Material based reconstruction and segmentation

1. General Info

Project Title: Material based reconstruction and segmentation

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2. Project Abstract

This project aims to jointly 3d reconstruct and segment an object into its material-based parts. Creating a small synthetic dataset of everyday objects with different materials will be the basis for exploring and evaluating different methods for reconstruction, material models and segmentation. Finally we will verify the generalization of the methods on real scans of objects.

3. Background and Motivation

Most of the everyday objects surrounding us are made of many different materials with different physical and optical properties. Reconstructing the 3d shape and material of these objects can help us to create digital twins as assets for augmented reality applications or the training of machine learning models. Further understanding the material composition of the objects can simplify the representation, improve the regularization and be used to segment objects into parts. The material based decomposition of objects allows us to better understand the function and similarity of parts of objects from the same category and can be used for semantic alignment. The 3d model with material annotations can further be used to disassemble and recycle objects once they have reached their lifecycle.

4. Technical Prerequisites

- Experience in 3D Computer Vision/Graphics
- Experience in Deep Learning
- Python
- PyTorch

5. Benefits:

- Prototype with synthetic data and evaluate on real data
- Learn about implicit 3d representations
- Learn about material models
- Learn about 3d segmentation

6. Students’ Tasks Description

Students’ tasks would be the following:

- Create synthetic multi-material object part dataset
  - Take available 3D object models
  - Create part specific materials
  - Propose lighting setup

  - Create dataset of volumetric/projective renderings
- Apply 3D & material reconstruction methods
  - Start with simple material models
  - Try more complex material models
- Evaluate performance with respect to
  - Number of views
  - Number of lighting conditions
- Segment object parts based on material information
  - Try different clustering methods
  - Try learning based methods

7. Work-packages and Time-plan:

	Description	#Students	From	To
WP1	Synthetic dataset creation			
WP2	Joined 3d & material reconstruction			
WP3	Material based part segmentation			
M1	Intermediate Presentation			
WP4	Collect real dataset			
WP5	Improve joined 3d & material reconstruction			
WP6	Improve material segmentation			
M2	Final Presentation			

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