

AI in beeldbeoordeling van PET / SPECT

Ronald Boellaard

r.boellaard@amsterdamumc.nl & r.boellaard@umcg.nl





EANM Disclosure of Interest Statement

I or one of my co-authors hold a position as an employee, consultant, assessor or advisor for a pharmaceutical, device or biotechnology company.

None commercially: EARL scientific advisor for PET accreditation program

I or one of my co-authors receive support from a pharmaceutical, device or biotechnology company.

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I or one of my co-authors hold property rights/patents for (radio)pharmaceuticals, medical devices or medical consulting firms.

None

I or one of my co-authors have written articles for (radio)pharmaceutical, medical device, biotechnology or consulting companies during the last 5 years.

None



Overview

- Commercially available AI tools (FDA/CE)
- AI in research



Commercially available AI tools in Nuclear Medicine

- <https://www.healtharegister.com/radiology/products>
- Radiology & Nuclear Medicine
 - Total 299 product are listed here
- Nuclear Medicine only:
 - Total of 8 products



Commercially available AI tools in Nuclear Medicine

Vendor	Product	Application	Type of processing	CE class
Qubio	Neurocloud SISCOM	SPECT-MRI coregistration, identification of epileptogenic zone	Coregistration and <u>segmentation</u>	I
Qubio	Neurocloud PET	Quantitative brain PET analysis. FDG and Amyloid	Coregistration and <u>segmentation</u>	I
United Imaging	uAI MI Oncology	Detection of whole-body abnormal uptakes	<u>Segmentation</u>	Ila
United Imaging	PET Neurology	Analysis of neurodegenerative disease.	<u>Segmentation</u> using thresholds/AI	Ila
Qynapse	QyScore	Automatic labeling and volumetric quantification (brain)	<u>Segmentation</u>	Ila
PAIRE	Pionus	Lesion segmentation (FDG)	<u>Segmentation</u> of FDG avid lesions	Ila
Subtle Medical	Subtle PET	Denoising of PET	Denoising	Ila
Nuclivision	Nuclarity	Denoising (FDG)	Denoising	Ila



Level of evidence/intended use

- Most of the time limited.
 - E.g. 1 published paper
 - Mixed population
 - Evaluation not focused on critical diagnostic cases such as Deauville score 3 versus 4
 - No clear benchmarking against reference or standard
- Intended use
 - ‘Assist’ physicians in.....often more technical claims
 - No statement on diagnostic performance
 - ‘Nor the software results nor the provided report are intended to provide a diagnosis.’



Other available AI tools*

* Based on personal knowledge of existence of these tools, may not be fully complete

Company	Product	Application
HERMES	HERMIA	Segmentation
MIRADA	Simplicit90Y	Segmentation
MIM (GE)	Sureplan(Y90)	Segmentation
MIM (GE)	Contour protegeAI+	Segmentation
GE	Xeleris V	Segmentation
GE	Precision DL	Reconstruction (DL-TOF)
GE	OMNI PET/CT	Anatomical landmarking
Siemens	ADAN (ALPHA)	Anatomical landmarking/workflow
Siemens	Syngo.via - PARS	Segmentation



Commercially available AI tools in Nuclear Medicine

AI based segmentation (majority of tools)

- Automisation of processing -> good, very fast
- Risk -> Low, results can be reviewed and if needed segmentations can be corrected (supervised, human in the loop)

Denoising (2 tools known)

- Automisation -> good, very fast
- Risk -> high, chance for hallucination, means of verification is low as input image has low quality

Diagnosis

- Automisation -> good, very fast
- Risk -> high if tools give a diagnostic score
- Risk -> moderate, if diagnostic score is based on segmentation results, can be reviewed



Overview

- Commercially available AI tools (FDA/CE)
 - Only a few
 - Limited evaluation
 - Weak claims
- What about AI in research?



Overview

- What about AI in research?

Main topics:

- Denoising (less interest)
- Image transformations
- Lesion segmentation
- AI image reconstruction
- Outcome prediction




Image transformations

- Generation of synthetic CT from NAC PET as input for attenuation correction
- Prediction of amyloid PET from MRI scan
- Prediction of sCT as intermediate step for improved alignment of CT and PET

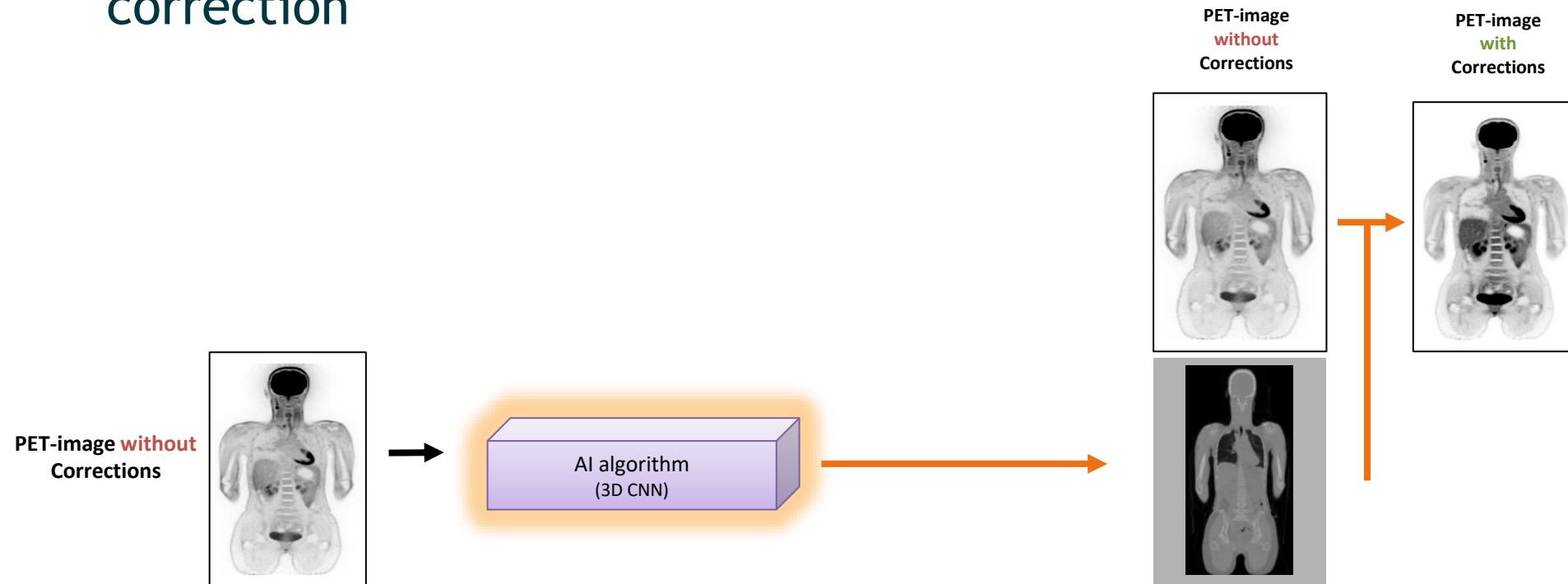
Image transformations

Article

Attenuation Correction of Long Axial Field-of-View Positron Emission Tomography Using Synthetic Computed Tomography Derived from the Emission Data: Application to Low-Count Studies and Multiple Tracers

Maria Elkjær Montgomery ^{1,†}, Flemming Littrup Andersen ^{1,2,*†}, Sabrina Honoré d'Este ¹, Nanna Overbeck ¹, Per Karkov Cramon ¹ , Ian Law ^{1,2}, Barbara Malene Fischer ^{1,2} and Claes Nøhr Ladefoged ^{1,3}

- Generation of synthetic CT from NAC PET as input for attenuation correction

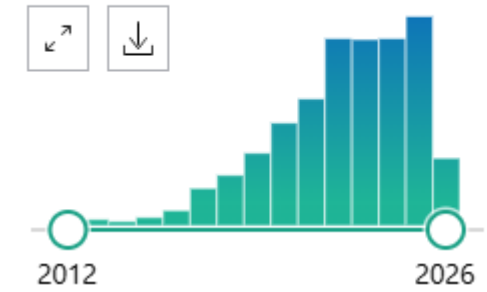




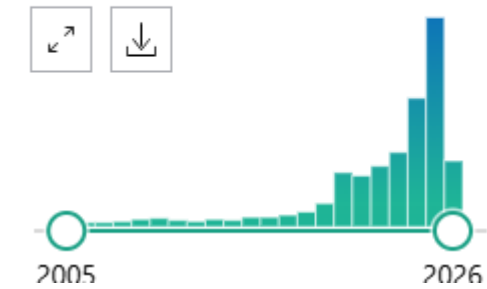
Outcome prediction

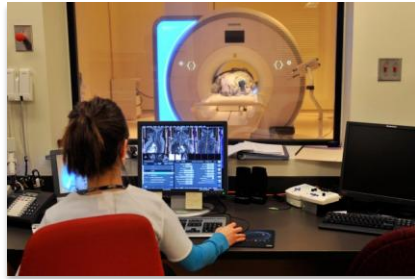
- Radiomics with machine learning
 - PUBMED ‘Radiomics PET FDG’ : 1048 results
 - 2025: 200+ publications
- Deep prediction
 - PUBMED : 566 publications
 - 2025 : 193

RESULTS BY YEAR

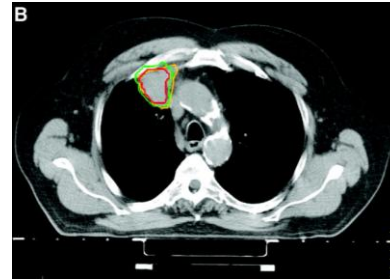


RESULTS BY YEAR

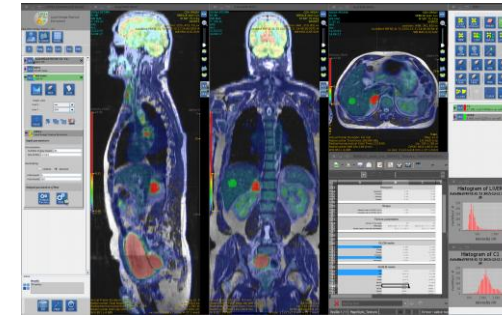




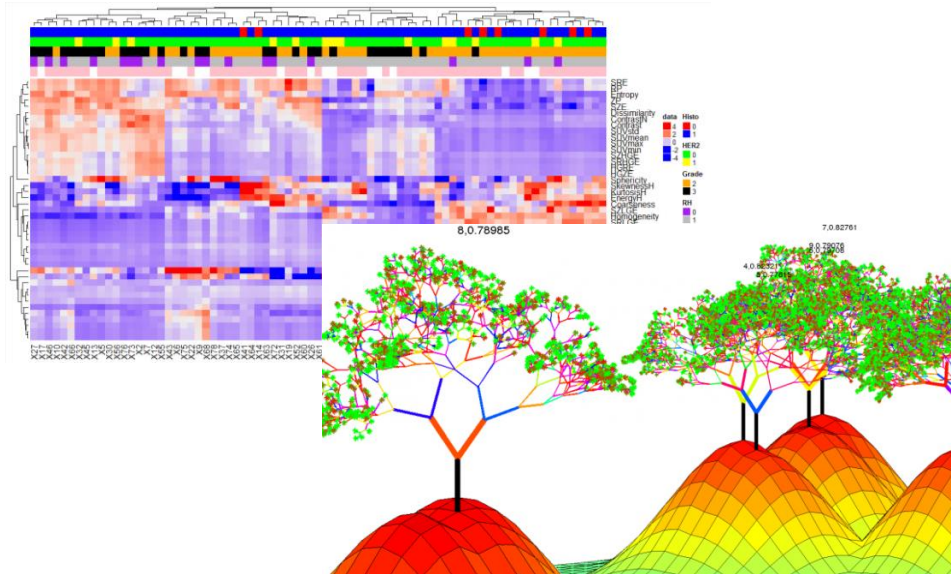
1 Image acquisition



2 Segmentation



3 Radiomic feature extraction



4 Feature analysis / creation of models
(training and validation sets)



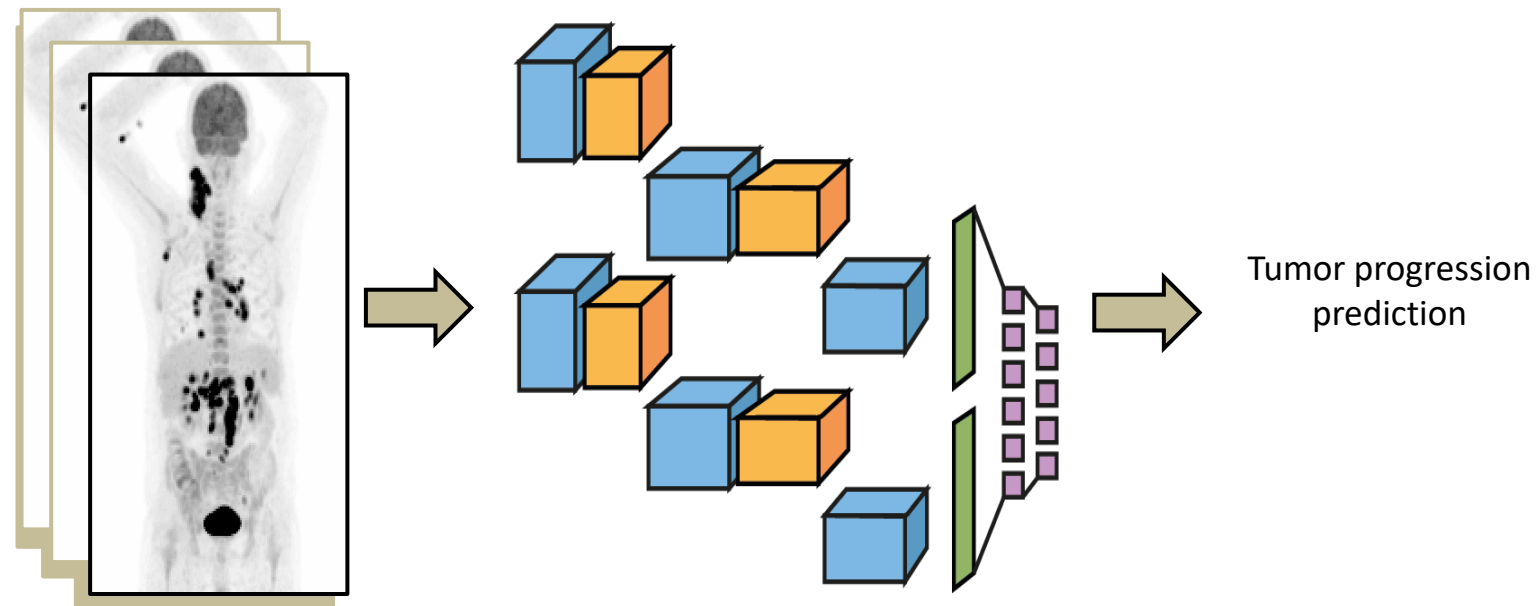
5 Model validation
(testing set)

Model development may be performed by AI

An artificial intelligence method using FDG PET to predict treatment outcome in diffuse large B cell lymphoma patients

[Maria C. Ferrández](#) , [Sandeep S. V. Golla](#), [Jakoba J. Fertink](#), [Bart M. de Vries](#), [Pieternella J. Lugtenburg](#), [Sanne E. Wiegers](#), [Gerben J. C. Zwezerijnen](#), [Simone Pieplenbosch](#), [Lars Kurch](#), [Andreas Hüttmann](#), [Christine Hanoun](#), [Ulrich Dührsen](#), [Henrica C. W. de Vet](#), [PETRA](#), [Josée M. Zijlstra](#) & [Ronald Boellaard](#)

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Future developments

Physics informed AI

- Embed knowledge of physics during learning of AI
- Physics can act as regularization to limit possible solutions to more correct ones
- Focus on information content of data
- Improves generalizability
 - E.g denoising or partial volume correction should not be tracer dependent
 - Train on non-medical images using synthetic data that enhances use of physics principles
 - Use physics in loss function or as GAN etc

Agentic AI

Unlike static LLM that wait for a prompt, an autonomous AI agent perceives its environment, formulates strategies, executes actions, and refines its approach based on intermediate results



Summary/conclusions

Number of commercially available tools in NM is very limited:

- Most apply segmentation (CT based with projected on PET/SPECT)
- Some PET based lesion segmentation tools
- AI in image reconstruction: only 1 or 2, but likely rapidly increasing

Research interests:

- Segmentation
- Image transformation
- Image reconstruction
- Outcome prediction : this is the main topic at present

Disclaimer: listed tools or research themes may not be fully complete



Artificial intelligence will not replace medical professionals, but professionals that master AI will rapidly replace those who do not