



**HAL**  
open science

# IMPACT OF MULTICENTER HARMONIZATION ON THE DETECTION OF RADIONECROSIS IN MULTIMODAL MRI RADIOMICS STUDY

Clément Acquitter, Benjamin Lemasson, Elizabeth Moyal, Soléakhéna Ken

► **To cite this version:**

Clément Acquitter, Benjamin Lemasson, Elizabeth Moyal, Soléakhéna Ken. IMPACT OF MULTICENTER HARMONIZATION ON THE DETECTION OF RADIONECROSIS IN MULTIMODAL MRI RADIOMICS STUDY. International Symposium on Biomedical Imaging, Apr 2021, Nice (virtual), France. hal-03178208

**HAL Id: hal-03178208**

**<https://hal.science/hal-03178208>**

Submitted on 23 Mar 2021

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# IMPACT OF MULTICENTER HARMONIZATION ON THE DETECTION OF RADIONECROSIS IN MULTIMODAL MRI RADIOMICS STUDY

Clément Acquitter, Benjamin Lemasson

Univ. Grenoble Alpes  
Grenoble Institut Neurosciences  
38000 Grenoble, France

Elizabeth Moyal, Soléakhéna Ken

Institut Universitaire du Cancer de Toulouse  
Département Radiothérapie et Phys. Médicale  
31059 Toulouse cedex 9, France

## ABSTRACT

This study presents the effect of multi-center harmonization on the selection and classification of radiomics features extracted from recurrent glioblastoma multiforme (GBM) multi-modal MR images to detect radionecrosis.

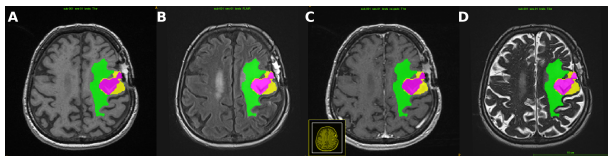
**Index Terms**— radiomics, multi-modal MRI, harmonization, glioblastoma, radionecrosis

## 1. INTRODUCTION

Hypo-fractionated stereotactic radiotherapy (hFSRT) is an effective treatment for recurrent GBM. Because a high gradient dose is delivered, radionecrosis may occur and complicate MRI interpretation. Radiomics analysis can be used to detect radionecrosis-related features [1]. However, the multi-centric nature of the data may affect the performance of such models. The impact of feature harmonization on the detection of radionecrosis is detailed in this study.

## 2. MATERIAL AND METHODS

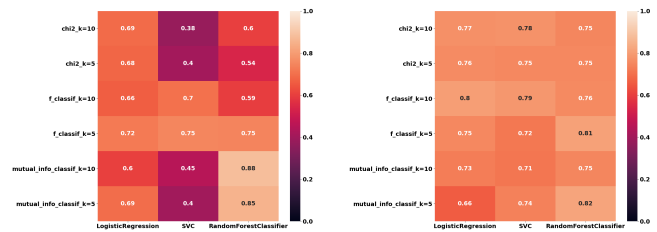
Multi-center clinical MRI database includes 75 examinations of T1w, T1w post-contrast, T2w, and FLAIR images from 6 centers. Brain tumor segmentation was performed thanks to a deep learning-based algorithm implemented in the BraTs Toolkit [2]. A manual correction was applied to retrieve a 3-label segmentation corresponding to the following areas: hyper-enhanced tumor, peritumoral edema, resection cavity (Fig. 1). A total of 1200 radiomics features were extracted from each examination (100 first-order, textural, and shape features for each label and each MR modality). The predictive ability of 18 radiomics models (6 features selection, namely chi2, F-classification and Mutual Information with respectively 5 and 10 features and 3 classification methods, namely logistic regression (LR), SVM and Random Forest (RF)) were evaluated with and without features harmonization with ComBat. [3].



**Fig. 1.** Labels of hyper-enhanced tumor (yellow), peritumoral oedema (green) and resection cavity (pink) are mapped over T1w (A), FLAIR (B), T1w post-contrast (C) and T2w (D) MRI.

## 3. RESULTS

For the LR, SVM and RF classification, mean area under the curve (AUC) scores was respectively  $0.67 \pm 0.04$ ,  $0.51 \pm 0.17$  and  $0.70 \pm 0.14$  without harmonization versus  $0.75 \pm 0.05$ ,  $0.75 \pm 0.03$  and  $0.77 \pm 0.03$  with harmonization. Heatmaps show increased performance for most of the models trained on the harmonized features (Fig. 2). The best score increase was obtained for the SVM classification method (+105%). Models based on RF showed slight performance decreases (from -0.4% up to -15%) with the harmonization process. Overall, the harmonization of radiomics features increases the precision of the detection of radionecrosis while decreasing the variability induced by the selection or the classification choices ( $0.75 \pm 0.04$  vs.  $0.67 \pm 0.15$ ; mean  $\pm$  SD).



**Fig. 2.** Classification scores (AUC) for each radiomics model without (left) and with harmonization (right)

## 4. CONCLUSION

Our results show that multicenter data harmonization increases the performance of radiomics models dedicated to the detection of radionecrosis in patients with recurrent GBM treated by hFSRT.

## 5. COMPLIANCE WITH ETHICAL STANDARDS

Patients gave their consent in agreement with the Ethic committee.

## 6. ACKNOWLEDGMENTS

This work is financially supported by the Project SIGN'IT.

## 7. REFERENCES

- [1] Peng et al., "Int. J. Radiat. Oncol. Biol. Phys.", 2018.
- [2] Kofler et al., "Frontiers in Neuroscience", 2020.
- [3] Fortin et al., "Neuroimage", Nov. 2017.