precision medicine

Maastricht University

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CYCLOTRON RESEARCH CENTRE

IN VIVO IMAGING

Development of a MR-based quantitative biomarkers for Alzheimer's disease using hippocampal Radiomics

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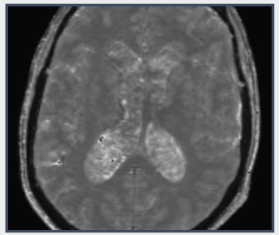
10th European Conference on Clinical Neuroimaging

Geneva, Switzerland

March 14-15, 2022

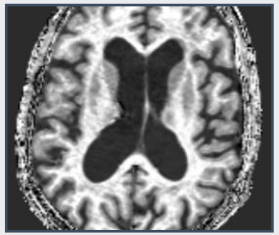
Aim

Unmet clinical need	Early diagnosis of AD
Background	Hippocampal changes in early AD
Technique	MRI: Non-invasive, appropriate contrast BUT: Expressed in arbitrary units → not robust/stable/reproducible
Hypothesis	Quantitative MRI (qMRI) and Radiomics enable automatic differentiation between AD and normal controls (NC)



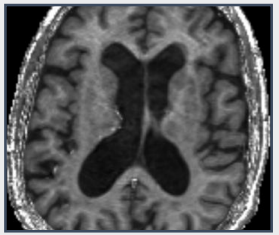
Proton density (PD)

Free water



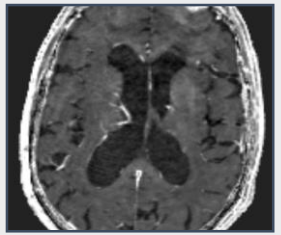
Magnetization transfer (MT)

Axonal myelination



Inversed T1 (R1)

Axonal myelination



Inversed T2 (R2*)

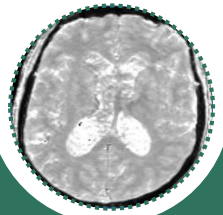
Iron accumulation

qMRI maps

Materials and methods

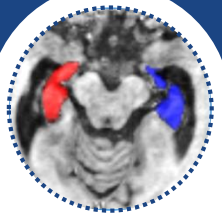
Radiomics pipeline

Data
CRC Liege, Belgium
3T MRI (1×1×1 mm^3)
Siemens Prisma
24 AD, 19 elderly NC



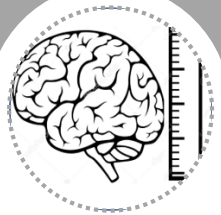
qMRI reconstruction
hMRI toolbox

Hippocampus segmentation
hippodeep

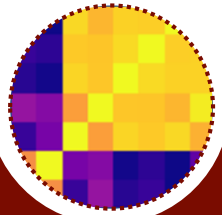


Radiomics features extraction
PyRadiomics

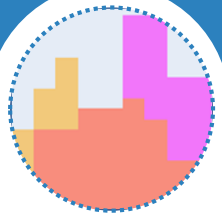
Exclusion of volume correlated features
|R| > 0.85
Precision-medicine-toolbox



Exclusion of inter-correlated features
|R| > 0.85
Precision-medicine-toolbox

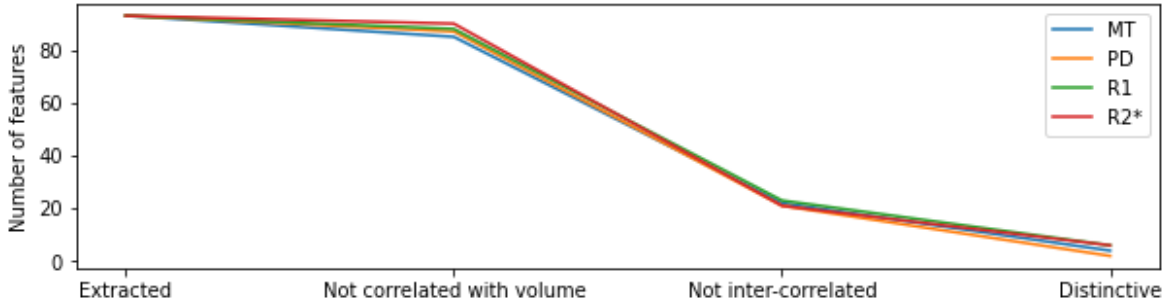


Distinctive features selection
Mann-Whitney test with FDR
Precision-medicine-toolbox



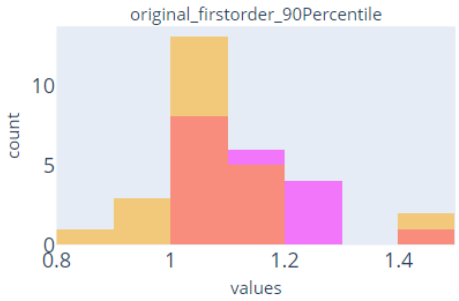
Results

Number of the features left after feature selection steps



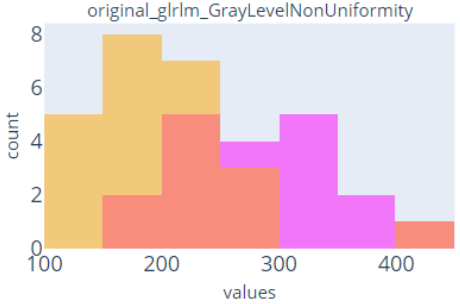
Non-AD
AD

MT



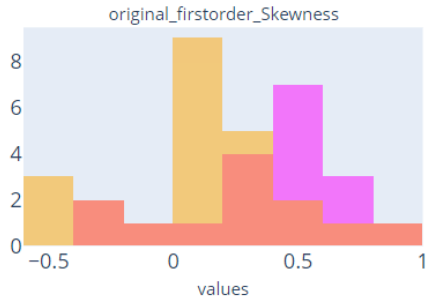
ROC AUC_{univar} = 0.72

PD



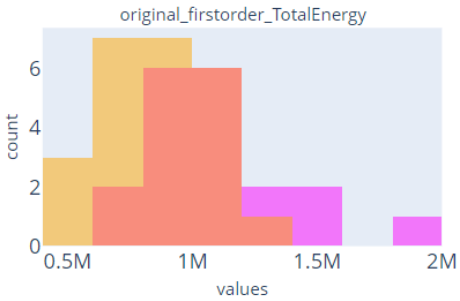
ROC AUC_{univar} = 0.81

R1



ROC AUC_{univar} = 0.73

R2*



ROC AUC_{univar} = 0.76

Conclusion

- Utility of Radiomics/qMRI approaches in automatic AD diagnosis is indicated
- Promising method for multi-center and multi-vendor studies
- Radiomic signature development is needed → more data is needed!
- Future potential of hippocampal texture MRI-based features in early AD diagnosis

precision-medicine-toolbox: an open-source tool for features analysis
https://arxiv.org/abs/2202.13965
https://github.com/primakov/precision-medicine-toolbox

ACKNOWLEDGEMENTS

Dr Henry Woodruff
Dr Christophe Phillips
Dr Christine Bastin
Prof Dr Eric Salmon
Prof Dr Philippe Lambin

THANK YOU FOR YOUR ATTENTION!

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