3D Vision

Robert Sablatnig
Tutoren: Simon Brenner, Stefan Schurischuster

UPDATE 2020-04-07
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’s and dont’s on the next slides
Don‘t s

- 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 \(~10^\circ\)-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=D7Torjkcfc4
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...)

3D Vision 2020
5. Evaluation

- Take measurements on real object and compare them to measurements on the digital objects
- >=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:

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