

Robust Segmentation of CT Images

Ausgangslage

Computed tomography (CT) images contain rich anatomical information that enables medical experts to diagnose bone fractures—such as wrist fractures—determine fracture types, and plan surgical interventions. However, this diagnostic process is complex and requires great care, as the resulting decisions directly affect patient outcomes.

At I4DS, in collaboration with the start-up **AINEAS**, we are developing a digital assistant that automatically segments bone fragments in CT scans of wrist fractures and provides data-driven suggestions for their repositioning during surgery. Earlier work has achieved promising results in improving segmentation accuracy, but the models still lack robustness in reliably identifying all fragments. We expect that combining **deep learning** with **classical computer vision** techniques and **domain knowledge** (e.g., anatomical landmarks) can significantly enhance model stability and performance.

Zielsetzung

The goal of this project is to design robust methods for the **automatic identification and classification** of wrist fracture fragments from 2D X-ray or 3D CT data. The focus is on techniques that:

- Improve segmentation robustness,
- Integrate domain-specific anatomical knowledge, and
- Provide a foundation for a production-ready solution.



Teilaufgabe für den Masterstudierenden

The project is structured into three main phases:

- **P7 – Familiarization and Reproduction:**
Understand the medical use case and reproduce results from previous work. Evaluate segmentation robustness and identify current limitations.
- **P8 – Method Exploration:**
Investigate methods to enhance robustness by combining deep learning with classical computer vision and incorporating anatomical landmarks. Select the most promising approaches and define a development strategy.
- **P9 – Implementation and Evaluation:**
Implement the chosen strategy and assess its effectiveness in improving segmentation performance and reliability.

Required Skills

Basic skills in machine learning, deep learning, and image processing; interest in data analysis (data wrangling, data exploration, statistical analysis, visualization), expertise in programming (Python).

Studienart: [x] Full-time study
[x] Part-time study (50%)

Arbeitsort: Windisch

Advisor: Prof. Dr. Martin Melchior (I4DS/FHNW), Dr. Cédric Huwyler