Radiomic features and segmentation: comparison between two readers

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INTRODUCTION

Background and aim of the study

RADIOMICS: BACKGROUND

OBJECT OF THE ANALYSIS

Data extracted from mammograms DCIS cases interpreted blindly by two radiologists

AIM (1)

Assess the agreement between the two readers in terms of segmentation

AIM (2)

Assess the reproducibility and robustness of radiomic features extracted from mammograms

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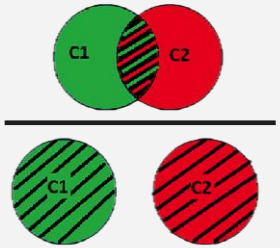
STATISTICAL METHODS

METHODOLOGY (I)

SEGMENTATION AGREEMENT BETWEEN RADIOLOGISTS

- ★ Delineation and identification of Regions Of Interest (ROI)
- ★ Dice Similarity Coefficient (DSC):
  - Index of spatial overlap between two sets of segmentation results
  - Ranges from 0 (= absence of spatial overlap) to 1 (= complete overlap)
  - A DSC higher than 0.7 represents an adequate agreement
  - Calculated within patient



METHODOLOGY (II)

ROBUSTNESS OF RADIOMIC FEATURES

- ★ Quantitative features extracted from each mammogram
- ★ Intraclass Correlation Coefficient (ICC)
  - Proportion of the total variability due to between-subjects variability
  - Single measurement per subject, fixed number of readers (k = 2), absolute agreement → two-way mixed effects model
  - Ranges from 0 (= absence of robustness) to 1 (= perfect reproducibility)
  - Calculated within features

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RESULTS

RESULTS (1): SAMPLE DESCRIPTION

- The sample consists of 394 women with diagnosis of DCIS
- The mammograms were performed with five different mammographs

Mammograph	Patients	
ESS_IEO1	28	
ESS_IEO2	61	
ESS_SLU	33	
SENO_2000	4	272
SENO_DS	268	
Overall	394	

Table 1: Number of patients per mammograph

- 59 radiomic features were extracted, but 56 were included in the analysis since we excluded the zero-variance
- Features grouped in seven categories

Label	Features
CONVENTIONAL	10
DISCRETIZED	14
GLCM	7
GLRLM	11
GLZLM	10
NGLDM	3
SHAPE	1
Overall	56

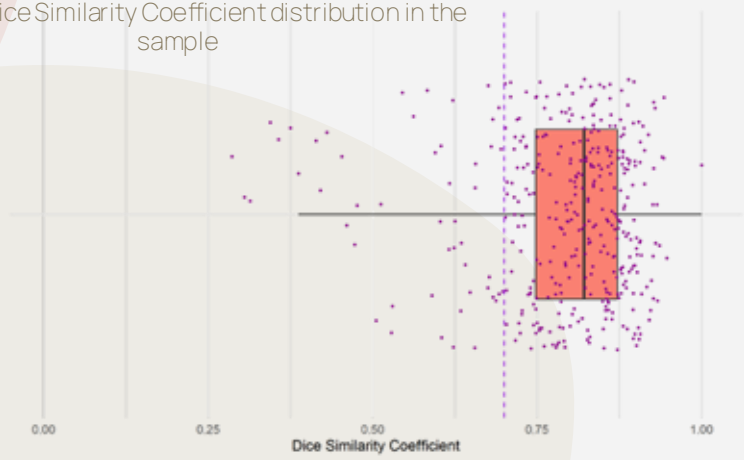
Table 2: Number of radiomic features per category

RESULTS: SEGMENTATION AGREEMENT

Table 3: Mean and Median DSC per mammograph

Mammograph	DSC: Mean (SD)	DSC: Median (IQR)
ESS_IEO1	0.79 (0.08)	0.80 (0.12)
ESS_IEO2	0.79 (0.12)	0.82 (0.11)
ESS_SLU	0.78 (0.10)	0.79 (0.13)
SENO	0.80 (0.12)	0.83 (0.13)
Overall	**0.79 (0.11)**	**0.82 (0.12)**

Figure 1: Dice Similarity Coefficient distribution in the sample



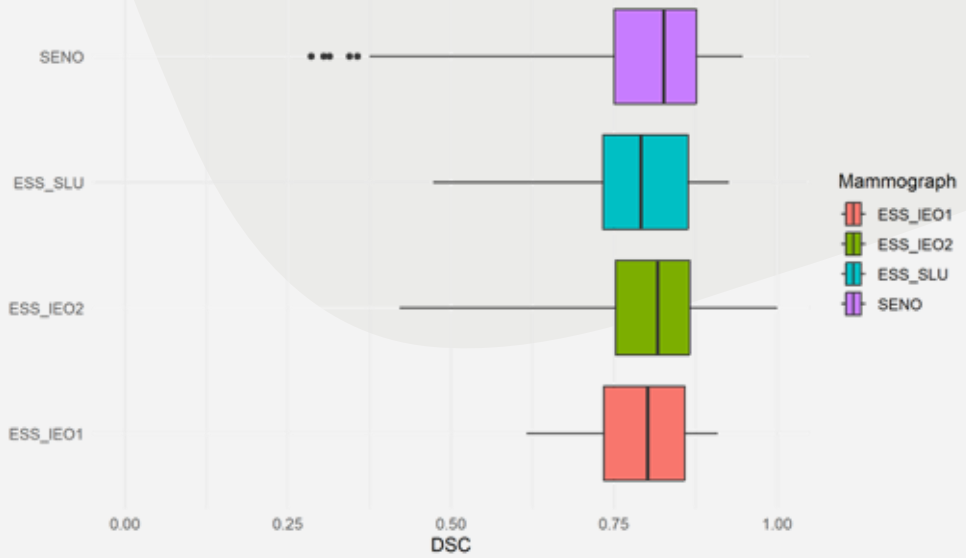


Figure 2: Boxplot of Dice Similarity Coefficient across mammographs

RESULTS: OVERALL FEATURES ROBUSTNESS

	ICC	
Category	Mean (SD)	Median (IQR)
Conventional	0.98 (0.023)	0.99 (0.96-0.99)
Discretized	0.93 (0.027)	0.93 (0.91-0.95)
GLCM	0.95 (0.017)	0.96 (0.94-0.96)
GLRLM	0.93 (0.037)	0.93 (0.91-0.96)
GLZLM	0.93 (0.041)	0.95 (0.93-0.95)
NGLDM	0.91 (0.040)	0.91 (0.89-0.93)
SHAPE	0.95 (0.00)	0.95 (0.95-0.95)
Overall	**0.94 (0.035)**	**0.95 (0.92-1.00)**

Table 4: Mean and Median ICC per radiomic category.

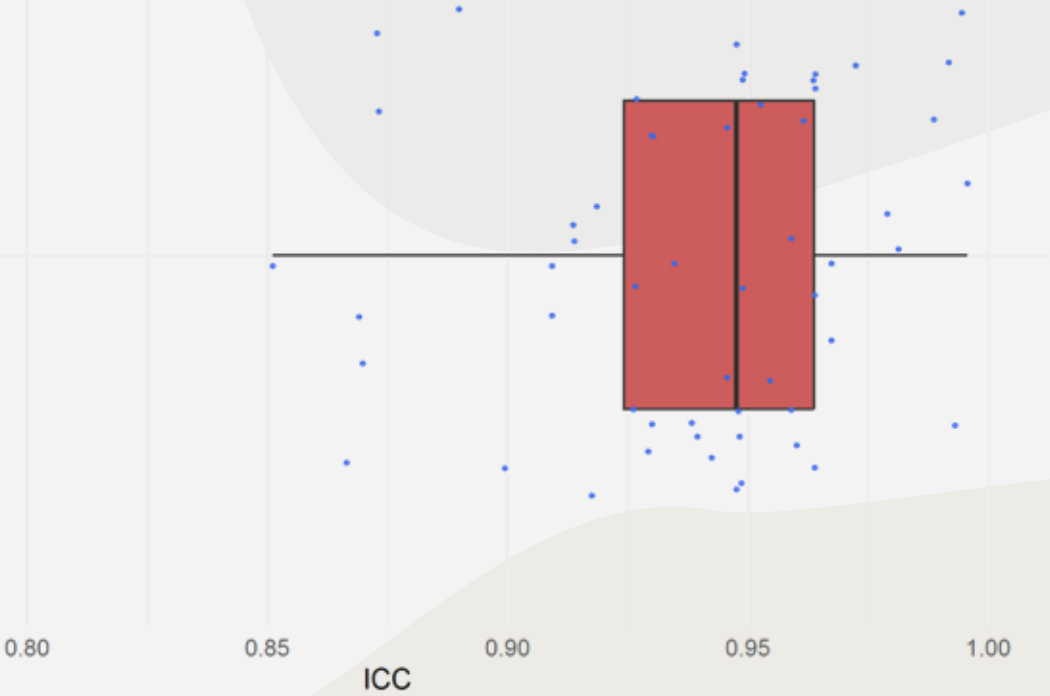


Figure 3: Boxplot of the Intraclass Correlation Coefficients overall

RESULTS: FEATURES ROBUSTNESS

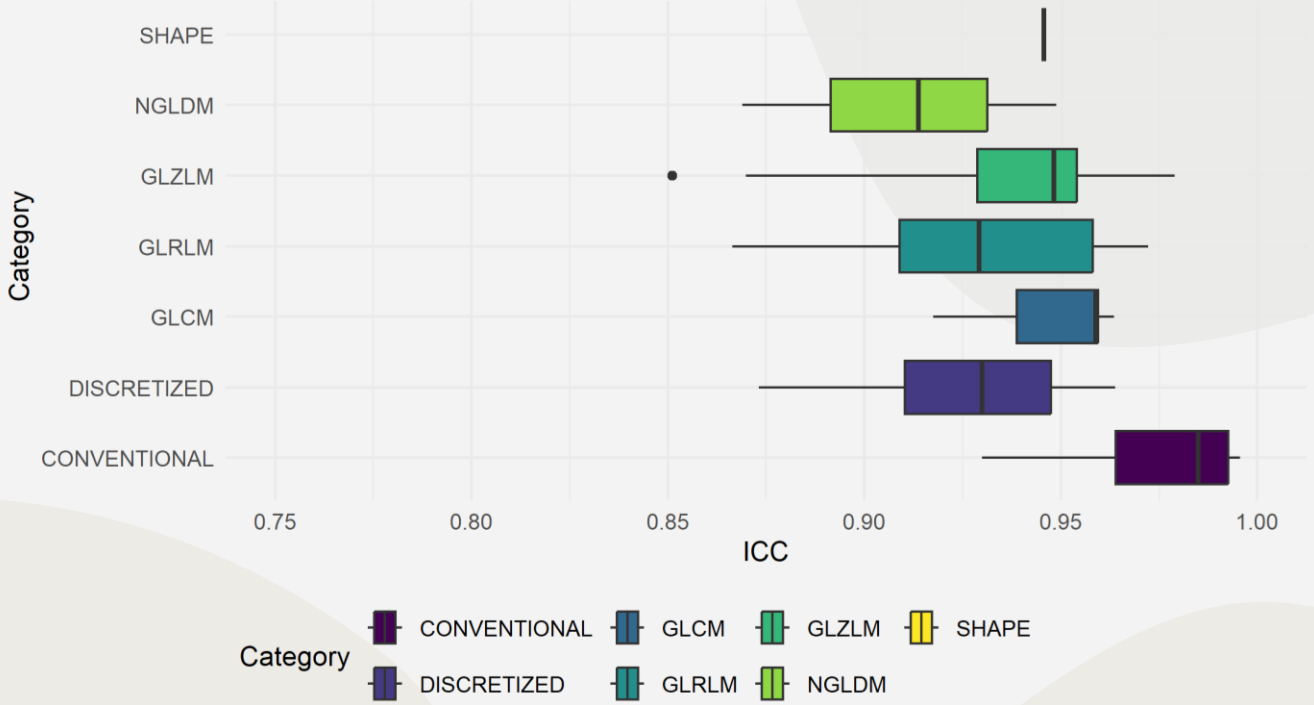


Figure 4: Boxplots of Intraclass Correlation Coefficients across features categories

RESULTS: FEATURES ROBUSTNESS BY MAMMOGRAPH AND CATEGORY

Table 5: Mean and Median ICC per radiomic category and mammograph

		MAMMOGRAPH				
		ESS_IEO1	*ESS_IEO2*	*ESS_SLU*	*SENO*	Overall
CATEGORY	*Conventional*	0.97 (0.98)	0.98 (0.99)	0.95 (0.98)	0.97 (0.98)	0.98 (0.99)
	Discretized	0.91 (0.91)	0.94 (0.95)	**0.88 (0.89)**	0.93 (0.93)	0.93 (0.93)
	GLCM	0.96 (0.95)	0.95 (0.95)	0.95 (0.95)	0.95 (0.96)	0.95 (0.96)
	GLRLM	0.90 (0.93)	0.95 (0.95)	**0.88 (0.85)**	0.93 (0.93)	0.93 (0.93)
	GLZLM	0.91 (0.93)	0.94 (0.95)	**0.88 (0.92)**	0.94 (0.95)	0.93 (0.93)
	NGLDM	**0.89 (0.88)**	0.92 (0.90)	0.91 (0.90)	0.91 (0.92)	0.91 (0.91)
	SHAPE	**0.89 (0.89)**	0.98 (0.98)	0.92 (0.92)	0.95 (0.95)	0.95 (0.95)
	Overall	0.92 (0.94)	0.95 (0.95)	0.90 (0.93)	0.94 (0.95)	0.94 (0.95)

RESULTS: FEATURES ROBUSTNESS BY MAMMOGRAPH AND CATEGORY

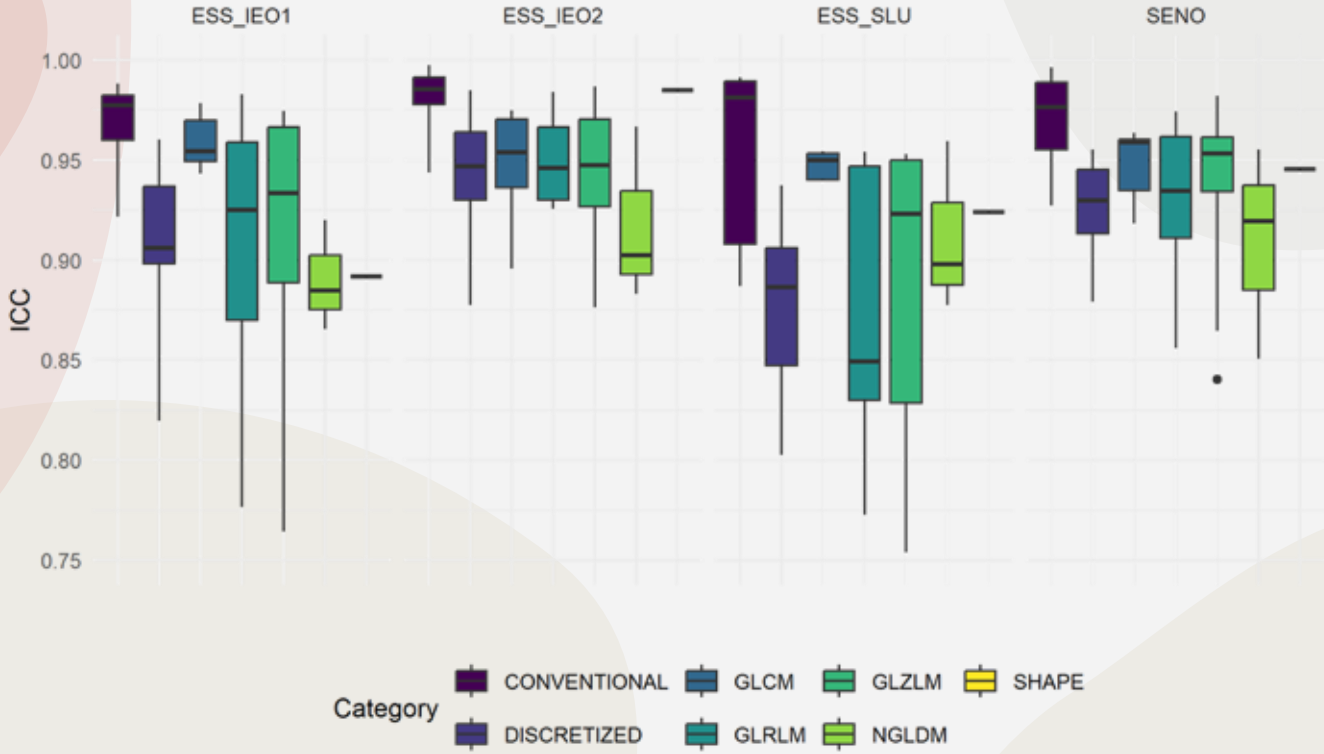


Figure 5: Boxplots of Intraclass Correlation Coefficients across features categories and mammographs

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DISCUSSION

Limits and further developments

CONCLUSIONS

- ★ A good agreement has been observed, related both to the segmentation and the features extracted
- ★ LIMITATIONS
  - ★ Limited number of radiomic features to analyse
  - ★ Features are imbalanced between category, especially for the shape
- ★ NEXT STEP
  - ★ Employ radiomic features as predictors in models to predict the upstaging of DCIS to invasive breast cancer.
  - ★ Prognostic models to identify high-risk patients integrating both clinical and radiomic features

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- ★ Fisica Medica (IEO): Radiomic Features extraction and computation of Dice Similarity Coefficient
- ★ Molecular and Pharmacoepidemiology Unit, Department of Experimental Oncology (IEO): Analysis of segmentation agreement and features robustness via Intraclass Correlation Coefficient

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THANK YOU FOR YOUR ATTENTION!

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