Assessment of Radiomics Feature Sensitivity to Field of View Variations in MRI Phantom Data

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Introduction

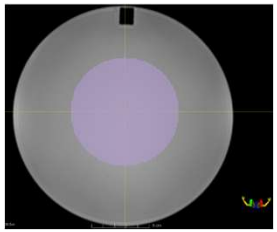
Radiomics features are increasingly used for quantitative image analysis; however, their robustness to image acquisition and reconstruction parameters remains a critical concern. Field of view (FOV) variations can alter image sampling and intensity distributions, potentially impacting radiomics feature values. This study investigates the variability in radiomics features to changes in FOV with the goal to use the robust features to assess disease progression during and post HDR gynecological treatments. Radiation treatment for gynecological cancers is time-sensitive, and delays in treatment delivery may lead to disease progression or reduced therapeutic efficacy. In this context, reliable imaging biomarkers are essential for accurately assessing tumor response over the course of treatment. The goal of this study is to identify radiomic features that remain stable with respect to variations in field of view, enabling their use in the longitudinal assessment of disease progression using MRI data acquired during and after high-dose-rate (HDR) brachytherapy.

Methodology

A set of radiomics features was extracted from MR images of ACR MRI large phantom. MRI images were reconstructed with four different FOVs (230, 300, 400, and 500). For each feature, values corresponding to the four FOVs were analyzed to assess variability and monotonic trends. Since only a single measurement per FOV was available, descriptive and non-parametric statistical metrics were employed. These included the mean, standard deviation, coefficient of variation (CV), percent change between FOV 230 and FOV 500, and Spearman rank correlation between feature values and FOV. Feature variation was visualized using line plots and logarithmic scaling to accommodate the wide dynamic range inherent to radiomics features

Results

Substantial variability in feature sensitivity to FOV changes was observed. Several features exhibited minimal variation across FOVs, characterized by low coefficients of variation and near-zero percent change, indicating robustness to FOV selection. In contrast, other features demonstrated pronounced monotonic trends with increasing FOV, reflected by strong positive or negative Spearman correlation coefficients. Logarithmic visualization further highlighted differences in relative sensitivity among features spanning multiple orders of magnitude.



In this study, images were acquired using the ACR large MRI phantom on a single MRI scanner. Radiomics features were extracted from the uniformity module of the phantom, as shown in Figure 1. All image acquisition parameters were held constant, with the exception of the field of view, which was varied from 230 to 500. A region of interest (ROI) was delineated on the same image slices for each dataset to ensure consistency across acquisitions. First order and Grey Level Cooccurrence Matrix features were extracted from the segmented ROIs.

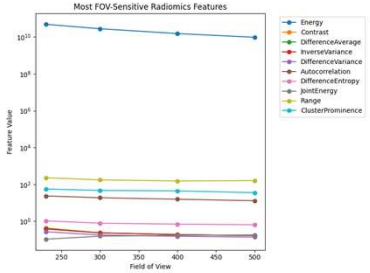
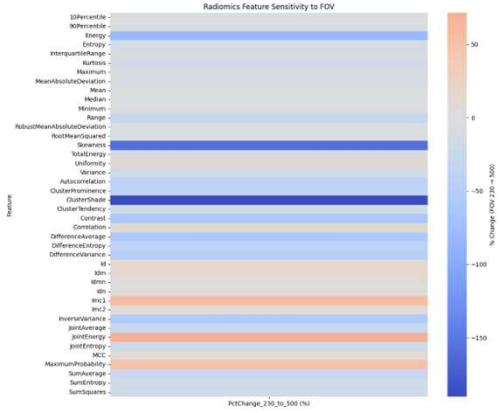


Figure above illustrates the variation of the most FOV-sensitive radiomics features using line plots as a function of field of view. Certain features, including Cluster Prominence, Joint Energy, and Difference Variance, demonstrated low variability across the range of FOVs studied. In contrast, other features, such as Energy and Range, exhibited higher variability with changes in field of view, indicating greater sensitivity to this acquisition parameter.



Similarly, another representation for all the extracted features is shown in Figure 3 in the form of a heat map.

Conclusions

Radiomics features are sensitive to changes in field of view. Features demonstrating low variability across FOVs may be preferable for modeling and longitudinal studies, while highly FOV-dependent features should be used with caution or standardized acquisition protocols. This analysis provides a practical framework for evaluating radiomics feature stability in the absence of repeated measurements.