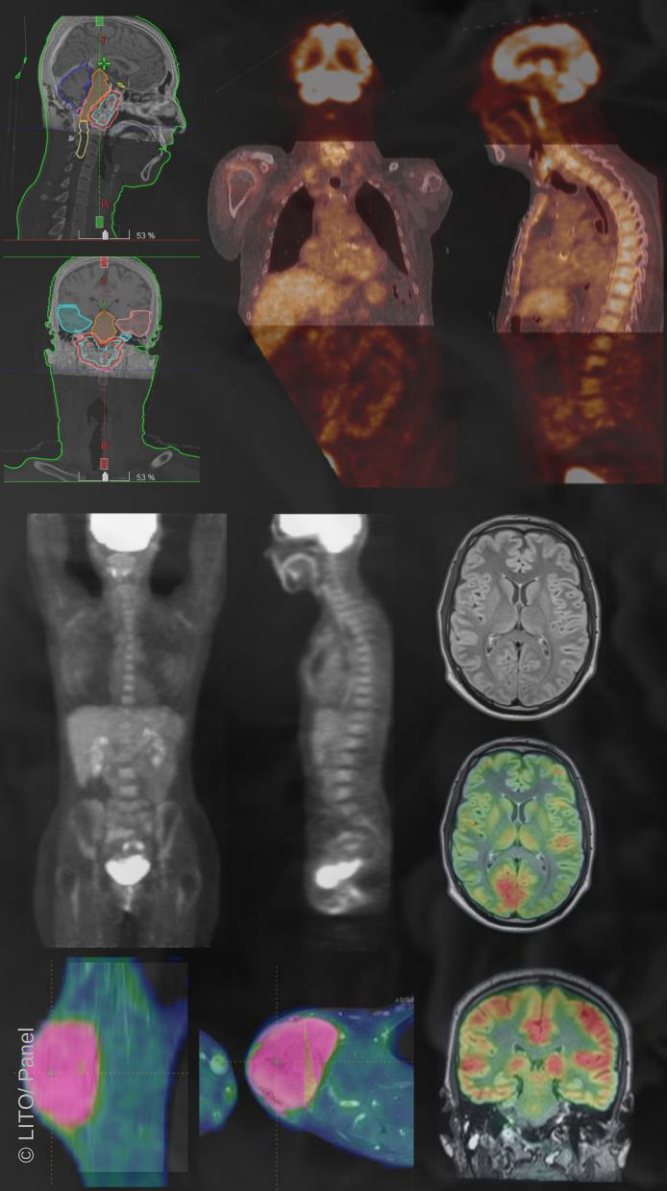


LITO

Prediction of response to neoadjuvant chemotherapy in Breast MRI

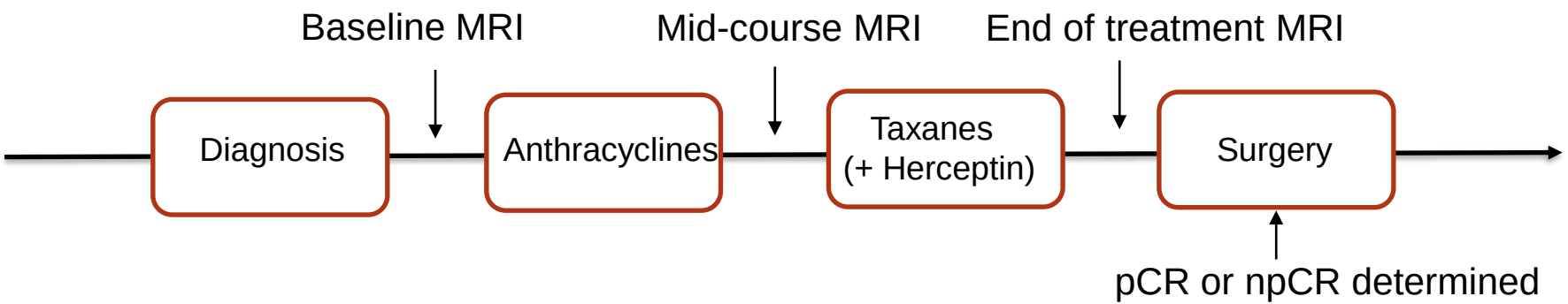
Summary

I. Project reminder
   a. Neoadjuvant chemotherapy
   b. Database
   c. Relevant information
   d. Volumes of interest

II. Radiomic analyses
   a. Pipeline of pre-treatment
   b. Experiments & Selection
   c. Results
   d. Interpretation
   e. Future work

Project reminder

- Neoadjuvant chemotherapy (NAC) is the usual course of treatment in locally advanced breast cancer, but its success rate is extremely variable depending on cancer types
- Main goals are to reduce tumour sizes for safer surgeries and improve breast conservation rates
- NeoElasto project images patients 3 times during therapy



I.b. Database

103 patients:

- Her^{2+}, Luminal B, TN
- segmented evenly by 2 radiologists

49 patients reached pathological complete response (**pCR**) / **54** not responders (**npCR**)

3 scanning settings:

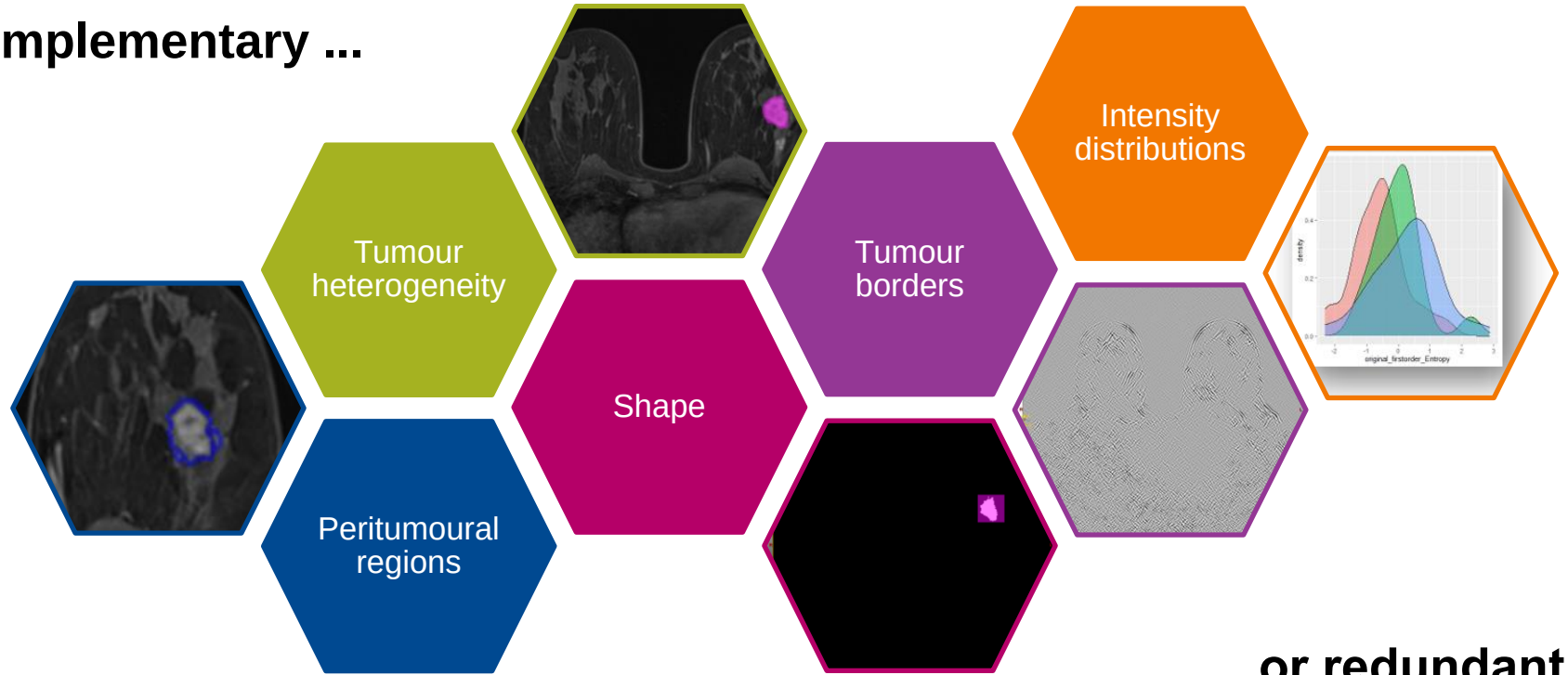
- Siemens machine (1.5T)
  - with 18-canal coil → 19 patients
  - with Sentinelle coil → 59 patients
- GE machine (1.5T) → 25 patients

2 modalities:

- First T1w-DCE after injection
- fat-saturated T2

Dependent: Reponse		npCR	pCR	p
MolecularSubtype	Her2+ (ER-, PR-, Her2+)	3 (25.0)	9 (75.0)	0.008
	Luminal B (ER+, PR<20, Her2 +or-, Ki >14%)	29 (69.0)	13 (31.0)	
	Triple negative (ER-, PR-, Her2-)	21 (43.8)	27 (56.2)	
MRIScanner	GE Curie Paris	15 (60.0)	10 (40.0)	0.389
	Siemens antenne 18 canaux Curie Paris	7 (38.9)	11 (61.1)	
	Siemens Sentinelle Curie Paris	31 (52.5)	28 (47.5)	
Radiologist	Caroline	26 (51.0)	25 (49.0)	1.000
	Pia	27 (52.9)	24 (47.1)	

Complementary ...



… or redundant ?

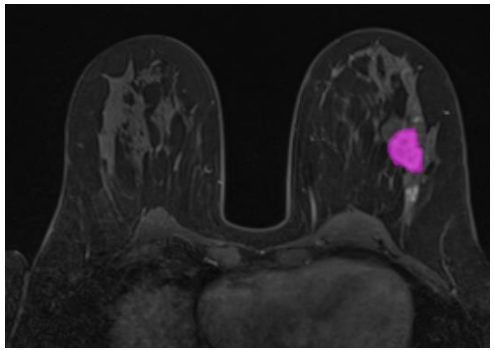
4 VOIs defined:

1) Radiologist segmentation (texture, intensity, shape)

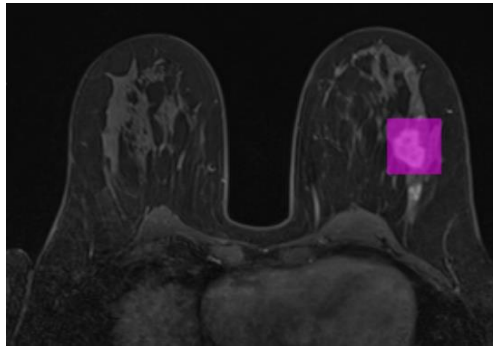
2) Minimal bounding box (texture, intensity, peritumoural regions, extent of the lesion, borders)

3) Constant box 12_x12_x12 mm^3 (texture & intensity) in tumours 14952 ± 13000 mm^3

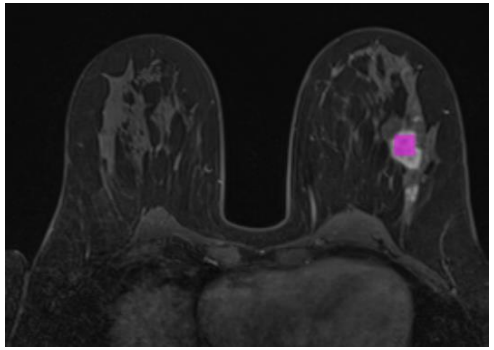
4) Minimal bounding box on binarized images (Shape & Borders)



1) Tumour ('T')



2) Bounding box ('BB')



3) Constant Box ('CB')

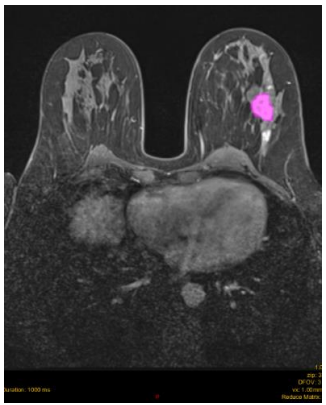
4) Binary Bounding box ('bBB')

Radiomic analyses

- Pre-processing of images

N4 correction with breast specific parameters [1]

Tumour Volume segmentation



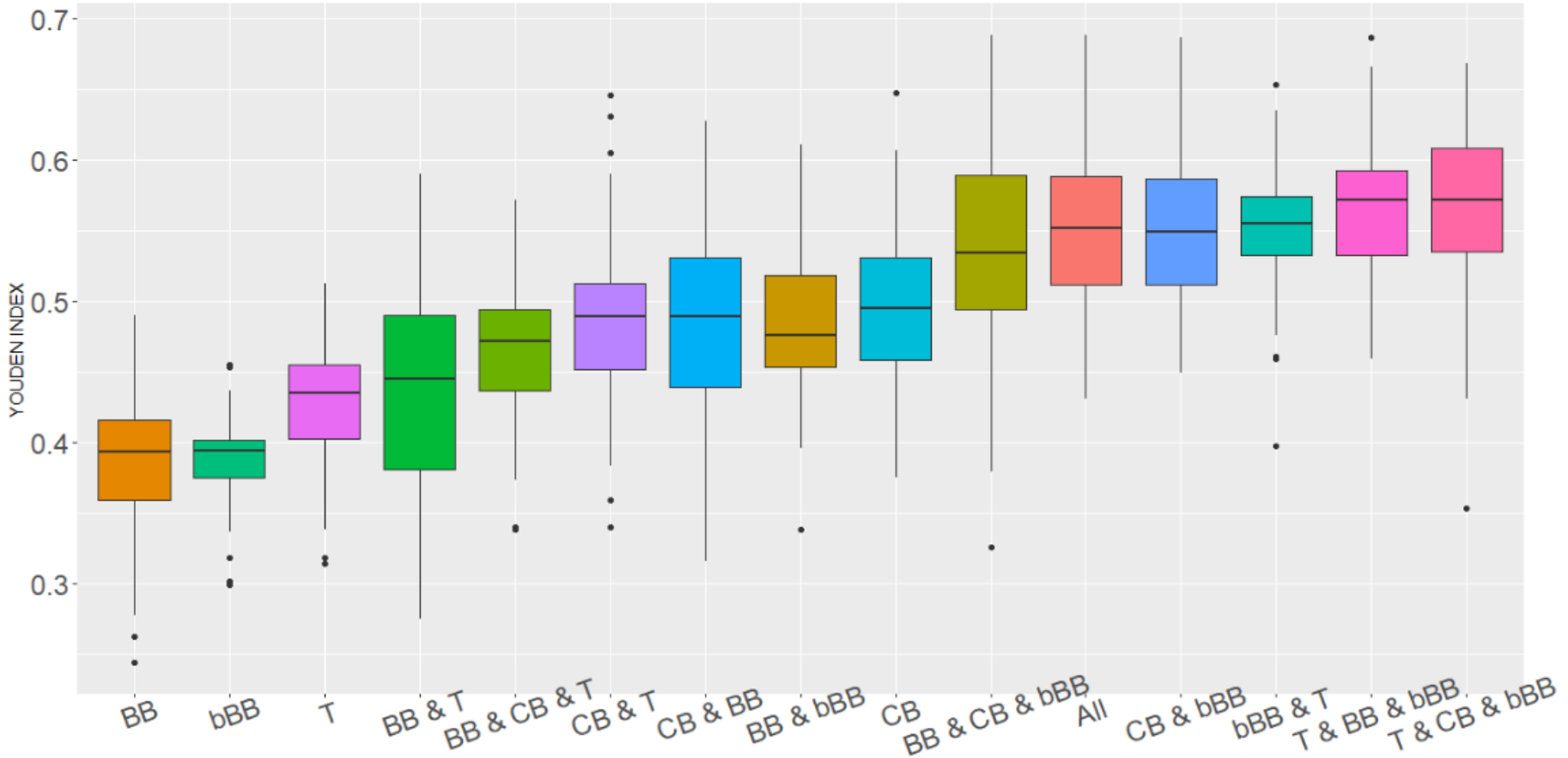
Spatial resampling & Z-score using sane breast parameters

- Extraction of radiomic features with Pyradiomics:
  - Absolute discretisation with bin width of 1
  - Use of linear filters (Wavelet with 8 decompositions) and non-linear filters (exponential, logarithm, square, square-root, gradient)
  - From T1w-DCE and T2 full and reduced forms

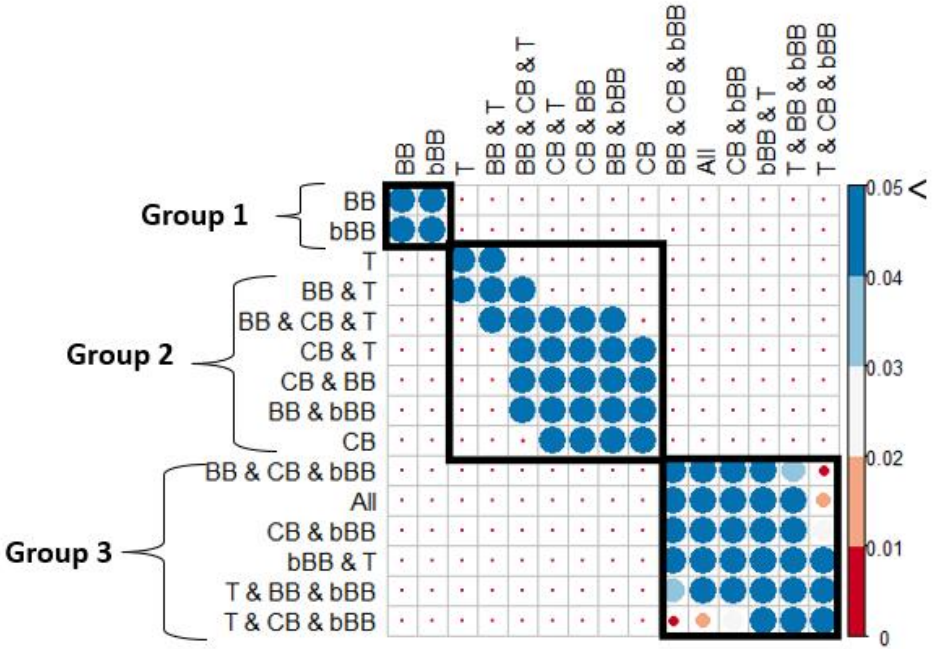
2638 features

- Balanced dataset
- 4 sets of features extracted from the 4 VOIs
- 15 experiments with combinations of 1, 2, 3 of all 4 sets
- 100 repetitons of Boruta selection and Random Forest evaluation

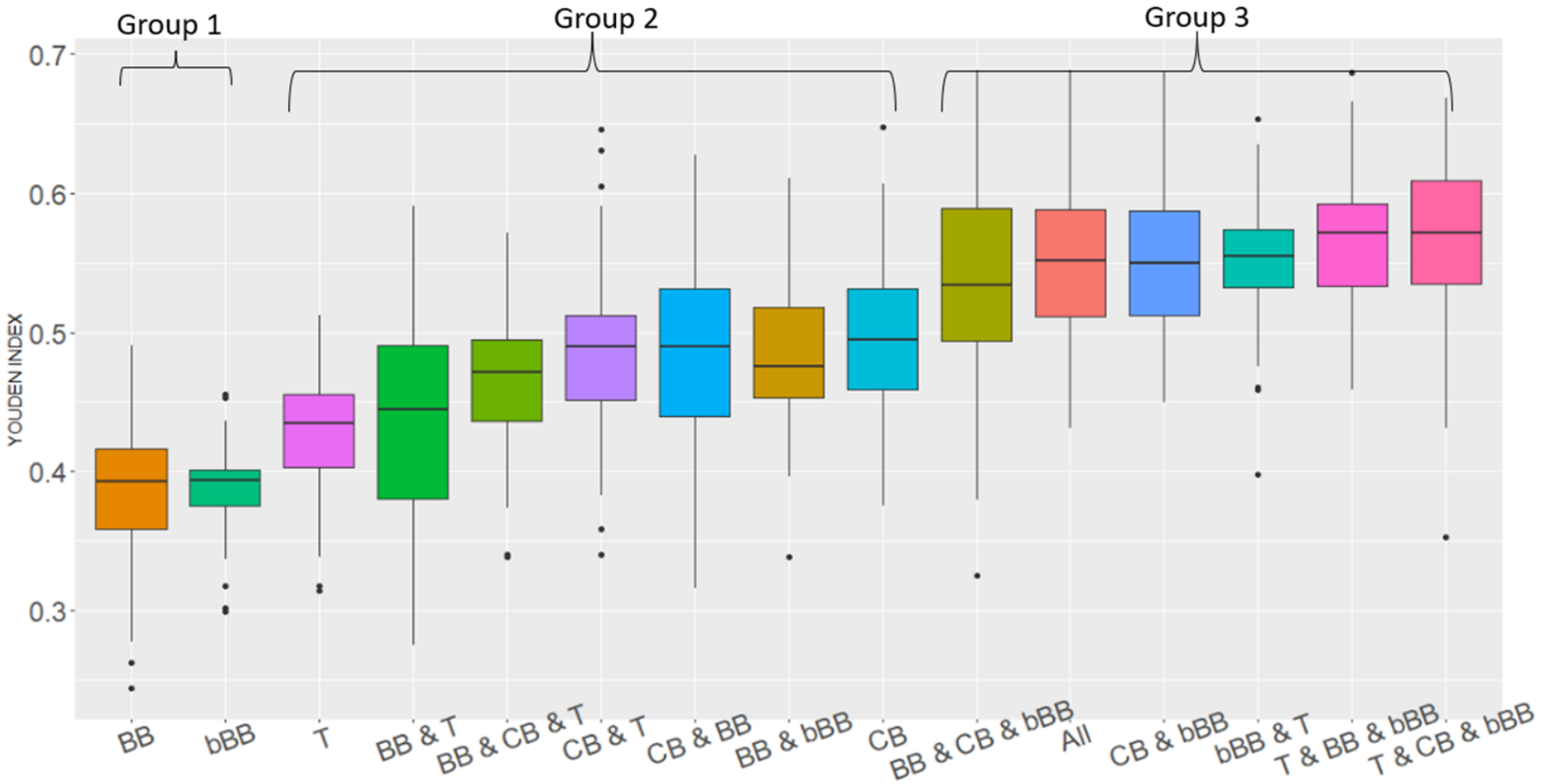
II.c. Results


YOUDEN INDEX
0.7
0.6
0.5
0.4
0.3
BB
bBB
T
BB & T
BB & CB & T
CB & T
CB & BB
BB & bBB
CB
BB & CB & bBB
All
CB & bBB
bBB & T
T & BB & bBB
T & CB & bBB

- Welch one-way anova test had a p-value < 0.0001
- Games-Howell post hoc testing: out of $\binom{15}{2}$=105, 82 comparisons experiments were statistically significantly different



II.c. Results


Group 1
Group 2
Group 3
YOUDEN INDEX
0.7
0.6
0.5
0.4
0.3
BB
bBB
T
BB & T
BB & CB & T
CB & T
CB & BB
BB & bBB
CB
BB & CB & bBB
All
CB & bBB
bBB & T
T & BB & bBB
T & CB & bBB

- Best experiment was ‘Tumour & Constant Box & Binary Bounding box’ with Y=0.57 ± 0.05 with an average of 9 features

- Binary Bounding box experiment present in all experiences of Group 3

Most selected features in best model across 100 selections

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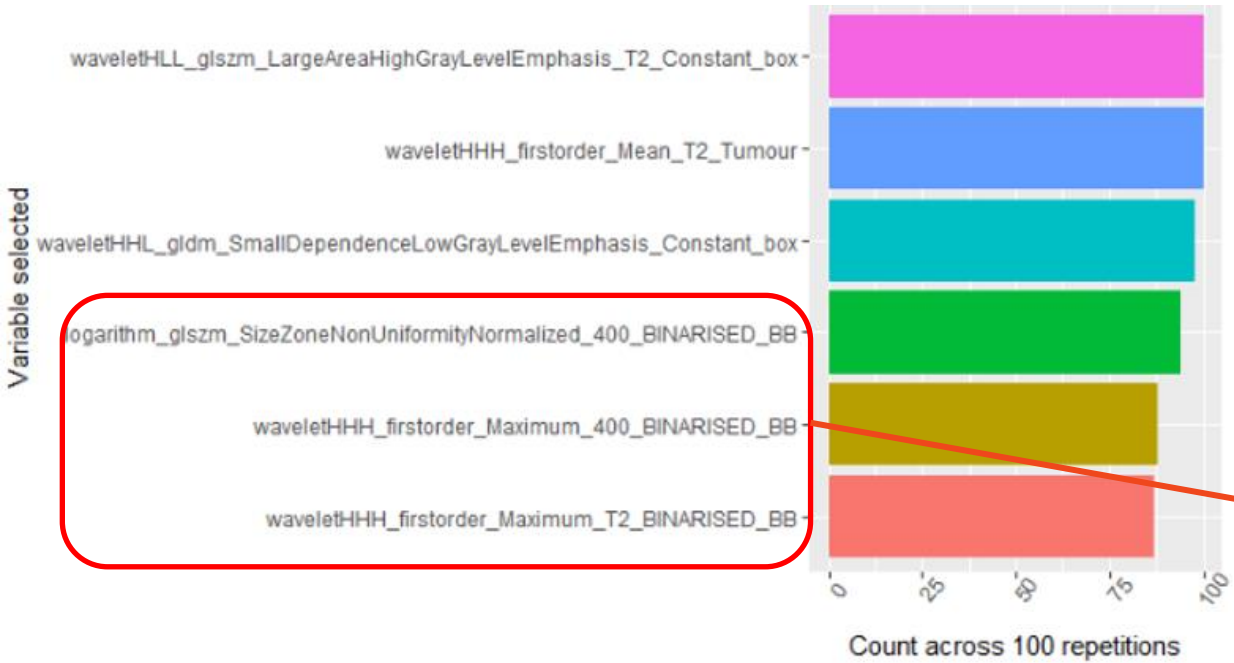
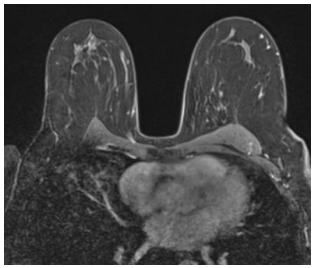


Most selected features in best model across 100 selections

What do they represent ?

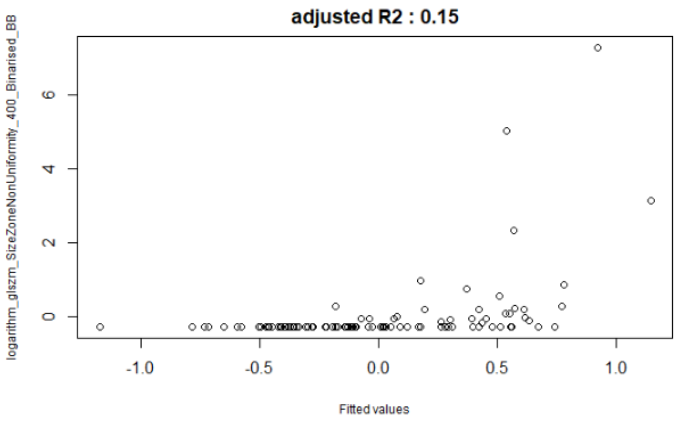
Could they be approximated by shape parameters ?

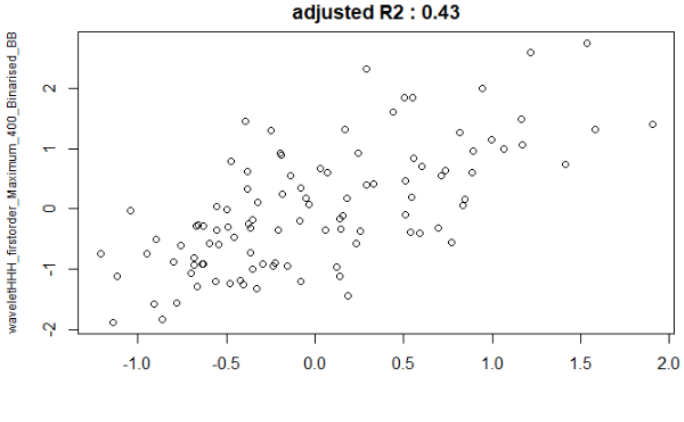
- Regression models to approximate Binary Bounding box features
- Based on shape Parameters
- Best subset regression approach: elongation, sphericity and flatness most selected

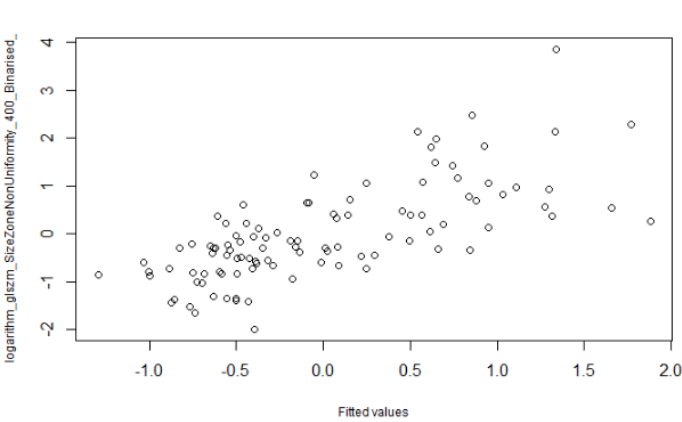


Wav-HHH

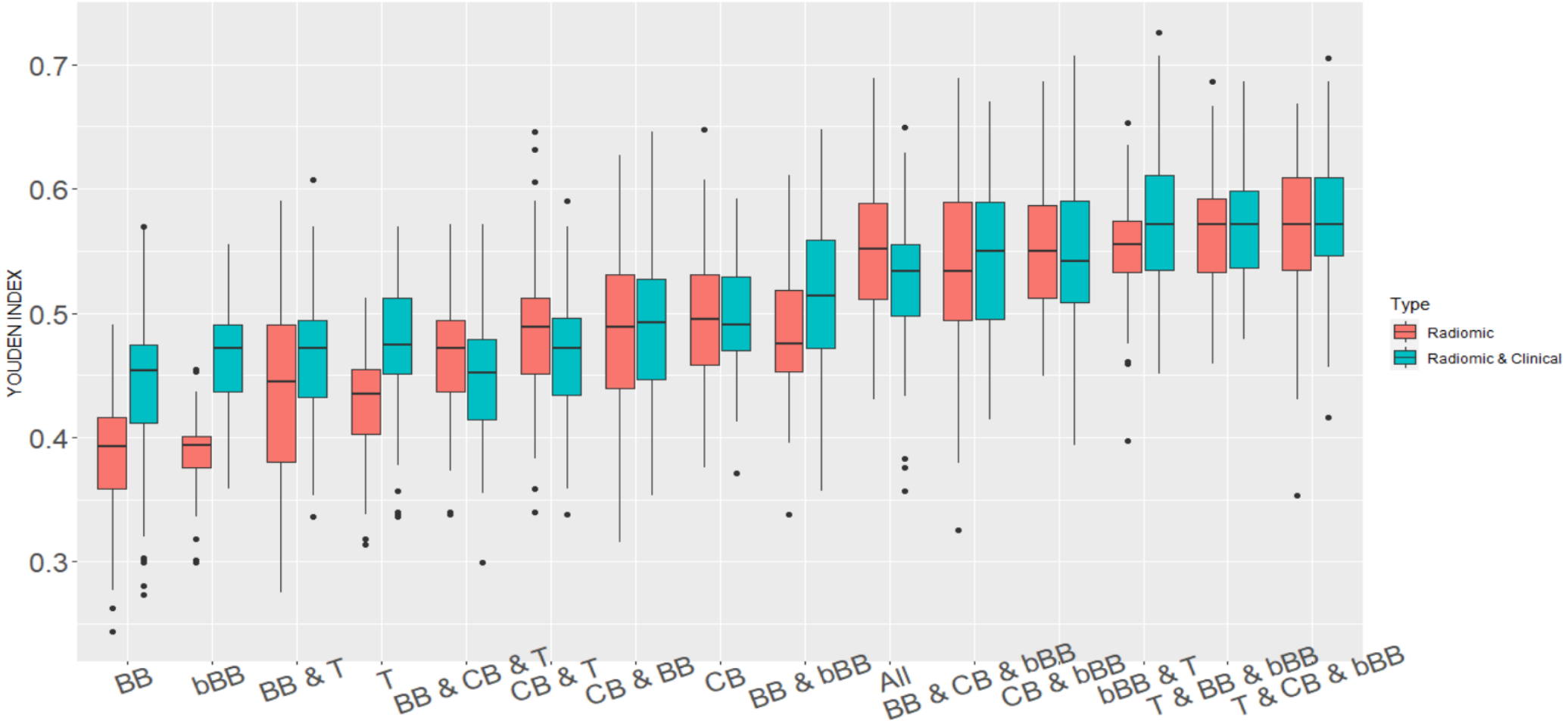
Wav-HHH on binary







II.e. Future work



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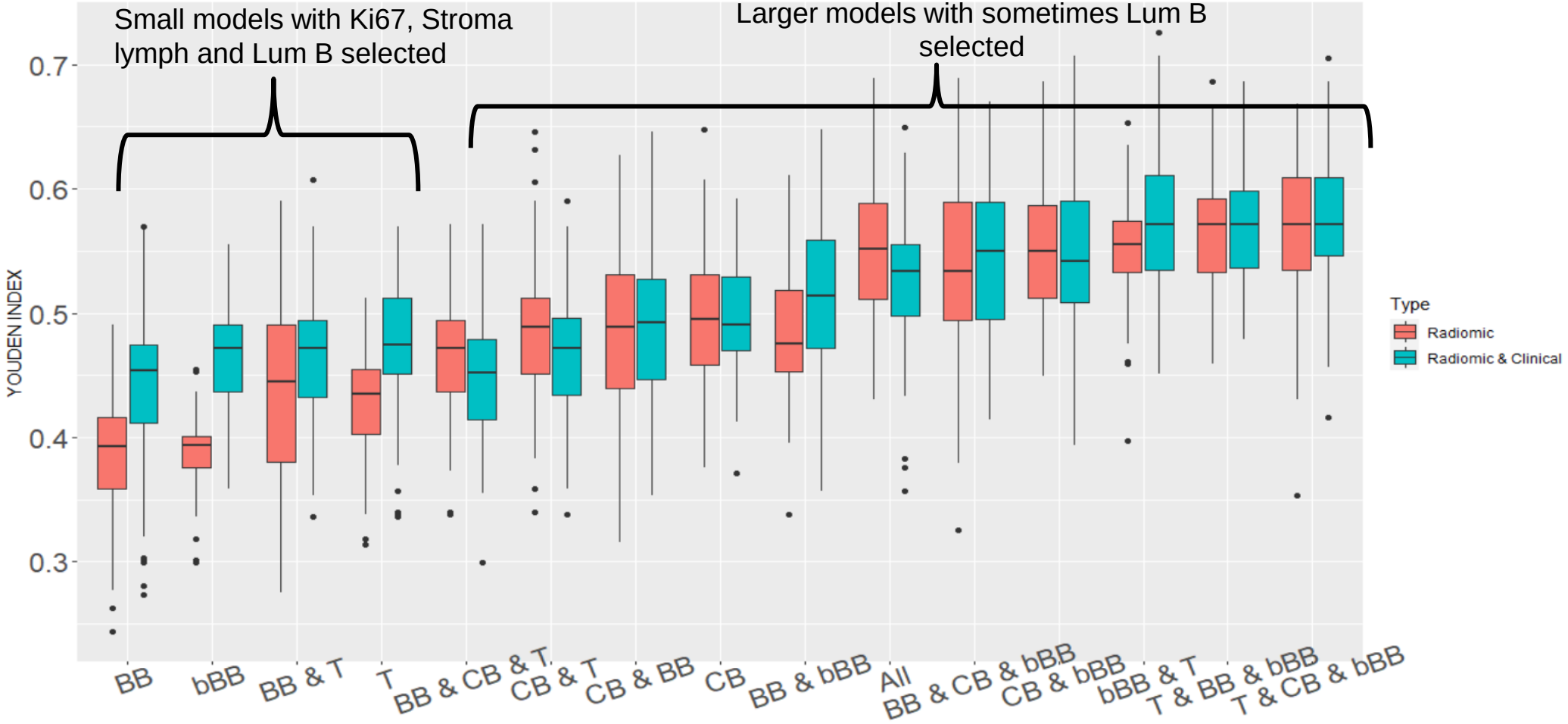

- Information extracted from different VOIs is complementary
- Precise delineation of tumours by radiologists is paramount to increase performances
- Binary experiment bring complementary information that cannot be captured by conventional shape parameters
- Clinical information does not increase performances in all experiments
- In the future: working on mid-course images and extraction of deep features

Thank you