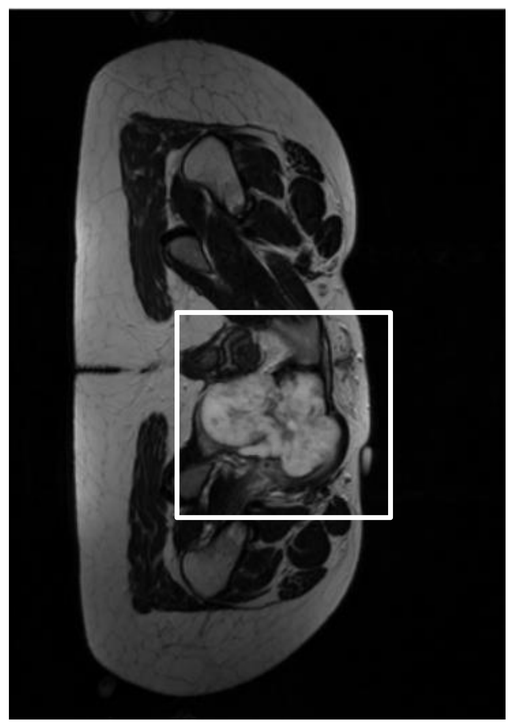
Institute for AI and Informatics in Medicine
Chair for Orthopaedics and Sports Orthopaedics
Technical University of Munich

Master Thesis: *Deep Learning for Bone Tumor Detection and Segmentation: 2D vs 3D*

Abstract

The detection and segmentation of bone tumors using magnetic resonance imaging (MRI) have crucial implications for clinical diagnosis and treatment planning. With the advent of deep learning techniques, there's a growing interest in leveraging these methods to analyze MRI bone tumor images. However, a fundamental question arises: Is 3D volumetric processing superior to traditional 2D slice-by-slice processing in deep learning tasks for MRI bone tumor analysis? This research addresses this question by evaluating the effectiveness of 2D versus 3D deep learning methodologies.



Methodology

The methodology involves implementing several deep-learning models to compare the efficacy of 2D and 3D techniques for MRI bone tumor analysis:

- Literature review on the current state-of-the-art techniques in 2D and 3D MRI-based detection and segmentation tasks using deep learning.
- Implement tumor detection and segmentation models in both 2D and 3D.
- Explore and implement a hybrid approach that combines the strengths of both 2D and 3D processing methods to achieve superior results.
- Presenting and discussing results.

Results

The experiments will be evaluated based on standard metrics and computational requirements to assess practical feasibility and provide insights into the benefits of 3D processing in deep-learning models for MRI bone tumor analysis.

Offer

- Very rare medical data with high potential for publication.
- Highly educated & interdisciplinary environment.
- Top-level hardware for scientific computing.
- Constant feedback from medical and computer science experts.

Prerequisites

- Advanced knowledge of deep learning with imaging data
- Beneficial but not necessary: experience in medicine/oncology
- Preferred starting date: September 2024 (with flexibility)

References

He, Avesta, et al. "Comparing 3D, 2.5D, and 2D Approaches to Brain Image Auto-Segmentation." Bioengineering 10 (2023): 181.

Ushinsky, A., et al. "A 3D-2D Hybrid U-Net Convolutional Neural Network Approach to Prostate Organ Segmentation of Multiparametric MRI." American Journal of Roentgenology 216, no. 1 (2021): 111-116.

Wang, H., et al. "Mixed 2D and 3D Convolutional Network with Multi-Scale Context for Lesion Segmentation in Breast DCE-MRI." Biomedical Signal Processing and Control 68 (2021): Article no. 102607.

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