Seminar: An Overview of Methods for Accurate Geometry Reconstruction

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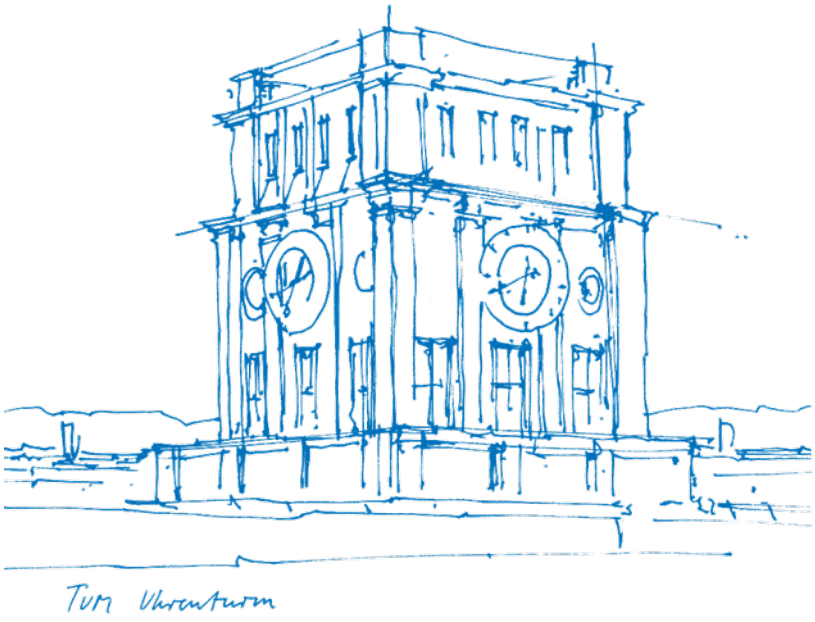

How can I access these slides?

- Option 1 (preferred): seminar web page
  - `https://vision.in.tum.de/teaching/ws2021/seminar_accurate3d`
  - Password for material page: `ws21-3dgeometry`
  - Material page will go online after this pre-meeting
- Option 2: contact organizers
  - `3dgeometry-ws21@vision.in.tum.de`
  - **Only use this option if you forgot the password**

Outline

- General Information
  - About the Seminar
  - Registration
- Possible Papers
  - Mono-view approaches
  - Multi-view approaches
- Questions

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How is the seminar organized?

- Seminar meetings: Talks and discussion
  - Day: Monday, October 4th and Tuesday, October 5th
  - Time: tba
  - Location: tba
  - In case of special circumstances please let us know and we will find a solution
  - Each day will consist of 4 or 5 talks which are held in English
  - **Attendance is mandatory!**

How is the seminar organized?

- Talk preparation / contact with supervisor
  - Read through your paper and write down what you don't understand
  - Three or four weeks before talk: meet supervisor for questions (optional, but recommended)
  - One week before talk: meet supervisor to go through slides (optional, but recommended)
  - Before October 4th: submit your slides via submission system (mandatory)
  - Before October 25th: submit your report via submission system (mandatory)

What about the presentation?

- General set-up:
  - Duration: 20–25 minutes talk + 10–15 minutes discussion
  - Make sure to finish on time - not too early and not too late!
  - Rule of thumb: 1–2 minutes per slide $\rightarrow$ 10–20 slides
  - Do not put too much information on one slide!
- Recommended structure (talk):
  - Introduction
  - Overview / Outline
  - Method description
  - Experiments and results
  - Personal comments
  - Summary

What about the discussion after each talk?

- Discussion afterwards **will** influence your grade
- Ask questions!
- There are **no** stupid questions!

What about the final report?

- General set-up:
  - Use LaTeX template provided on web page
  - Length: 3-4 pages
  - Upload final report as pdf via submission system
  - Submission deadline: **25.10.2021**
- Recommended structure (main text only):
  - Introduction
  - Method description
  - Experiments and results
  - Discussion of results
  - Summary

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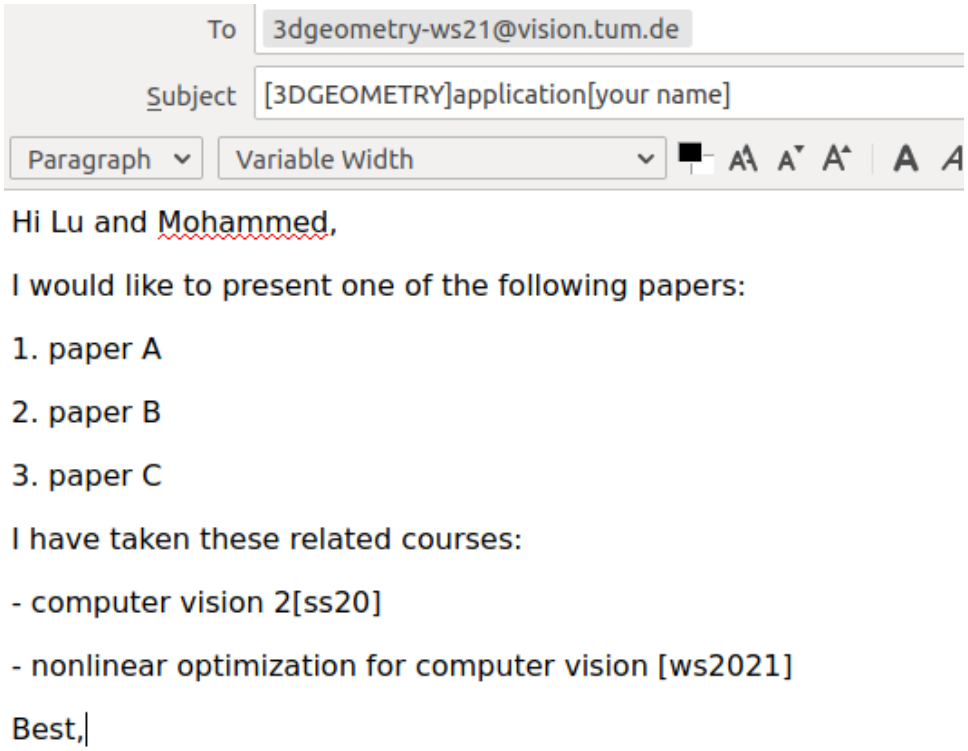
How do you register for the seminar?

- Step 1: Official registration via TUM matching system
  - Go to `https://matching.in.tum.de`
  - Register for seminar with the title *An Overview of Methods for Accurate Geometry Reconstruction*
- Step 2: Personal registration via email
  - In the list of papers on the web page, select your three favorites
  - Write an email ranking these three favorites to the seminar email address
  - Email subject: "[3DGEOMETRY] application [your name]"
  - Include information about related lectures / courses you have taken so far.
  - We do **not** need your CV or a motivation letter!
  - Registrations without email / emails with missing information will be ignored!
- **(NEW!!)** Deadline for matching system: 20.07.2021, for email: 24.07.2021

How do you register for the seminar?

Example registration email:



How do we select candidates and assign papers?

- Candidate selection
  - Only students registered in the matching system **AND**

    emails containing all required information will be considered
  - Among students meeting the formal criteria, selection will be random
  - Note that if you have not taken any related course, you must be willing to invest a lot of work to learn the required basics
  - You will get notified by the matching system about the decision.
- Paper assignment
  - Papers are assigned after the participant list is finalized
  - We give our best to accommodate your preference list in the assignment

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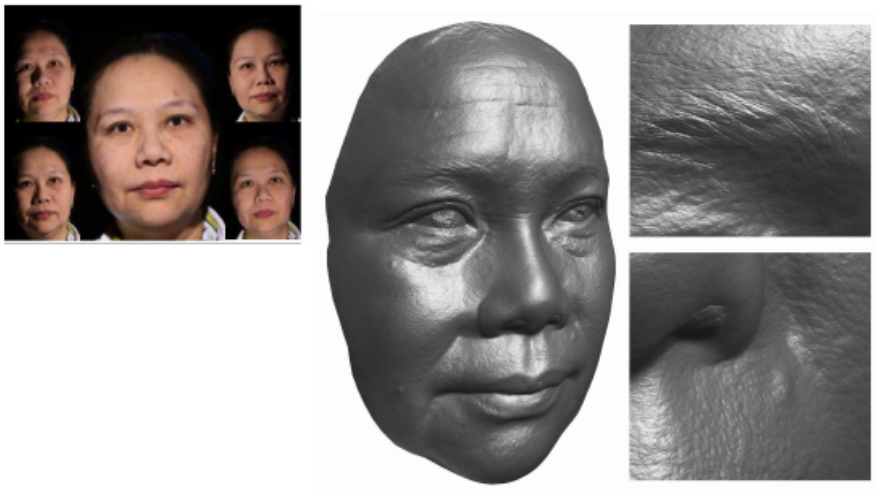
Sparse Photometric 3D Face Reconstruction Guided by Morphable Models

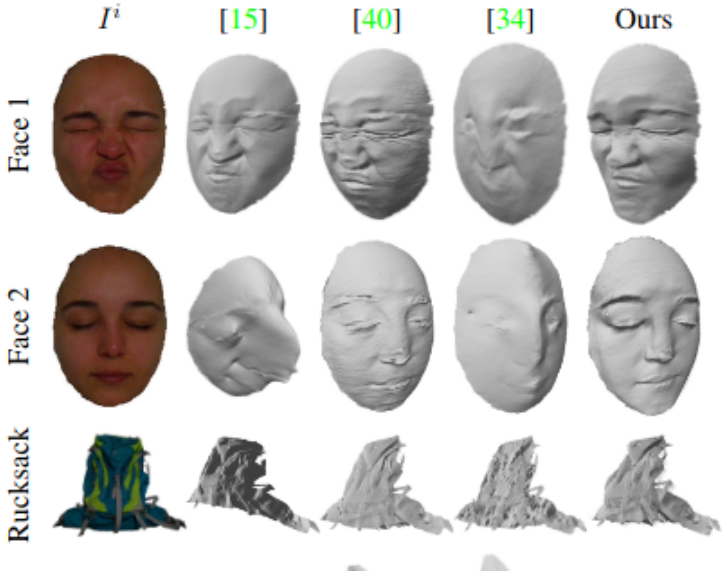
Xuan Cao et al. CVPR 2018



- A highly accurate 3D face is generated by solving an inverse rendering problem with the help of a 3D morphable model, using few input images taken by a fix camera, under unknown changing lighting.

Variational Uncalibrated Photometric Stereo under General Lighting

Björn Haefner et al. ICCV 2019



- Fundamental paper that uses a simple photometric stereo method to get accurate 3d geometry
- Traditional method with elegant optimization technique

Fight ill-posedness with ill-posedness: Single-shot variational depth super-resolution from shading

Björn Haefner et al. CVPR 2018

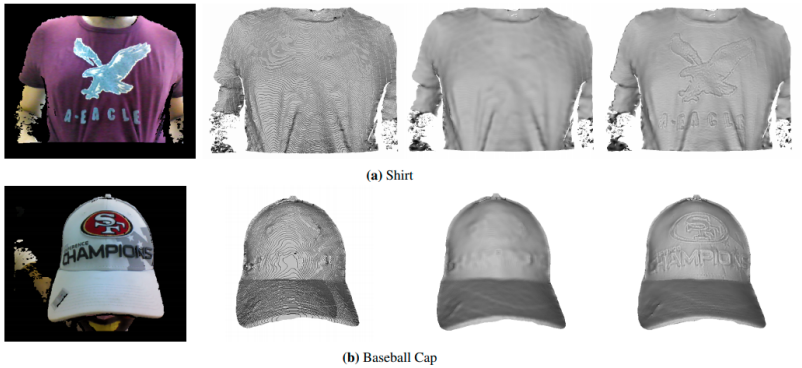
Input: one low-resolution depth map and its companion high-resolution image

Our result

- introduction paper to shape from shading method
- traditional method to achieve good results

RGBD-Fusion: Real-Time High Precision Depth Recovery

Roy Or - El et al. CVPR 2015



(a) Shirt

(b) Baseball Cap

- real time capable
- different approach to achieve accurate geometry reconstruction

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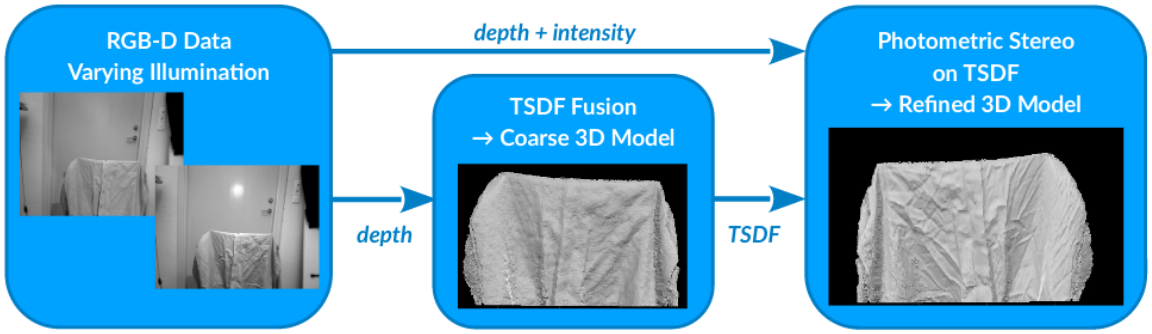
Combining Depth Fusion and Photometric Stereo for Fine-Detailed 3D Models

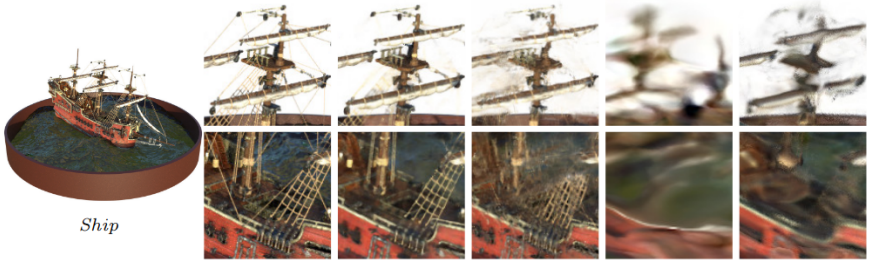
Erik Bylow et al. SCIA 2019



- combine photometic stereo with SDF method
- a full 3d detailed model reconstruction

NeRF: Representing Scenes as Neural Radiance Fields for View Synthesis

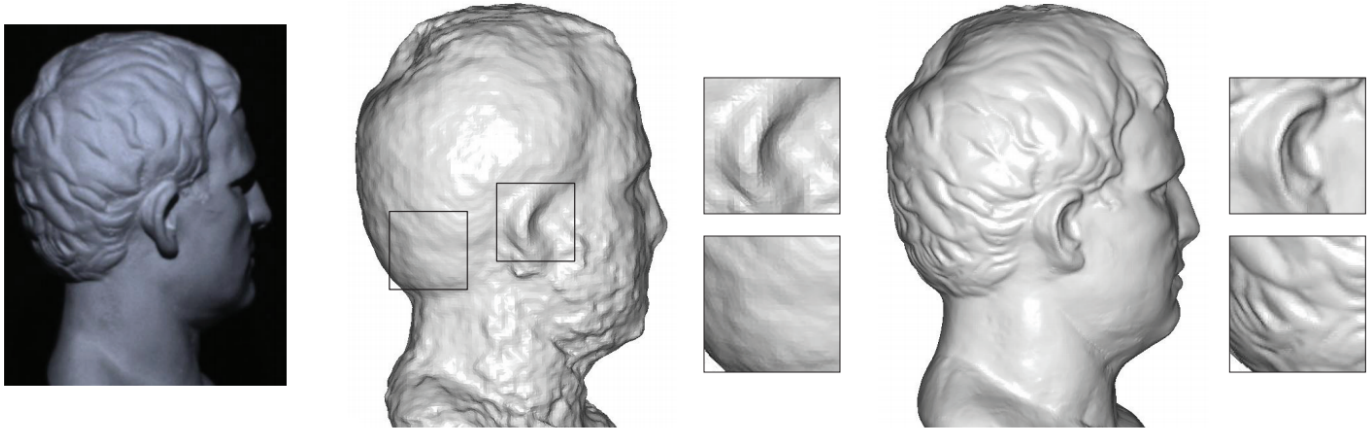
Ben Mildenhall et al. ECCV 2020



- deep learning based approach
- very popular and high cited paper

Multiview Photometric Stereo using Planar Mesh Parameterization

Jaesik Park et al. ICCV 2013



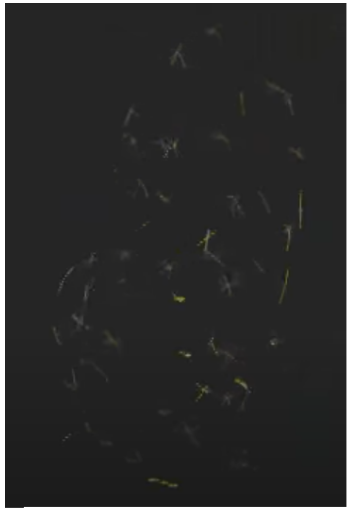
Initial 3D reconstruction

Refined result

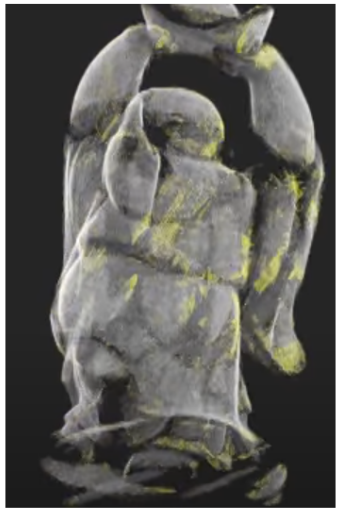
- Many images of an object are taken by several fix cameras, under unknown changing lighting.
- By using the input images and an initial coarse mesh obtained with an existing multiview technique, a displacement map is optimized in order to produce a detailed mesh.

Multi-view Photometric Stereo with Spatially Varying Isotropic Materials

Zhenglong Zhou et al. CVPR 2013



Initial sparse point cloud



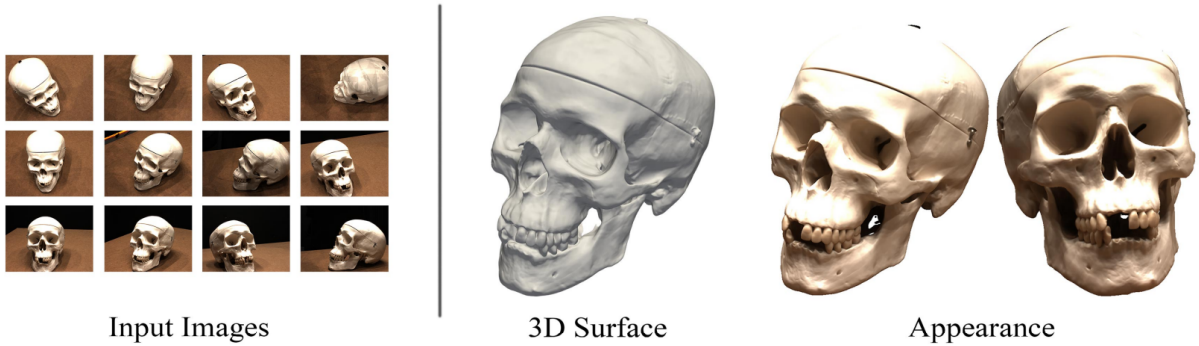
Densified point cloud

Final colored 3D model

- A sparse point cloud is densified using photometric cues to obtain a high quality mesh.
- Material is also estimated based on the acquired geometry.

Multiview Neural Surface Reconstruction by Disentangling Geometry and Appearance

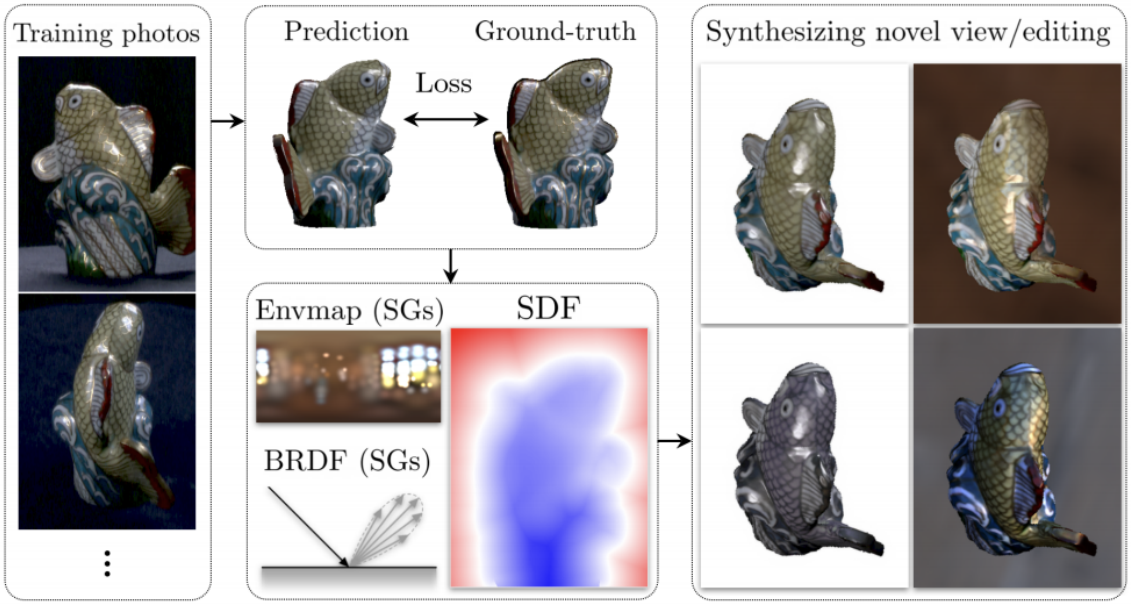
Lior Yariv et al. NeurIPS 2020



- One RGB image is captured for many known camera positions with one unique lighting.
- Two MLPs representing respectively the SDF and the appearance are optimized jointly to obtain a good 3D mesh and rendering from novel viewpoints with the same illumination.

PhySG: Inverse Rendering with Spherical Gaussians for Physics-based Material Editing and Relighting

Kai Zhang et al. CVPR 2021



- The appearance is decoupled into lighting and material, which are optimized jointly with the geometry.

Questions?

Reminder:

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