Artificial Intelligence in Medicine

next AIM

Nuclear NeuroImaging Quantification and Radiomics

Alessandro Stefano, PhD
Ingegnere Informatico

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WP3. Applications to real data

Nuclear NeuroImaging Quantification and Radiomics [GE, BO, *LNS*]

AI-assisted quantification and predictive models on PET and SPECT scans, acquired on the *brain district*.

Focus on neurodegenerative diseases (Alzheimer, Parkinson, Multiple Sclerosis) and *oncological applications*.

Available data: EADC amyloid-PET dataset, ADNI dataset, IRCCS S. Martino (GE), HUG (Geneve, CH), AIMN clinical dataset, Collaboration with *Cannizzaro Hospital of Catania and Giglio Hospital of Cefalù*.

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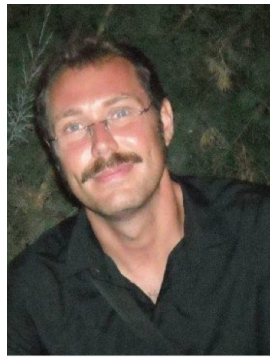
Consiglio Nazionale delle Ricerche

Istituto di Bioimmagini e Fisiologia Molecolare (IBFM)

Fondazione Ri.MED

Giorgio Russo
(Fisico Medico)

Alessandro Stefano
(Ingegnere informatico)



Albert Comelli
(Informatico)

2020 - To date: 24 PEER-REVIEWED PUBLICATIONS (SCOPUS)

- *PET, MRI, and CT Radiomics analyses (13)*
- *PET, MRI, and CT Image Segmentation (11)*

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Clinical Collaborations

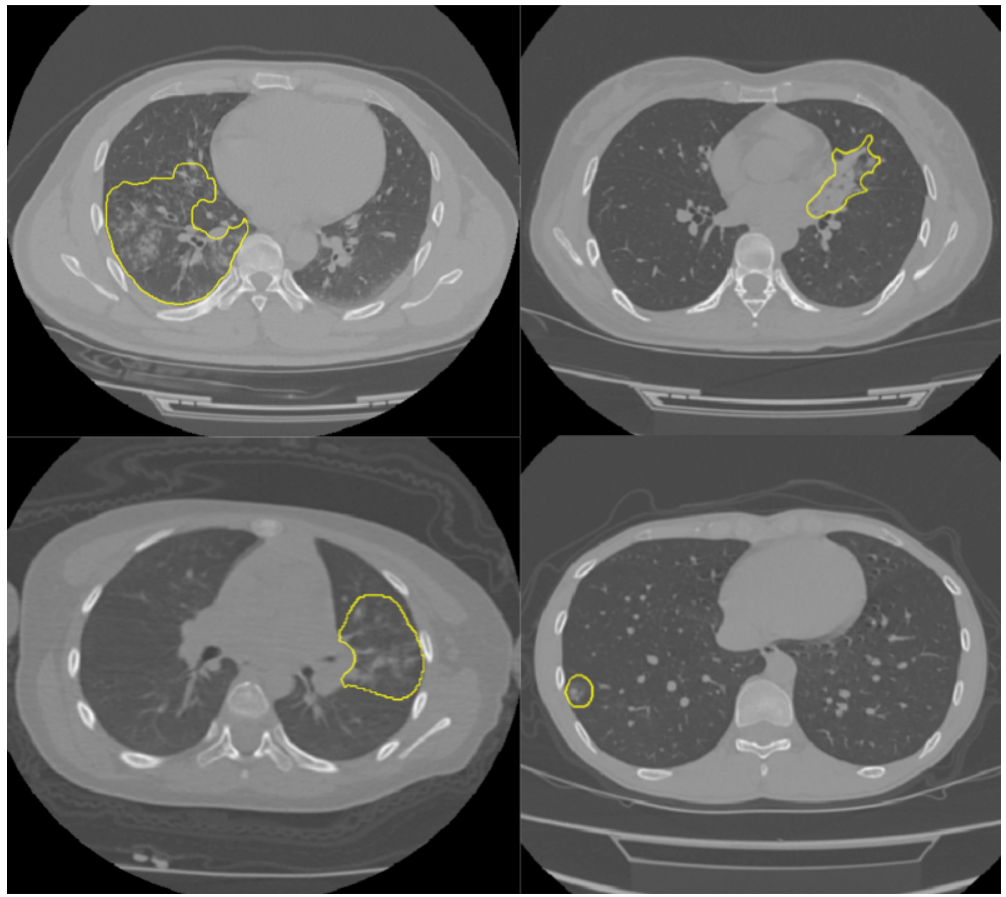
PET

CT and MRI

COVID-19 Lung CT Lesion Segmentation Challenge - 2020

(COVID-19-20)

MICCAI ENDORSED EVENT



Our team participated in the COVID-19 LUNG CT LESION SEGMENTATION CHALLENGE (COVID-19-20), organized by the Medical Image Computing and Computer Assisted Intervention Society.

It was an international challenge for the development of artificial intelligence (AI) algorithms for the segmentation and quantification of lung lesions caused by SARS-CoV-2 infection from multicenter, multinational, and patients of different age, gender, and disease severity.

The challenge committee assessed the performance of the algorithms by comparing their results with actual diagnoses.

The customized ENet algorithm proposed by our group was ranked first in Italy.

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Artificial Intelligence in Medicine

AIM

Journal of *Imaging*

MDPI

Article

Customized Efficient Neural Network for COVID-19 Infected Region Identification in CT Images

Alessandro Stefano [1] and Albert Comelli [2,*]

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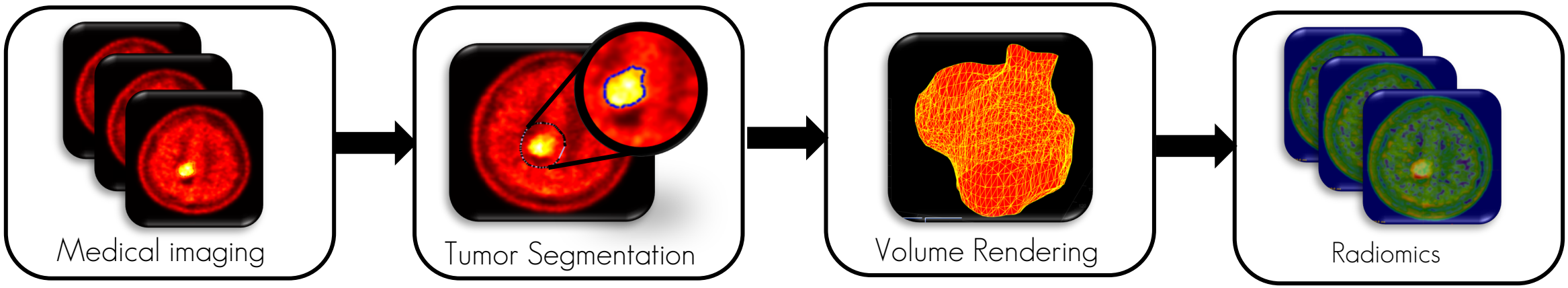
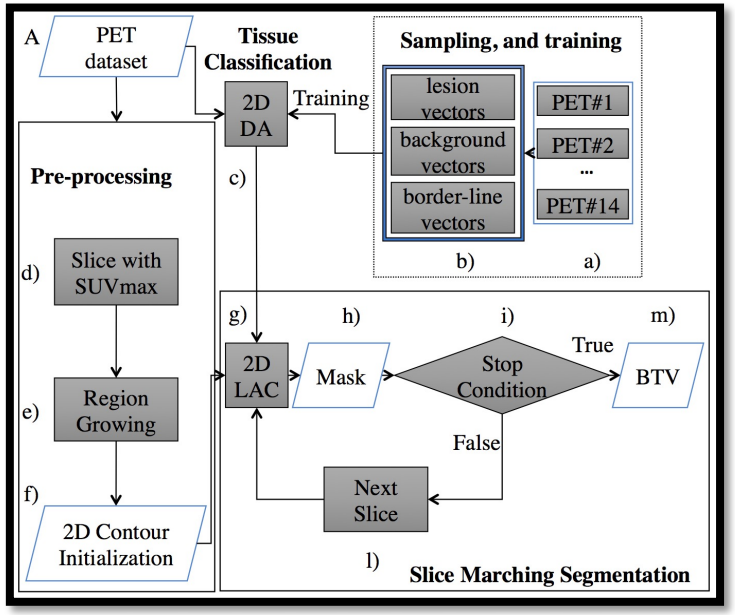
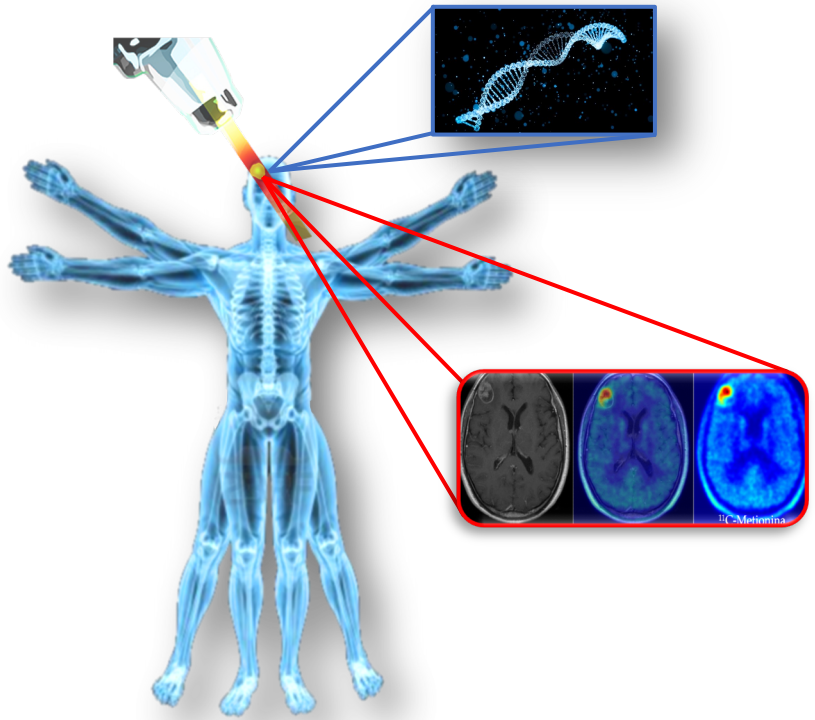
Abstract: Background: In the field of biomedical imaging, radiomics is a promising approach that aims to provide quantitative features from images. It is highly dependent on accurate identification and delineation of the volume of interest to avoid mistakes in the implementation of the texture-based prediction model. In this context, we present a customized deep learning approach aimed at addressing the real-time, and fully automated identification and segmentation of COVID-19 infected regions in computed tomography images. Methods: In a previous study, we adopted ENET,

Stefano, A. and Comelli, A., *Customized efficient neural network for covid-19 infected region identification in CT images.* J. Imaging 2021, 7. 10.3390/jimaging7080131





Intelligent systems with machine learning components to "mimic" how a human would perform complex operations



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Seminario

UNIVERSITÀ DEGLI STUDI DI PALERMO

Georgia Institute of Technology

National Research Council of Italy

Facoltà Dipartimentale di Ingegneria

Image Processing for Medical Decision Support System

Human eyes are not always able to detect and interpret complex patterns in bio-medical images. Considering the need to make rapid clinical decisions, quantitative methods to analyze bio-images are mandatory in clinical environment.

Two approaches in terms of High-Resolution Computed Tomography (HRCT) and Positron Emission Tomography (PET) image analysis will be presented:

- Radiomics in idiopathic pulmonary fibrosis and lung cancer
- A smart and operator independent system to delineate tumors in PET studies

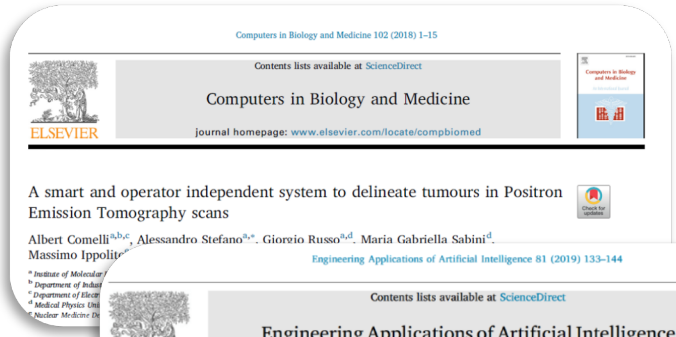
These approaches are used as a Medical Decision Support System to enhance the current daily methodology performed by healthcare operators.

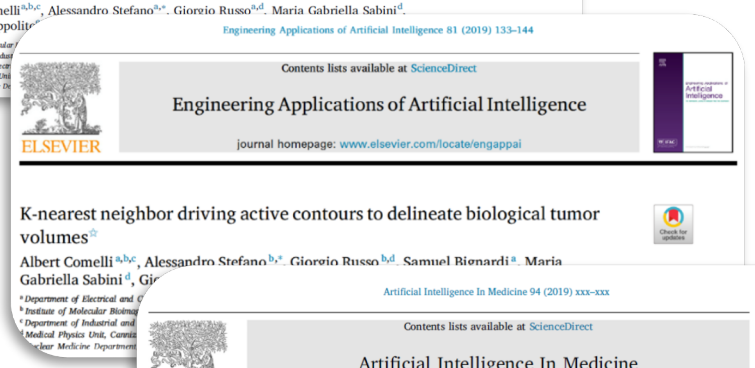
Dott. Albert Comelli. Born in 1981, he is a PhD Student in Computer Engineering at the University of Palermo and Research Affiliate at the Laboratory of Computational Computer Vision (LOCV) in the School of Electrical and Computer Engineering at Georgia Institute of Technology, Atlanta, Georgia, USA. He received the Combined BSc's/MSc's Degree in Computer Science in 2013 (University of Catania). His research interests include medical image processing and medical data analysis.
Author of 9 publications in peer-reviewed journals and international conference proceedings.

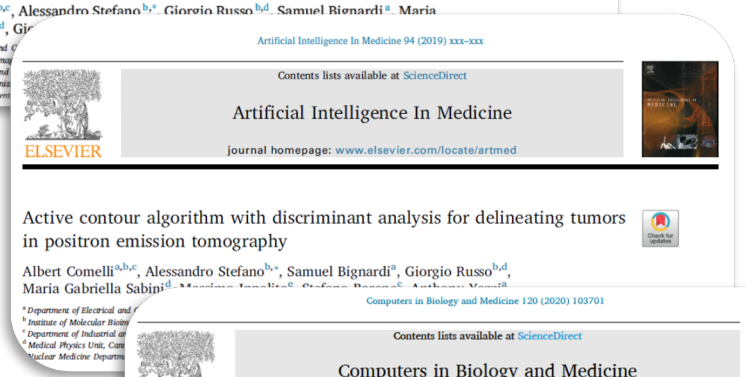
Ing. Alessandro Stefano. Born in 1980, he is a Research Scientist with the Institute of Molecular Bioimaging and Physiology, National Research Council (IBFM-CNR), Cefalù. He received the Laurea degree (summa cum laude) and the Ph.D. in computer engineering in 2005 and 2016, respectively. His research interests include medical image processing.
Author of more than 20 publications in peer-reviewed journals and international conference proceedings.

Prof. Anthony Yezzi holds the position of Julian Hightower Chair Professor within the School of Electrical and Comptuer Engineering at Georgia Institute of Technology where he directs the Laboratory for Computational Computer Vision. He has over twenty years of research experience in shape optimization via geometric partial differential equations. He has consulted for a number of companies including GE, 3M, MZA, Philips, Picker, and VTI.

Martedì, 12 giugno 2018 - ore 14:00
Aula R5 - PRABB
Università Campus Bio-Medico di Roma
Via Álvaro del Portillo, 21
Info: presidenza.ingegneria@unicampus.it


Computers in Biology and Medicine 102 (2018) 1–15
Contents lists available at ScienceDirect
Computers in Biology and Medicine
journal homepage: www.elsevier.com/locate/compbiomed
A smart and operator independent system to delineate tumours in Positron Emission Tomography scans


Engineering Applications of Artificial Intelligence 81 (2019) 133–144
Contents lists available at ScienceDirect
Engineering Applications of Artificial Intelligence
journal homepage: www.elsevier.com/locate/engappai
K-nearest neighbor driving active contours to delineate biological tumor volumes


Artificial Intelligence In Medicine 94 (2019) xxx–xxx
Contents lists available at ScienceDirect
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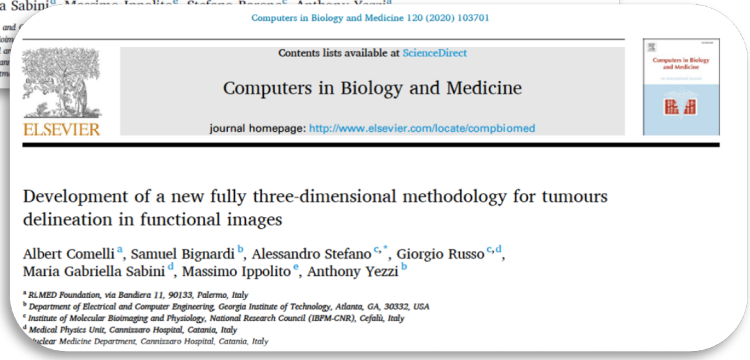
journal homepage: www.elsevier.com/locate/artmed
Active contour algorithm with discriminant analysis for delineating tumors in positron emission tomography


Computers in Biology and Medicine 120 (2020) 103701
Contents lists available at ScienceDirect
Computers in Biology and Medicine
journal homepage: http://www.elsevier.com/locate/compbiomed
Development of a new fully three-dimensional methodology for tumours delineation in functional images

Georgia Tech

Artificial Intelligence In Medicine 94 (2019) 67–78

Contents lists available at ScienceDirect

Artificial Intelligence In Medicine

journal homepage: www.elsevier.com/locate/artmed

Active contour algorithm with discriminant analysis for delineating tumors in positron emission tomography

Albert Comelli[a,b,c], Alessandro Stefano[b,*], Samuel Bignardi[a], Giorgio Russo[b,d], Maria Gabriella Sabini[d], Massimo Ippolito[e], Stefano Barone[c], Anthony Yezzi[a]

[a] Department of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta GA, 30332, USA

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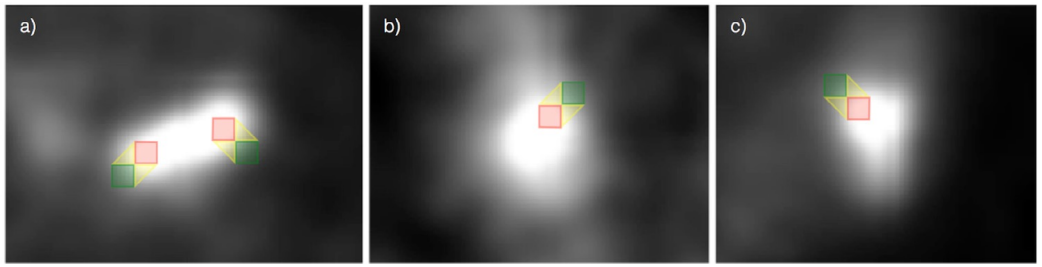
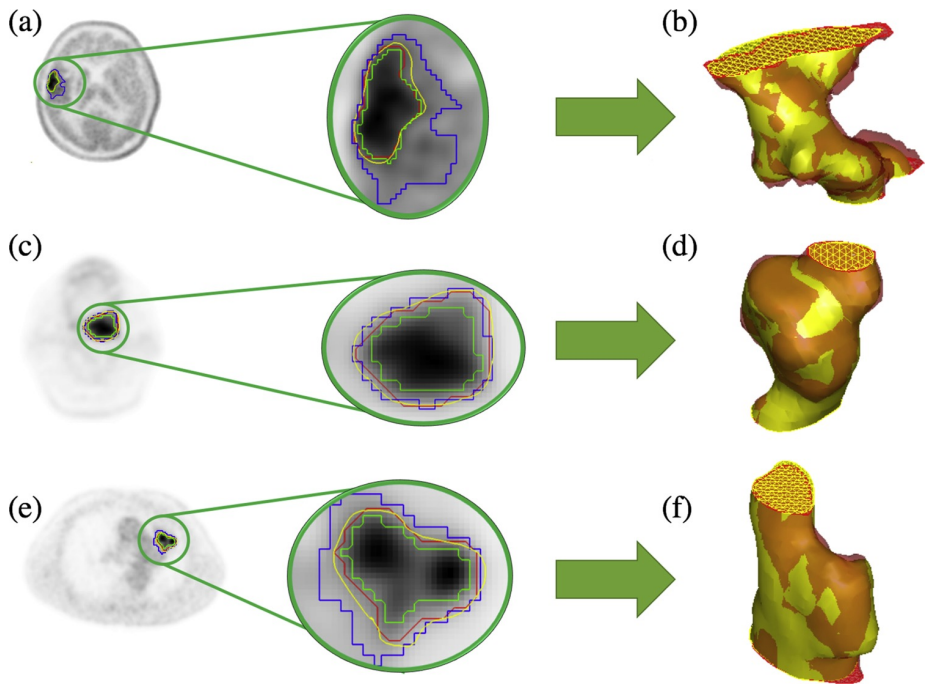
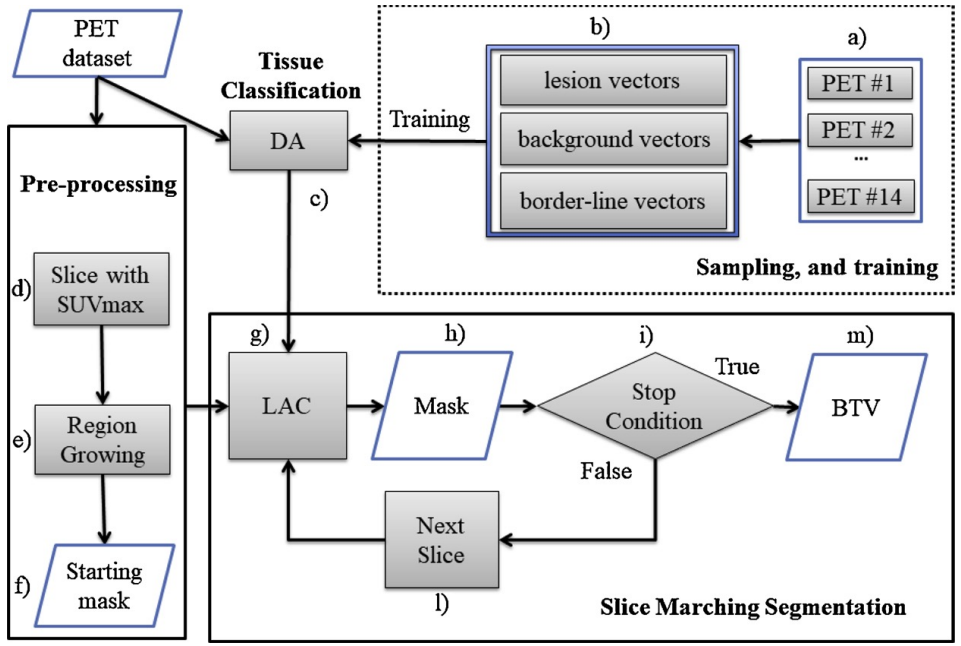






Stefano *et al. BMC Bioinformatics* 2020, **21**(Suppl 8):325
https://doi.org/10.1186/s12859-020-03647-7

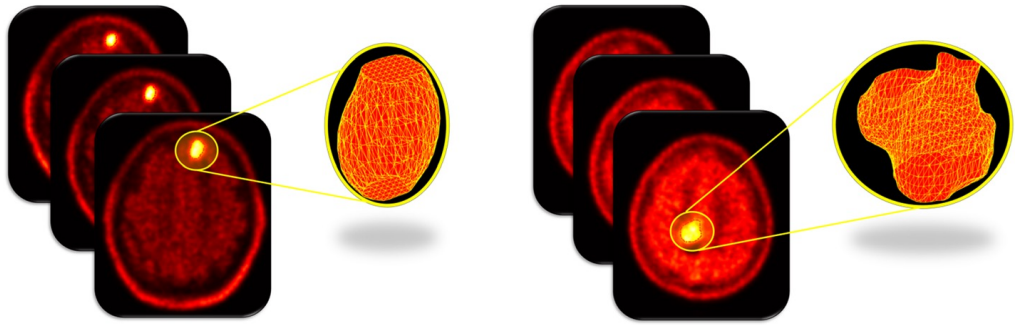
BMC Bioinformatics

RESEARCH Open Access

A preliminary PET radiomics study of brain metastases using a fully automatic segmentation method

Alessandro Stefano[1], Albert Comelli[1,2], Valentina Bravatà[1*], Stefano Barone[3], Igor Daskalovski[4], Gaetano Savoca[1], Maria Gabriella Sabini[5], Massimo Ippolito[6] and Giorgio Russo[1,5]

- 31 patients underwent L- [11C]methionine (11C-MET) PET
- Radiomics analysis to stratify between patients who respond to treatment or not.



- Three selected features (accuracy 78.27%)
  Follow-up study: Eight selected features (accuracy 86.57%)

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Computers in Biology and Medicine 120 (2020) 103701

Contents lists available at ScienceDirect

Computers in Biology and Medicine

journal homepage: http://www.elsevier.com/locate/compbiomed

Development of a new fully three-dimensional methodology for tumours delineation in functional images

Albert Comelli [a], Samuel Bignardi [b], Alessandro Stefano [c,*], Giorgio Russo [c,d], Maria Gabriella Sabini [d], Massimo Ippolito [e], Anthony Yezzi [b]

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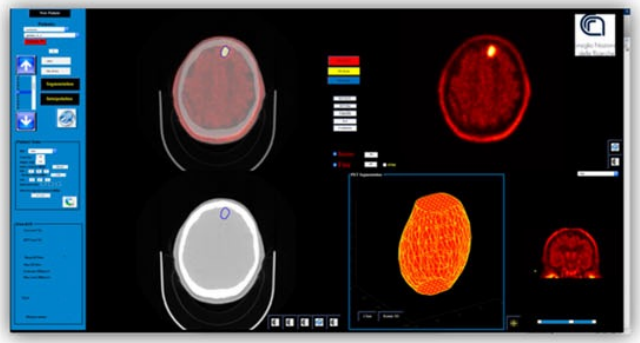
RESEARCH ARTICLE

WILEY

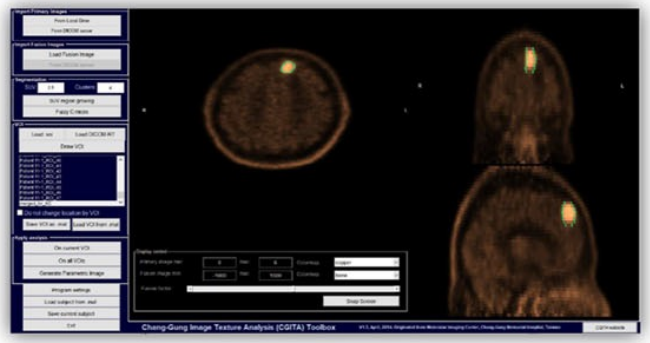
Hybrid descriptive-inferential method for key feature selection in prostate cancer radiomics

Stefano Barone[1] | Roberto Cannella[2] | Albert Comelli[3,4] | Arianna Pellegrino[5] | Giuseppe Salvaggio[2] | Alessandro Stefano[4] | Federica Vernuccio[2]

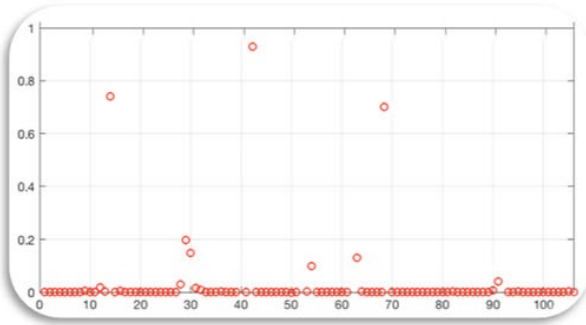
Automatic BTV segmentation using our tool



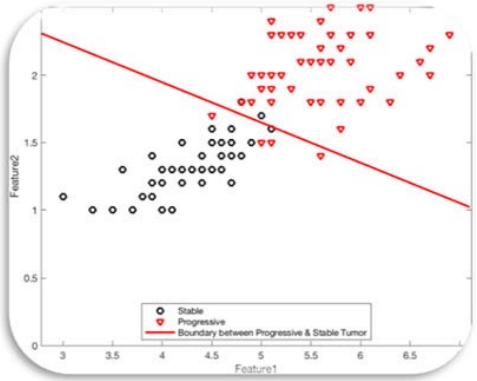
Feature extraction using CGITA tool



Feature reduction and selection using the proposed approach



Feature classification using DA approach



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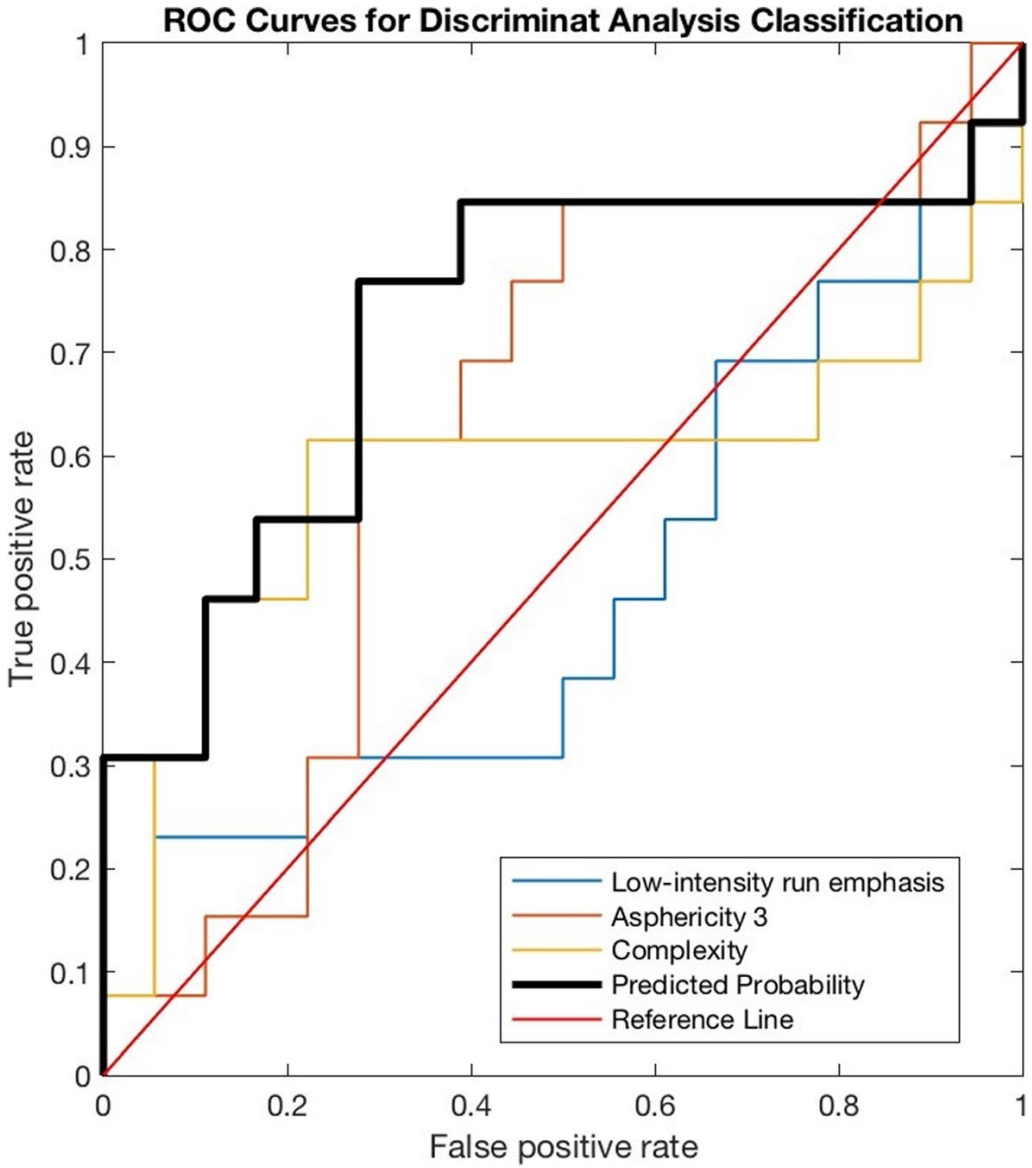

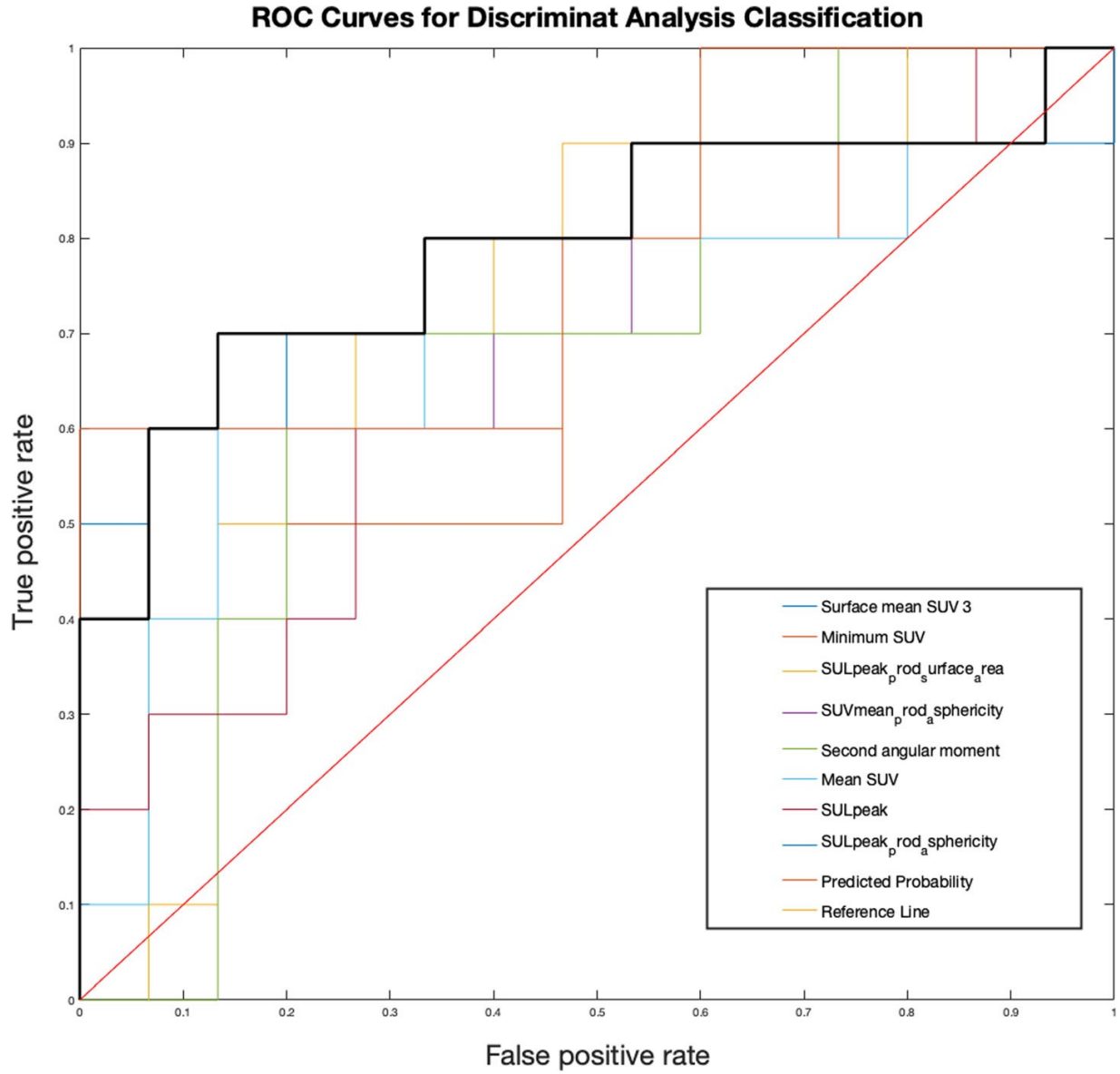

Artificial Intelligence in Medicine

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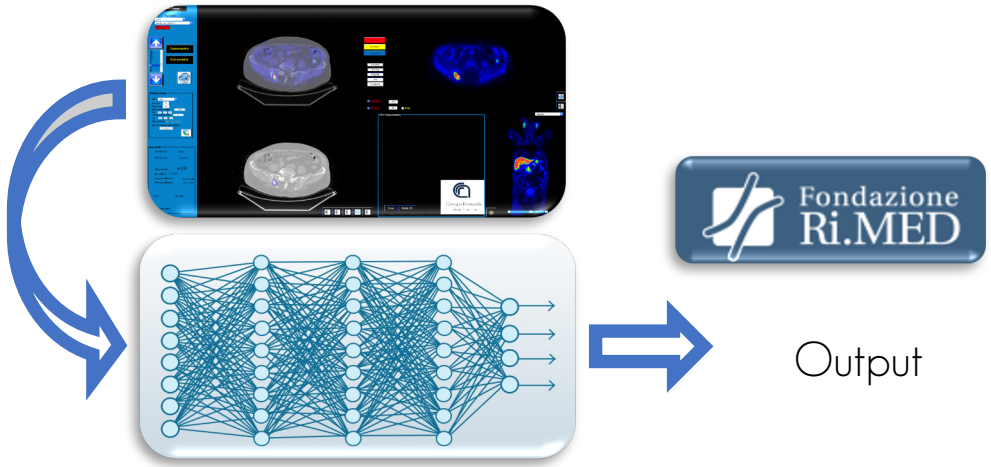
- Increase the number of cases

Deep learning

Istituto di Bioimmagini e Fisiologia Molecolare (IBFM)



Fondazione Ri.MED

Output

A new radiomics tool
in collaboration with Sapienza University

Istituto di Bioimmagini e Fisiologia Molecolare (IBFM)

SAPIENZA
UNIVERSITÀ DI ROMA

Work in progress...