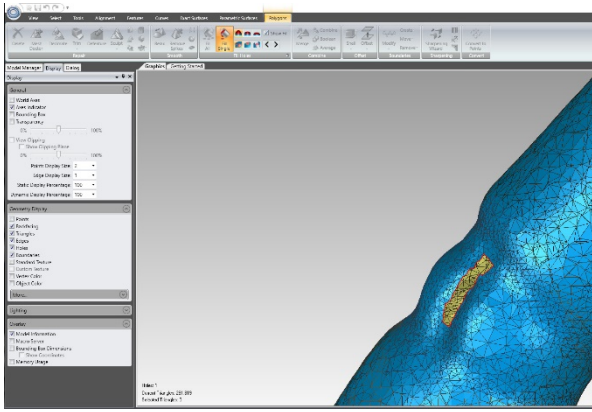




Anatidaephobia: The fear that somewhere, somehow, a duck is watching you.





# Post-Processing: Geomagic Wrap



- Professional 3D editing software
  - Registration, noise removal, hole filling etc.
  - Validation
- Installed on Pong Lab PCs
- @Home: 15 Days fully functional trial available (should be enough time..)
- As you will geomagic for processing of the Scanner-Models as well, we don’t recommend you to activate your trial on your PC yet (as we don’t know when we can start with the scanning..)
- Setting up a virtual machine and activating your trial there could be a solution, if you can’t wait to start ☺
- Also, lab PCs with Geomagic isntalled will be available once TU is open again..

# Laboratory Sessions @ Pong Lab

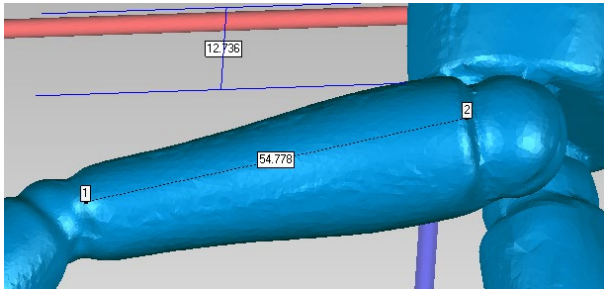
- Starting in May, see TISS for dates (given TU is open by then)
- Not mandatory
- You can use those sessions to do your processing, while a tutor is there to answer your questions / help you with your problems
- From the start of the lab sessions, you can work at the lab any time (when it is not occupied by another lecture)
- Once your accounts are ready, we will let you know via TISS

# Documentation

- 2-4 pages per student
  - Show your results
  - Write about the lessons learned when scanning and processing your object
  - Evaluate & compare results from scanner & SfM (see next slide)
  - (Do not explain how the scanner works..)
  - You can find an example report on the LVA Website

# Evaluation

- Take measurements on real object and compare them to measurements on the digital objects (scanner model and SfM model)
- >=3 lengths
- Volume
  - Measure the amount of Water displaced by your object!
  - Sand works as well (if your object can’t get wet)




# Presentation

- Length
  - 5-7 minutes **per group**
  - Maximally 12 slides **per group** (including title page)
- Content
  - Short summary of your report
  - Point out troubles when modelling your object
  - Give a short evaluation (compare models & physical objects)

# Submission

- You must submit:
  - Finished Scanner Model
  - Finished SfM Model
  - Written Report
- Please don’t submit intermediate results, input pictures, etc..
- Create a zip archive following this structure:
  - - Group[xx]
    - Group[xx]_report.pdf
    - [Member 1]
      - [object name]_scanner.[wrp, obj, stl,..]
      - [object name]_sfm.[wrp, obj, stl,..]
    - [Member 2]
      - …
- Give us the zip file directly at the presentation session, or send it via wetransfer, dropbox, etc.

# Schedule

- 3D scanning — we don't know when
  - At the institute (HA 0420, Favoritenstraße 9)
- Tutorium — May – June (see TISS)
  - Pong Room (HG EG15, Favoritenstraße 9)
  - Monday 12:00 – 14:00
  - Thursday 10:00 – 12:00
- Deadlines
  - Presentation — End of Semester (TBA)
  - Final Model & Documentation — same day as the presentation

Registration is now open. Please register for the course via TISS.

For any questions, please contact:

Simon Brenner (sbrenner@cvl.tuwien.ac.at)

thank you