

# Master-Thesis

## Material Classification Using Time-of-Flight (ToF) Camera

Time-of-Flight (ToF) cameras are active imaging sensors primarily used to capture the 3D geometry of a scene. However, recent research has demonstrated that ToF cameras can also perform **material recognition on a per-pixel basis**, a capability known as material sensing. Unlike conventional computer vision methods that rely on color and texture, ToF-based material recognition exploits the unique temporal response of different materials to incident light. This temporal response is often characterized by the **Material Impulse Response Function (MIRF)** or **Temporal Point Spread Function (TPSF)**, which relates to the material's surface and subsurface scattering properties. This master's thesis will focus on implementing and evaluating modern techniques for material classification using a ToF camera. The goal is to collect novel datasets of similar materials, develop new deep neural networks, compare them with existing models, and develop a robust system that enables real-time material classification.



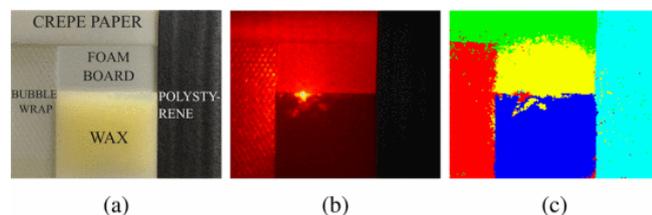
The ToF camera and the material map.

### Requirements:

- **Experience in sensor data processing and computer vision** (e.g., signal processing, feature extraction)
- **Familiarity with machine learning/deep learning frameworks** (e.g., for implementing 3D deep neural networks)
- **Good programming skills** (e.g., Matlab/Python/C++)
- **Good English**

After completing this work, there are good career prospects in the following fields:

- Machine Learning
- Data Science
- 3D imaging



The demonstrator setup (a) Consists of five different materials placed at approximately the same distance to the camera. (b): NIR amplitude image, (c): Material image © R. U. Singh, M. Heredia Conde (2022).

**Betreuer:** Zhibin Liu  
**Raum:** W-Tec 00.09  
**Telefon:** +49 202/317 13141  
**Email:** [zhliu@uni-wuppertal.de](mailto:zhliu@uni-wuppertal.de) [herediaconde@uni-wuppertal.de](mailto:herediaconde@uni-wuppertal.de)  
**Gutachter:** Dr.-Ing.habil. Migue Heredia Conde