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## 3D Vision

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# Course overview

- **Structured light scanning is cancelled this semester!**
- Instead you create only one Structure from Motion model, but with higher requirements:
  - Scan from all sides
  - Watertight
  - Scaled to real-world units
- Team size:
  - Due to the situation you work **ALONE**
  - → **Group assignments in TISS are meaningless**

# 1. Choose an object to scan

- Choose an object which you can access throughout the whole term
- Size: as we are only doing SfM this semester, there are no hard size restrictions.
- Ideally waterproof (for volume measurement)
- Rigid, matte surface, fine-grained texture, medium geometric complexity
- ...more detailed dos' and dont's on the next slides



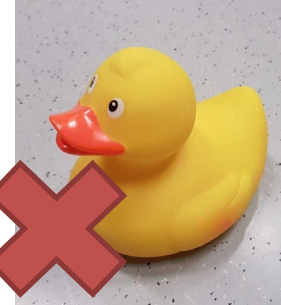
# Don'ts



Shiny  
even specular plastic  
can be problematic



Transparent/translucent



Uniform surfaces  
→ bad for SfM (no unique  
feature points)



Too complex  
lots of work



Too simple / symmetric  
a) boring  
b) problematic ambiguities



deformable

# Dos

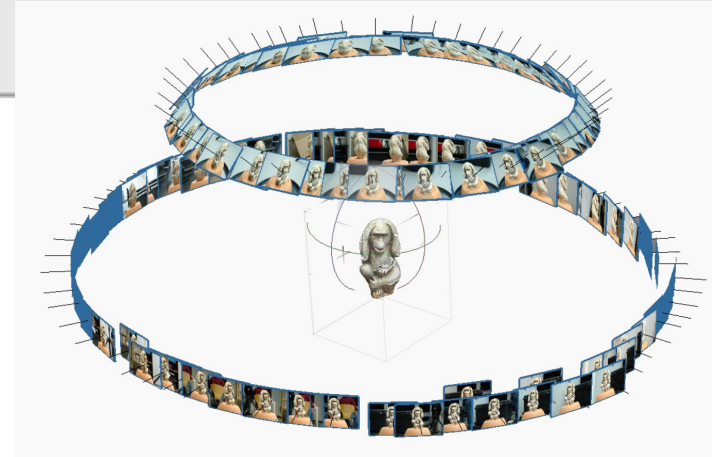


„natural“ materials usually work best



## 2. Take photos

- Move around the object at constant height and distance in  $\sim 10^\circ$ -steps; do several rounds from different heights.
- Turn the object upside down and repeat the process
  - So that you acquire also the bottom surfaces.
- **Put a ruler/grid in the scene!**
  - This allows you to correctly scale your object in real-world units



# More tips for taking pictures

- If possible, use a proper camera (DSLR, mirrorless) rather than a phone (image sensors is where size does matter!). If you can't get a camera, just use your phone and expect some quality losses.
- 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)
- 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
- Watch this video, it is a nice intro for photogrammetry basics and practical tips: <https://www.youtube.com/watch?v=D7Torjkefc4>

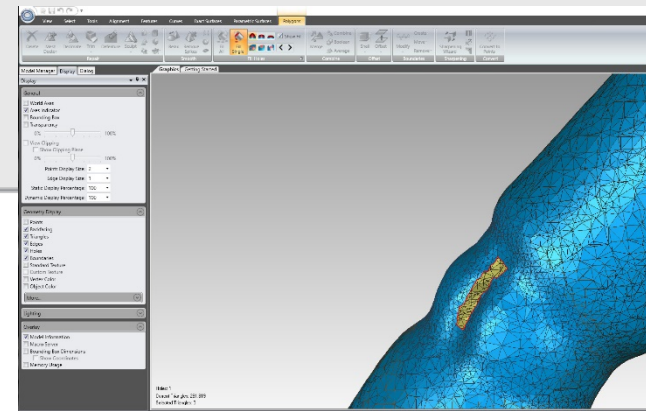
# 3: 3D Reconstruction

- Use SfM software, e.g:
  - 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/>)  
Please note though that we can only support you with Agisoft Metashape
- Things you should do in the SfM software:
  - Estimate camera parameters
  - Create dense point clouds
  - Scaling of the object, using the grid/ruler that you have put in your scene!
  - Background removal
  - Put together different top-and bottom halves.. („chunks“ in Agisoft); can be done later as well, but might be more tricky
  - Optional: meshing (experience says that meshing doesn't work so well in Agisoft)
  - Export point cloud or mesh



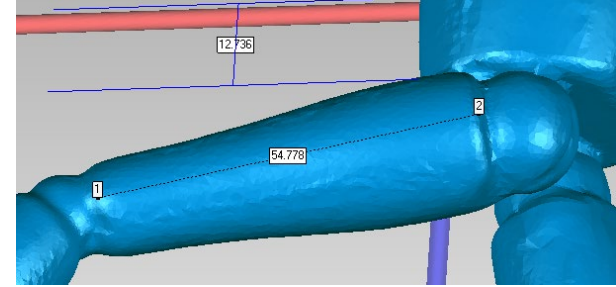
# 4. Post-Processing: Geomagic Wrap

- Professional 3D editing software
- What you should do in Geomagic:
  - If necessary: registration and merging of different parts of a model
  - Noise removal, smoothing etc.
  - Hole filling
  - Evaluation (see next slide)
- End-Result: clean, **watertight** 3D model!
- No Lab-Workspaces this semester, sorry ☹️
- Using Geomagic Wrap @Home: 15 Days fully functional trial available (should be enough time to finish; if not, work with virtual machines...)



# 5. Evaluation

- Take measurements on real object and compare them to measurements on the digital objects
- $\geq 3$  lengths
- Volume
  - Measure the amount of Water displaced by your object!
  - Sand works as well (if your object can't get wet)



# 6. 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 reports from past semesters on the LVA Website

# Support

- Normally, there would be supervised lab sessions. Not happening this semester.
- **Instead, we offer regular ZOOM meetings, for which you can sign up via TUWEL.**
- Up to 5 participants can sign up for a meeting.
- A tutor will be there to answer your questions and help you with your problems (as far as they concern the course)

# Final presentations: Via ZOOM as well

- Length
  - 2 minutes **per person**
- Content
  - Short summary of your report
  - Point out troubles when modelling your object
  - Give a short evaluation (compare models & physical objects)
- More infos about when and how this will be organized follows!!

# Submission

- You must submit:
  - Final SfM 3D model
  - Written Report
- Please don't submit intermediate results, input pictures, etc..
- Please submit the following files via TUWEL:
  - - Report: 3DVision2020\_[Lastname].pdf
  - - Model: 3DVision2020\_[Lastname]\_model.[wrp, obj, stl,..\*]

\*you can submit your Geomagic Wrap project file (.wrp) or any common 3D format.

# Grading

- 50% Model
  - We mainly rate the geometry of the model: watertightness (!), presence of non-manifold geometry, holes, noise, etc.
  - Nice texture is bonus
- 30% Report
- 20% Presentation

# Schedule

- ~~3D scanning~~ **cancelled**
- Tutorium May – June
  - Via ZOOM
  - See TUWEL for available slots
- Deadlines
  - Presentation End of June (TBA)
  - Final Model & Documentation **30.6.2020**



Thank you for participating and sorry for any inconveniences!

For any questions, please contact:

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