



NeuroTect: Intelligent Cerebral Artery Stenosis Detection from MRI via Deep Learning and Topological Data Analysis

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Abstract

According to the 2021 report of the World Health Organization (WHO), stroke is the third leading cause of death worldwide and continues to rise. This project aims to develop a system for analyzing cerebral artery stenosis from T2-weighted Magnetic Resonance Imaging (MRI-T2) by integrating deep learning techniques with Topological Data Analysis (TDA) to improve accuracy and the localization of abnormalities in medical images. MRI-T2 images are first processed using a U-Net convolutional neural network (U-Net CNN) for segmentation, after which the results are analyzed through two approaches: structural assessment based on radial changes and topological analysis via TDA. Extracted features are converted into risk scores ranging from 0 to 1, and the two scores are averaged to produce an overall risk estimate. The findings show that combining deep learning with TDA effectively identifies and segments stenotic regions with high spatial accuracy, with detected locations closely matching the true pathological areas on MRI-T2 images as confirmed by radiology experts. This demonstrates the potential of integrating artificial intelligence (AI) and TDA to support future medical diagnostics.

Keywords: stenosis, MRI-T2, TDA, U-Net CNN