Wydział Automatyki, Elektroniki i Informatyki
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ROZPRAWA DOKTORSKA

Modele predykcyjne wspomagające diagnostykę choroby Alzheimera oraz łagodnych zaburzeń funkcji poznawczych z wykorzystaniem obrazowania metodą rezonansu magnetycznego

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Abstract

Alzheimer's disease (AD) is a progressive, neurodegenerative brain disease that causes memory loss, changes in behaviour, and problems with everyday tasks. Detecting early-stage Alzheimer’s disease is still problematic in clinical practice. This work aimed to find T1-weighted MRI-based markers for Alzheimer's disease (AD) and mild cognitive impairment (MCI) and build the mathematical model to improve the screening process. The assumption was to build a screening model that would be accessible and easy to use for physicians in their daily clinical routine.

The multinomial logistic regression was used to detect status: AD, MCI, and normal control (NC) combined with the Bayesian information criterion for model selection. Several T1-weighted MRI-based features were considered as explanatory variables in the prediction model. A 5-fold cross-validation was executed for ADNI dataset. The multinomial logistic regression model was also trained on the whole ADNI dataset and tested on the independent EDSD dataset.

The best T1-weighted MRI-based predictor was the relative brain volume. This work shows that the proposed T1-weighted MRI-based biomarker, combined with standard clinical predictors, gives excellent early-stage AD status predictions. Moreover, this method, as based on MRI, doesn't require invasive and expensive laboratory tests and, as being a classical statistical learning model, doesn't require large calculation power. Additionally, this model detects some patients transitioning from MCI to AD as AD patients a few years earlier before regular medical diagnosis, allowing for earlier treatment and delaying disease progression.

The created method is non-invasive, inexpensive, clinically accessible, and efficiently supports the AD/MCI screening. The model is based on easily available parameters (T1-weighted MRI is standard) and can be calculated in a simple way, so this method is ready to use in medical practice.