BSc/Guided Research Project: Multi-object and multi-modal image segmentation of periodontal lesions in MRI

Abstract: 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 computed tomography (CBCT). Recent studies report the successful use of magnetic resonance imaging (MRI) in the application of periodontitis diagnosis [1]. 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 several anatomical structures, such as the mandibular bone, the alveolar nerve and the periodontal lesion are of utmost importance.

The objective of this project is the multi-modal segmentation of mandibular bone, alveolar nerve and periodontal lesions in MRI images. The prospective student will explore state-of-the-art deep-learning-based segmentation methods, and compare them for binary and multi-class segmentation.

Requirements:

- Prior experience and good understanding in machine learning and statistics.
- Good programming skills in Python (and PyTorch).
- Interest in medical imaging.

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References

[1] Probst, Monika, et al. "Magnetic resonance imaging as a diagnostic tool for periodontal disease: A prospective study with correlation to standard clinical findings - Is there added value?" Journal of Clinical Periodontology (2021).