TUHH
Hamburg University of Technology

MTEC
Medical Technology | Intelligent Systems

Exposé for Bachelor Thesis

Title: Impact of different Data Augmentation Techniques for Deep Learning with Optical Coherence Tomography

Background: Intravascular Optical Coherence Tomography (OCT) is one way to threat diseases e.g. stenoses caused by plaque. For each patient hundreds or thousands of images are created as a result and must be evaluated to decide for the right treatment. Decision support systems are required to decide if plaque is detected. Deep Learning (DL) algorithms are applied to give decision support for the treating person. Data Augmentation Techniques can improve their performances. It has been shown that Data Augmentation can have a positive effect on the performance of DL models with Optical Coherence Tomography. However there are many questions left on how to improve the overall performance further by optimizing Data Augmentation.

Objectives and Research Interest: Different Data Augmentation techniques for DL models in OCT are investigated and compared. It will be determined which Deep Learning models applied to OCT work well with which Data Augmentation techniques and how they affect the overall performance.
The following are the objectives of the work:

- Illustrate what different, documented and new/proprietary augmentation techniques for DL in OCT can be applied to (given) Intravascular(IV)-OCT data sets.
- Implement in (partially provided) code various Data Augmentation techniques for IV-OCT.
- Apply Data Augmentation techniques for IV-OCT where possible to other OCT data sets that have yet to be collected.
- Evaluate different Data Augmentation techniques for polar as well as cartesian images and test them with the implemented applications.
- Evaluation: benchmark, contrast and relate the impact of the collected Data Augmentation techniques using various metrics.
- Based on the results, answer the following research question: Under what circumstances are which Data Augmentation techniques best suited for DL with OCT?

Preliminary Outline:

1. Introduction
2. Theoretical Concepts
    - OCT: Spectral Domain, Swept Source
    - IV-OCT
    - Deep Learning
    - DL Metrics
3. State of the Art Research
    - Problem
4. Objective / Question
5. Methodology
6. Data Augmentation
    - Common Techniques
    - New Techniques
7. Implementation
8. Results
    - Testing
    - Systematic Evaluation
    - Assessment of Performance
9. Behavior on other Data Sets
    - Testing
    - Systematic Evaluation
    - Assessment of performance
10. Discussion
    - Transfer Learning
    - Conclusion / Proposition

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