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Titolo

Development and Validation of Artificial Intelligence Methods for Magnetic Resonance Imaging Studies

Relatori

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Riassunto

The implementation of Artificial Intelligence (AI) tools in medical imaging shows great promise in assisting healthcare professionals in the diagnostic process. In this thesis, a series of approaches has been studied and implemented to address different challenges that arise when AI methods are developed in the medical imaging field, with a focus on their application to large Magnetic Resonance Imaging (MRI) datasets as case studies. The implementation of AI methods, including machine learning (ML) and deep learning (DL) models, is facilitated by the availability of large, publicly shared imaging datasets. However, challenges arise in aggregating data from multiple centers. Data acquisitions made with different scanners and/or different acquisition protocols encode confounding information in the data, which can confound ML classifiers and introduce biases. In this thesis, the implementation of a harmonization protocol designed to mitigate batch effects in brain features was presented. Moreover, the thesis highlights the importance of addressing challenges in the integration of features from different imaging modalities within the framework of personalized and precision medicine. Additionally, in the medical field, a high level of transparency in models is required to enhance the reliability and interpretability of AI systems. In this thesis, two different algorithms designed to explain decision-making processes are discussed. Addressing these challenges is fundamental to obtaining more reliable results in neuroimaging studies, particularly for a better understanding of the neural correlates of Autism Spectrum Disorders (ASD) conditions and the categorization of brain tumors, ultimately contributing to better patient care and outcomes.