Phys Med. 2023 Feb 14;107:102538. doi: 10.1016/j.ejmp.2023.102538. Online ahead of print.

Deriving quantitative information from multiparametric MRI via Radiomics: Evaluation of the robustness and predictive value of radiomic features in the discrimination of low-grade versus high-grade gliomas with machine learning

Leonardo Ubaldi [1], Sara Saponaro [2], Alessia Giuliano [3], Cinzia Talamonti [1], Alessandra Retico [4]

Affiliations

Affiliations

1 National Institute for Nuclear Physics (INFN), Firenze Division, Firenze, Italy, Firenze, Italy; Department Biomedical Experimental and Clinical Science "Mario Serio", Univeristy of Firenze, Firenze, Italy.
2 University of Pisa, Pisa, Italy; National Institute for Nuclear Physics (INFN), Pisa Division, Pisa, Italy. Electronic address: sara.saponaro@pi.infn.it.
3 Medical Physics Department, San Luca Hospital, Lucca, Italy.
4 National Institute for Nuclear Physics (INFN), Pisa Division, Pisa, Italy.

PMID: 36796177 DOI: 10.1016/j.ejmp.2023.102538

Abstract

Purpose: Analysis pipelines based on the computation of radiomic features on medical images are widely used exploration tools across a large variety of image modalities. This study aims to define a robust processing pipeline based on Radiomics and Machine Learning (ML) to analyze multiparametric Magnetic Resonance Imaging (MRI) data to discriminate between high-grade (HGG) and low-grade (LGG) gliomas.

Methods: The dataset consists of 158 multiparametric MRI of patients with brain tumor publicly available on The Cancer Imaging Archive, preprocessed by the BraTS organization committee. Three different types of image intensity normalization algorithms were applied and 107 features were extracted for each tumor region, setting the intensity values according to different discretization levels. The predictive power of radiomic features in the LGG versus HGG categorization was evaluated by using random forest classifiers. The impact of the normalization techniques and of the different settings in the image discretization was studied in terms of the classification performances. A set of MRI-reliable features was defined selecting the features extracted according to the most appropriate

normalization and discretization settings.

Results: The results show that using MRI-reliable features improves the performance in glioma grade classification (AUC=0.93±0.05) with respect to the use of raw (AUC=0.88±0.08) and robust features (AUC=0.83±0.08), defined as those not depending on image normalization and intensity discretization.

Conclusions: These results confirm that image normalization and intensity discretization strongly impact the performance of ML classifiers based on radiomic features. Thus, special attention should be provided in the image preprocessing step before typical radiomic and ML analysis are carried out.

Keywords: Glioma grading; Image normalization; Machine learning; Magnetic resonance imaging; Radiomics; Robustness of features.

LinkOut - more resources