MSc Project:

Multi-object and multi-modal image segmentation in dental MR using limited data

Abstract:

Deep learning methods have revolutionized the field of medical imaging, in particular image segmentation. Supervised methods, often based on the popular U-Net architecture, show state-of-the-art results in many medical applications. But a large annotated database for training is not always available. The objective of this project is to explore and develop methods for learning segmentations using limited data, e.g., using transfer [1], self-supervised [2,3] or meta learning [4–6]. This project is a collaboration between the Department of Diagnostic and Interventional Neuroradiology (TUM), the Department of Periodontology (LMU) and the Chair of the Artificial Intelligence in Medicine (TUM).

The clinical application is the identification of periodontal lesions in magnetic resonance (MR) and computed tomography (CT) images. The study aims at detecting intraosseous pathologies automatically. Periodontitis (chronic or acute alterations of the periodontium) is among the globally widest spread diseases, and interacts with cardiovascular and metabolic disorders. The diagnosis and monitoring of periodontitis is mainly based on imaging modalities exhibiting ionizing radiation: X-ray (panoramic radiography) and cone-beam CT. Recent studies report the successful use of MR imaging in the application of periodontitis diagnosis [7]. Two MRI sequences were developed: a T1-weighted sequence to visualise osseous tissue, and a T2-weighted sequence to visualise the periodontal lesion. To enable automatic diagnosis and monitoring of the disease, accurate segmentations of the bone and periodontal lesion are of utmost importance. A prior collaborative effort between the previously mentioned departments has already resulted in the development of an AI algorithm capable of differentiating between bone and nerve tissue in the mandibular bone. The subsequent objective is to automatically detect periodontal lesions within the bone. [8]

The prospective student will explore existing deep-learning-based segmentation methods for training with limited data, to segment periodontal lesions in MR sequences.

Requirements:

- Prior experience and good understanding in machine learning and statistics.

- Very good programming skills in Python (and PyTorch).
- Interest in medical imaging.

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References

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