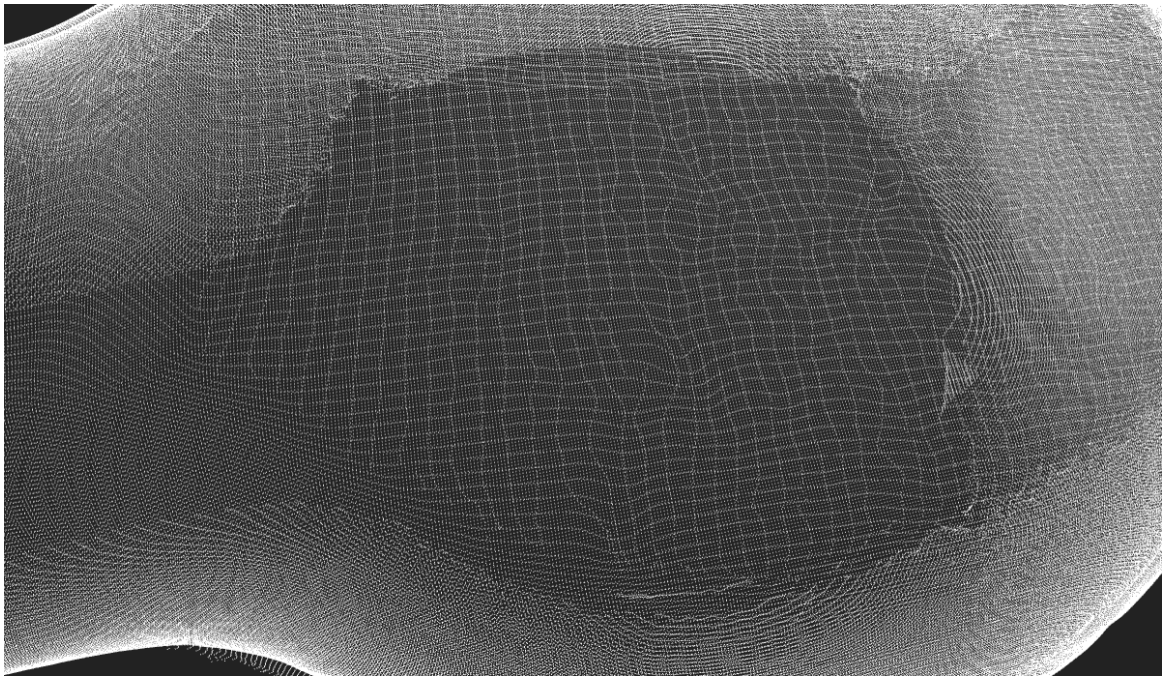
Seminar Thesis

Topic: **Reconstruction of meshes from point clouds for trajectory planning in robot-based manufacturing processes**



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For Mr.: Steve Sandhoop
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Title: **Reconstruction of meshes from point clouds for trajectory planning in robot-based manufacturing processes**

In robot-based machining processes, such as milling, grinding, or coating components, trajectory planning requires a cleaned, detailed mesh of the workpiece surface. The initial data often consists of point clouds captured by optical sensors. However, these point clouds inevitably contain measurement noise and artifacts that make it difficult to use them directly for process planning.

The central challenge is to generate a mesh that reliably suppresses sensor noise while preserving fine geometric features such as depressions and elevations on free-form surfaces of cast or forged parts without distortion. Only in this way can precise robot trajectories be generated that ensure high-quality machining.

Approach:

- **Requirement definition:** Specification of mesh quality requirements specifically for trajectory planning (e.g., smoothness, detail accuracy, geometric accuracy, robustness against different noise levels).
- **Analysis of existing approaches:** Research and evaluation of methods for mesh reconstruction from point clouds (e.g., Poisson surface reconstruction, ball pivoting, Delaunay method, ML-based methods).
- **Data basis:** Generation of synthetic point clouds with varying geometries and noise levels in a simulation tool (e.g., Blender) for controlled investigation.
- **Implementation and evaluation:** Implementation of appropriate procedures and their systematic evaluation in relation to:
  - Different geometries (free-form surfaces, components with local depressions/elevations)
  - Varying noise levels
  - Requirements for reuse in the trajectory planning process

Thesis goal: To develop a robust workflow for generating cleaned meshes from point clouds, which will form the basis for reliable and efficient trajectory planning in robot-based manufacturing processes