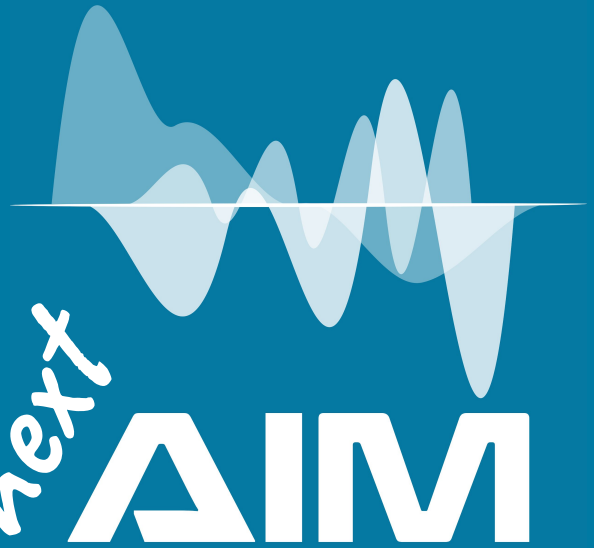
Artificial Intelligence in Medicine



Working with clinicians: the DORIAN Tech. experience

Ruben Gianeri
next_AIM annual meeting
15.02.2023, Milano

DORIAN
evolving neuroimaging
INFN

DORIAN TECHNOLOGIES srl (Diagnosis ORIented ANalysis)

DORIAN delivers a fast and reliable tool for the **quantification** of medical imaging to support the early and differential diagnosis of neurodegenerative disorders. It provides clinicians and researchers with state-of-the-art robust, rater-independent and reproducible quantitative biomarkers to **better evaluate** dementias stage and progression, **complementing** their ability to write informed medical reports and improve on the early detection and diagnosis of neurodegenerative diseases.

Dorian recent activity

> Spin-off foundation	[May 2020]
> **Start of beta-tests @ 6 italian centers**	**[Apr 2021]**
> **Lab sessions @ Nucl. Med. school in Neurology**	**[Sep. 2021]**
> EBAN finalist	[Mar.2022]
> Unicredit StartLab 3rd classified	[May 2022]
>> Amazon AWS academy invitation	[Sep. 2022]
> **Lab sessions @ Nucl. Med. school in Neurology**	**[Oct. 2022]**
> First fulfilled contract	[Dec. 2022]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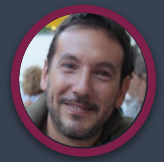
(INFN-GE)


P. Bosco
(IRCCS Stella Maris, Pisa)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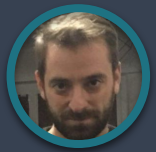
F. Sensi
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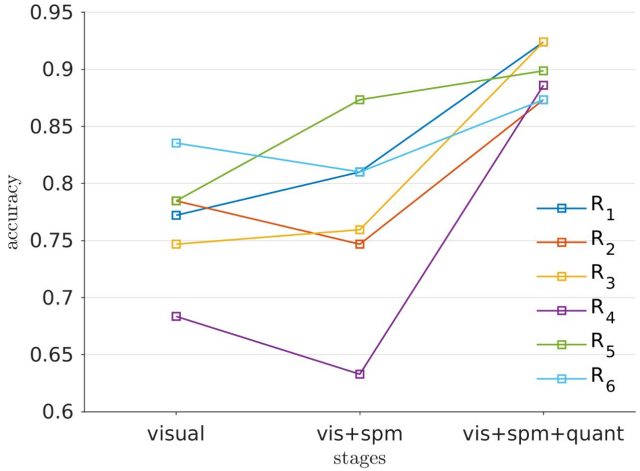
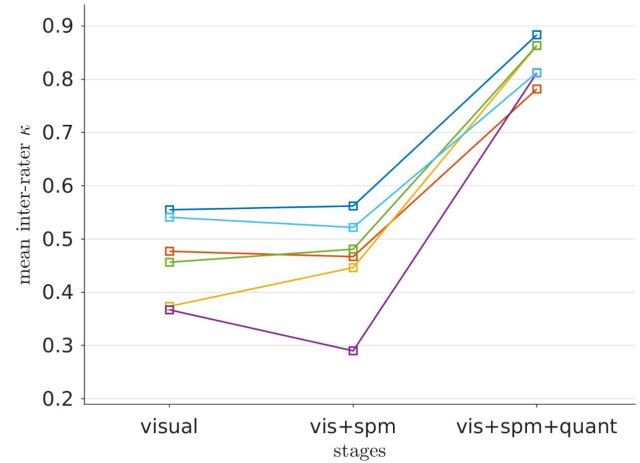




Benefits of quantification

Inter-rater agreement of 6 expert clinicians in the differential assessment of 100 FDG-PET cases, which have been confirmed with a diagnosis of MCI-LB or MCI-AD.

The accuracy and agreement (w Cohen's *k*) of each clinician is plotted with respect to 3 different diagnostic settings:

1. "visual": PET data is presented as acquired,
2. "vis+spm" where the PET data is presented together with a consolidated semi-quantification algorithm
3. "vis+spm+quant" where the PET data and semi-quantification are complemented with a third machine learning-based method, and a comprehensive analysis is presented to the clinician.

The added information and its synthesis not only **improves the accuracy** of the single clinician with respect to the true diagnosis, but it also delivers a much **higher intra-rater agreement**.

Quantification in clinical practice

There are several solutions for image analysis, but they are usually provided as workstations:

> Difficult access to the workstation: the console is not necessarily in a space accessible to all clinicians, and it can only be used by one person at a time.

> Rely on local computational resources.

> Require constant maintenance and upgrading is usually done with the purchase of a new workstation.

> Analysis are often restricted to certain Scanners only.

> Semi-automated analyses: direct intervention of the clinician is required.

DOlab is

- Accessible from any device
- Computes on cloud
- Supports multiple users
- Easy to extend
- Secure, GDPR compliant
- Fully automated

Dorian Technologies approach

1. **include clinicians/NM experts** in the process from the beginning
2. use of **multi-algorithm** approach, integrating standard methodologies with AI
3. aim at **quantification** (i.e. a direct product of the exam, open to interpretation) rather than at the diagnostic label (the outcome of a more complex process often involving several experts, difficult to challenge)
4. use **explainable** algorithms
5. **train users** & get feedback
6. keep implementation **simple**

Working with clinicians

Past activities

> Collaboration with clinicians for early research development

> Clinical testing @ 5 Italian centers: Genoa, Milan, Prato, Bergamo, Padua [2021 - 2022]

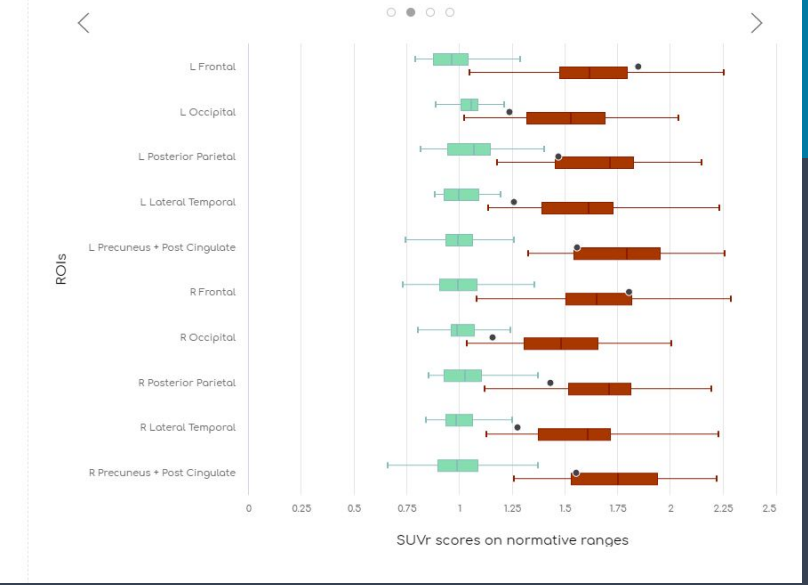
> Training session at the AIMN National School of Nuclear Medicine (Advanced course) [Sep 2021]

> Training session at the AIMN National School of Nuclear Medicine (Base course) [Oct 2022]

Planned activities

> First release installation in AIMN-Neurology centers (15 Hospitals Nationwide) [May 2023]

> First certified training course for DOlab usage in clinical practice [Dec 2023]



Absolute Scores | Absolute Vs. Normative Scores | Analysis Checks

ROI	SUVr		ELBA		TDr		CmpLS	
	Score	Cut-off	Score	Cut-off	Score	Cut-off	Order	Visual
L Frontal	1.85	1.15	1.09	0.8	0.68	0.54	1st	●
L Occipital	1.23	1.2	0.68	0.71	0.49	0.47	9th	●
L Posterior Parietal	1.47	1.24	0.9	0.81	0.64	0.55	3rd	●
L Lateral Temporal	1.25	1.18	0.73	0.73	0.58	0.53	7th	●
L Precuneus + Post Cingulate	1.56	1.32	0.86	0.9	0.58	0.58	8th	●
R Frontal	1.8	1.23	1.08	0.81	0.65	0.57	2nd	●
R Occipital	1.16	1.12	0.65	0.68	0.48	0.46	10th	●
R Posterior Parietal	1.43	1.29	0.9	0.78	0.66	0.52	5th	●
R Lateral Temporal	1.27	1.14	0.76	0.76	0.6	0.49	6th	●
R Precuneus + Post Cingulate	1.55	1.25	0.88	0.83	0.6	0.53	4th	●

CmpLS is around (●), below (●) or above (●) its cut-off

AIMN training [2021 & 2022]

Survey results

- about 50% of participants regularly use quantification tools.
- 92% would use DOlab in clinical practice.

Preferred features

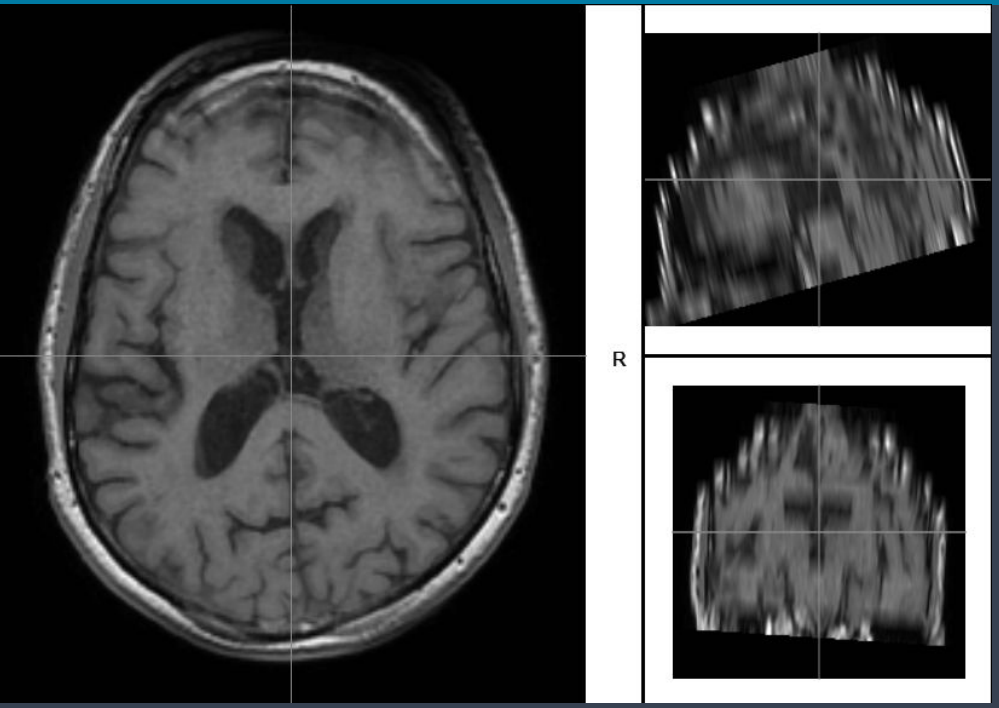
> multi-algorithm quantification

> explainability of analysis algorithms

> regional analysis

> comparison of patient results with normative population

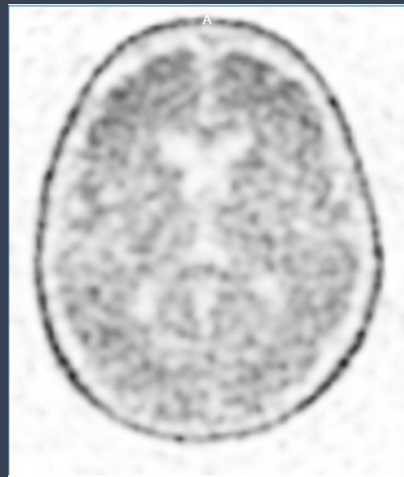
From research to clinical practice



Real world data

Heterogeneity of images:

- Quality
- Format
- Acquisition protocol

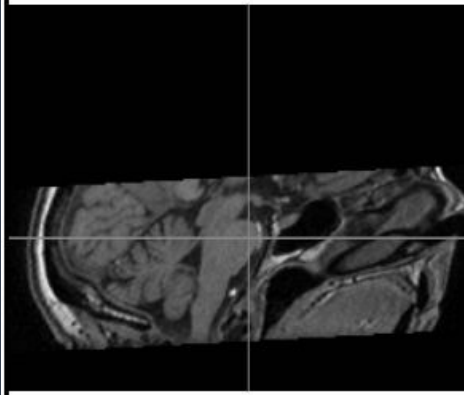


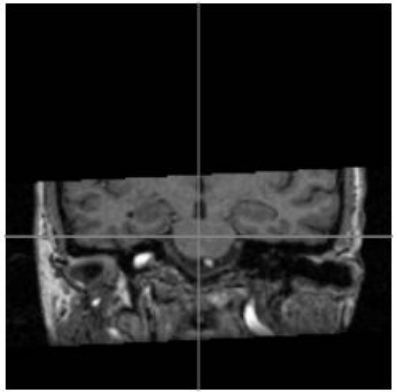
- Model validation on large multi-center dataset (~1000 clinically validated cases).
- Introduction of automatic checks on input data, providing warnings to the user.

Human mistakes

> Wrong image uploaded:
  - NM image (i.e. Early AmyPET/FDG-PET instead of Late AmyPET)
  - Wrong patient
  - Flipped/preprocessed image

> Incomplete data





- Provide a comprehensive manual and adequate user training.
- Continuous checks and requests for confirmation of data submitted by the user.
- Automatic inspection on input data (FOV, resolution, ...).
- Image recognition with AI algorithms

Clinical Advisors

Diego Cecchin

Director of Nuclear medicine unit
@ University Hospital of Padua

"Many reliable analyses. A sound tool to increase diagnostic confidence!"

Silvia Morbelli

Nuclear Medicine Physician
@ IRCCS S.Martino, Genoa

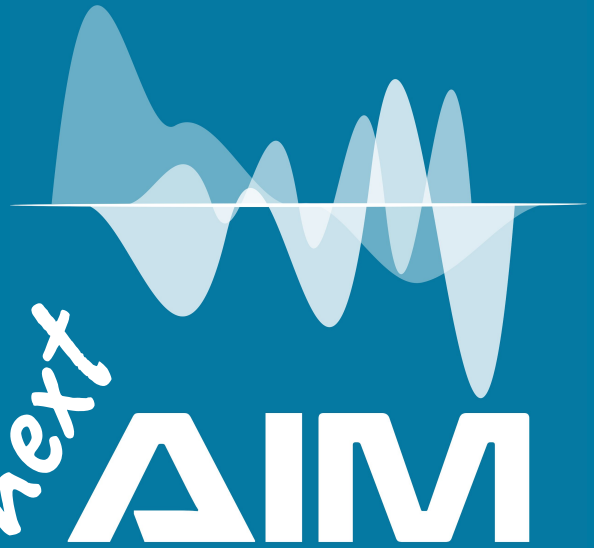
"DOlab is a real gem! I use it everyday and I gladly suggest it to my colleagues!"

Stelvio Sestini

Director of Nuclear medicine unit
@ Prato Hospital

"Quantification made with the DOlab platform is really helpful to detect damaged brain regions and precisely monitor the therapy efficacy."

Artificial Intelligence in Medicine



Thank you

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