Said Harb

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Education

- **Technische Universität Braunschweig** — Braunschweig, Lower Saxony, Germany
  Master of Science - Computational Science in Engineering; Grade (GER): 1.1 — *Oct 2022 - Sep 2025*
  ***Courses** (All English-taught): Machine and Deep Learning, Continuum Mechanics, Numerics, Parallel Computing, Software Eng.*
- **University of Rhode Island** — Kingston, RI, USA
  International Student - Computer Science; Grade (GER): 1.0, Grade (US): 4.0 GPA — *Aug 2023 - Jan 2024*
  ***Courses:** Algorithms for Big Data, Numerical Methods for Partial Differential Equations, Ecological Statistics*
- **Technische Universität Ilmenau** — Ilmenau, Thuringia, Germany
  Bachelor of Science - Mechanical Engineering; Grade (GER): 1.4 — *Oct 2018 - Sep 2022*
  ***Courses:** Machine Elements, Electrical Engineering, Materials Science, Production Engineering, Project Management*
- **Pestalozzi-Gymnasium** — Dresden, Saxony, Germany
  Abitur; Top of the year, Grade (GER): 1.1 — *Aug 2009 - Jul 2017*

Skills Summary

- **Programming Languages**: Python (Advanced), Matlab (Intermediate), Julia (Intermediate), C++ (Beginner)
- **Programming Frameworks**: PyTorch, TensorFlow, Cuda, Open3D, OpenCV, Pandas, NumPy, Matplotlib
- **Technologies**: Git, Docker, WandB, GPU Clusters, Linux, Cloud Compare, Helios++, Blender, Microsoft Office
- **Languages**: German (Native), English (Full Professional Proficiency), Spanish (Conversational), Arabic (Conversational)

Experience

- **Technische Universität Braunschweig** — Braunschweig, Lower Saxony, Germany
  Master Thesis, Grade (GER): 1.0 — Institute of Geodesy and Photogrammetry — *Nov 2024 - Sep 2025*
  - **Title: "Reconstructing CAD models of non-complex objects from point clouds: A data-driven approach"**: Point cloud data from laser scanners can be acquired in large quantities, yet it lacks explicit connectivity. CAD models, in contrast, offer structured and parametric representations used widely across industry. In this work I developed a deep learning model that transforms point clouds of scanned objects into their corresponding CAD models (sketch-and-extrude operations). The model is trained on the publicly available DeepCAD dataset. To improve reconstruction performance, a segmentation approach is applied that splits each CAD model into its individual extrusions, forming primitive CAD models. Experiments show that training on these segmented primitives not only increases reconstruction quality and model generalizability but also enables the inference of more complex CAD models.

  Student Assistant — Institute of Geodesy and Photogrammetry — *Oct 2024 - today*
  - **LiDAR simulation for ISPRS benchmark dataset PC2Model**: Developed and curated a point cloud to 3D model registration dataset within a small team. Investigated multiple 3D model datasets to select samples. Created a Python Blender add-on to interface with the Helios++ laser-scanning simulation software and conducted simulations of objects and buildings. Co-authored the paper for the dataset for submission to ISPRS Toronto 2026 and gained hands-on experience with real LiDAR scanners.

  Student Assistant — Institute of Applied Mechanics — *Apr 2023 - Sep 2024*
  - **Software developement**: Developed an importable module in Julia for using the tesselation software Neper for creating, meshing, and visualizing polycrystal tesselations (NeperStructureGenerator.jl). Furthermore, I designed interactive Pluto notebooks in Julia to visualize, teach, and explore various topics in continuum mechanics (e.g. deformation gradient, elasticity, material models).
  - **Teaching**: Conducted 14 seminars on advanced engineering mathematics, preparing civil engineering undergraduates for their final technical mechanics exams.
- **Schaeffler Technologies AG & Co. KG** — Herzogenaurach, Bavaria, Germany
  Bachelor Thesis — Grade (GER): 1.3 — With Frauenhofer-IDMT — *Apr 2022 - Sep 2022*
  - **Title: "NVH-analysis of the interface stiffness of attachment parts of electric drive units"**: Developed an analytical and a numerical model of an electric drive to study the impact of attachment part interface stiffness on vibration and sound radiation. Determined mechanical methods to optimize the interface stiffness, thereby reducing vibration transmission and sound radiation.

  Internship — Simulation department — *Oct 2021 - Mar 2022*
  - **Structural dynamics analysis**: Conducted literature research on structural dynamics and vibration transmission. Developed analytical two-mass oscillator models in MATLAB and performed modal and harmonic analysis using Abaqus CAE. Determined interface stiffness optimization methods for electric drives.
- **Technische Universität Ilmenau** — Ilmenau, Thuringia, Germany
  Student Assistant — Machine Elements Group — *Apr 2021 - Aug 2021*
  - **Surface roughness measurements**: Conducted roughness measurements on spring wires using a laser scanning microscope to assess and improve manufacturing processes.

Publications

- **ISPRS — Multi-temporal crack segmentation in concrete structures using deep learning approaches:**
  Harb, S., Achanccaray Diaz, P., Maboudi, M., and Gerke, M.: Multi-temporal crack segmentation in concrete structures using deep learning approaches, ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci., X-G-2025, 341–348, https://doi.org/10.5194/isprs-annals-X-G-2025-341-2025:
  This paper addresses the importance of structural health monitoring for civil concrete structures, which are vital to modern society. Cracks are one of the earliest indicators of structural decay, therefore, early detection is important. Using deep learning, the study focuses on pixel-level image segmentation to identify cracks. For this, the temporal domain of crack progression is addressed in this work. I manually created and annotated a multi-temporal crack propagation dataset for semantic segmentation, consisting of 1356 samples, each illustrating crack growth on concrete over a series of 32 sequential images. A Swin Transformer adapted for three-dimensional input (Swin UNETR) was trained on the multi-temporal dataset. Its performance was compared to a mono-temporal model (U-Net) that was trained on exactly the same, but deserialized, data. Results demonstrate that the multi-temporal approach surpasses the mono-temporal model in terms of IoU and F1-score significantly, alongside superior visual predictions, all while using half the parameters of the mono-temporal model. The multi-temporal approach holds potential for long-term structural health monitoring of concrete structures, even with limited sequential data.

Projects

- **Computer Vision and Remote Sensing — Improving object detection performance on hard to detect instances in DOTA (2024)**:
  This project improved mean Average Precision (mAP) for hard-to-detect instances in the DOTA dataset. I implemented dataset augmentation (oversampling, copy-pasting hard-to-detect objects and their bounding boxes within images), preprocessing pipelines, training routines, object detection evaluation metrics, and post-processing in PyTorch to train a YOLOv5 model for object detection. The approach increased mAP for hard-to-detect instances significantly in comparison to the baseline (Homepage portfolio link).

- **Computer Vision and Autonomous Driving — Entropy maximization for anomaly detection in complex driving scenes using a UNet architecture (2023)**:

  This project trained deep learning segmentation models to detect out-of-distribution objects in driving scenes using entropy maximization. Real-world scenarios often feature classes not included in training datasets. To detect these objects, I implemented entropy maximization, which modifies the standard cross-entropy loss function to boost the model's prediction entropy for out-of-distribution objects. A U-Net model was trained using this modified loss function and compared to baseline models. The results indicate a substantial improvement in the anomaly detection capability of the U-Net model, with a significant increase in segmentation metrics like AUROC and AUPRC and a decrease in FPR95 (Homepage portfolio link).

- **Natural Language Processing — Song generator (2024)**: To gain a deeper understanding of modern chat tools like ChatGPT, I implemented a decoder-only transformer model from scratch using PyTorch. Additionally, I developed a pipeline to extract song lyrics of any given artist from the web, enabling the transformer model to be trained on these lyrics for the creation of new songs. For further comprehension, I created educational notebooks with code implementations of backpropagation, Multi-Layer-Perceptron and Batch Normalization (Homepage portfolio link, work in progress).

Honors and Awards

- Graduated with honors in Computational Science in Engineering 2025, ranked as best student since 2022.
- Ranked among the top 7 graduates in the Mechanical Engineering Bachelor's program at TU Ilmenau since 2019.
- Graduated as top of the year in high school.

Extraculicular Work

- **Work & Travel** — New Zealand
  Personal development, Language skills, Agricultural work — *Sep 2017 - June 2018*
- **Hobbies & Interests**
  Brazilian Jiu Jitzu, Scuba diving, Drone flying, Videography, Literature
- **Current Research Interests**
  Handheld point cloud capturing, Graph Neural Networks, SPH particle method, 3D animation