

CHIST-ERA Projects Seminar 2021

Topic XAI

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INFORM:
Interpretability of Deep Neural Networks for Radiomics

April 13, 2021

General Info

INFORM:

Interpretability of Deep Neural Networks for Radiomics

- Topic: XAI
- Starting date: March 2021
- Duration: 36 months
- Consortium: 3 Partners (BIOEMTECH - UW - LaTIM)

Scientific Background (I)

INFORM falls within the field of Medical Physics and Bioinformatics

Goal: to improve clinical diagnosis and decision making through extraction of engineered image features (intensity, shape, textures) called Radiomics.

Radiomics is defined as the high-throughput extraction of “engineered/handcrafted” features from medical images

- Deep Neural Networks (DNNs) broad implementation in classification, denoising, segmentation medical image synthesis
- Limited adaptation in Radiomics

Scientific Background (II)

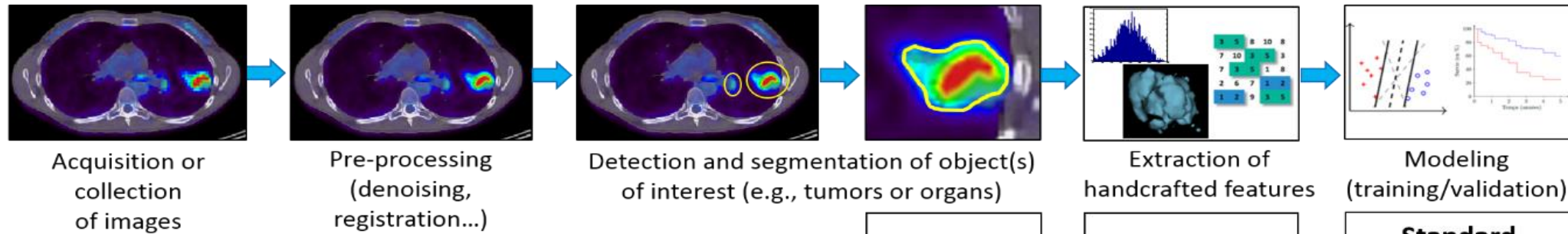
Background: Potential of DNNs to improve oncological classification performances in radiomics.

Lack of interpretability of such models prevents their broad utilization, performance and generalizability.

INFORM's approach (investigate XAI):

- Build high performance DNN-based classifiers
- Develop novel interpretability techniques for radiomics

Scientific Background (III)



Standard radiomics workflow:

Input data

Engineered features

Standard machine learning classifiers

Deep networks exploited to improve radiomics workflow:

Input data

Automated detection and segmentation using 2D or 3D U-Net type network(s)

Deep features from pre-trained network(s)

Neural network(s) as classifier(s)

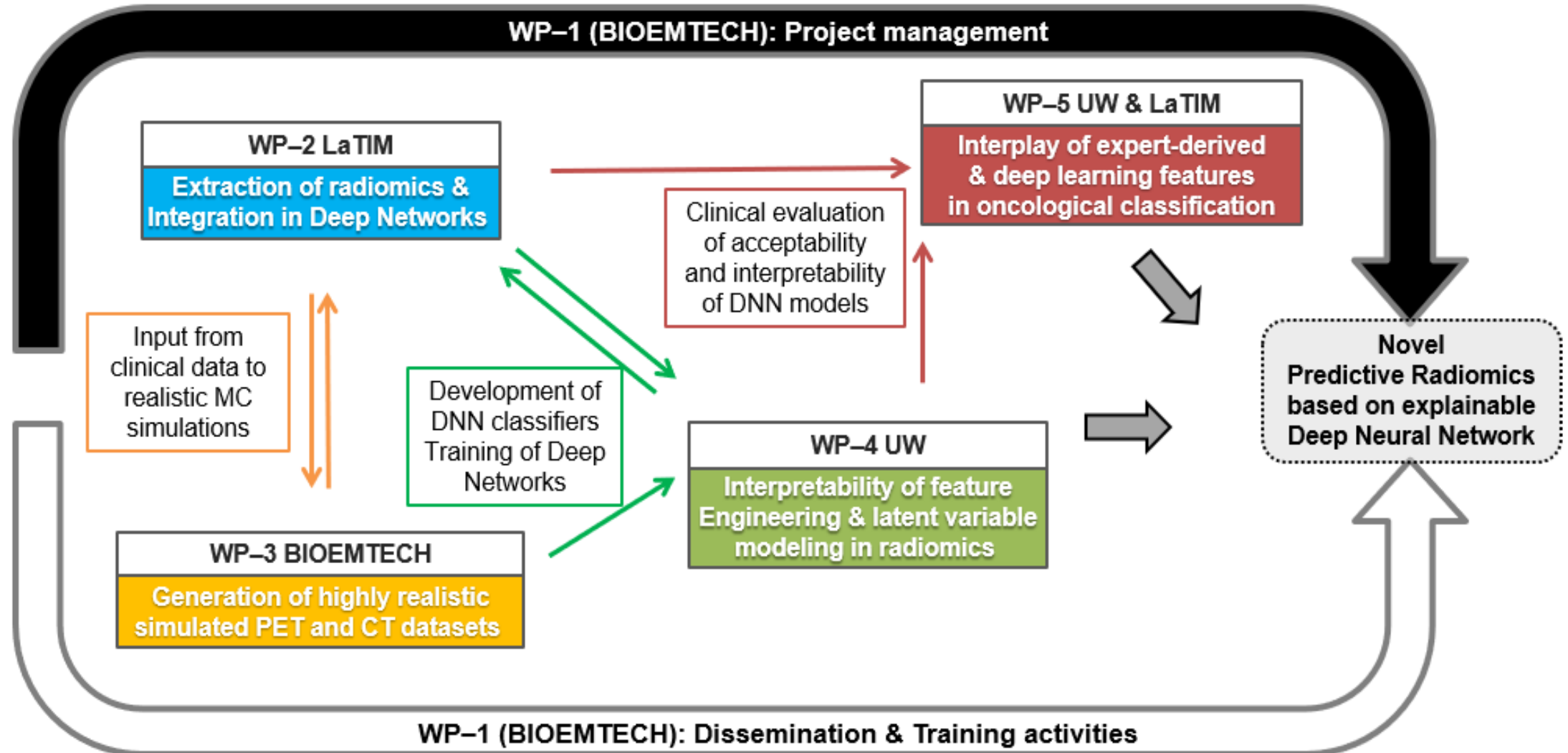
Fully « deep » radiomics workflow:

Input data

One or several networks trained from scratch, or transfer learning with pre-trained ones
Convolution / pooling layers / pooling
Extract / aggregate features

Connected layer
Classification

Methodology



Key challenges

- Alternative therapeutic strategies based on AI prediction models.
- Crucial to integrate data from several sources (clinical, imaging, dosimetry, genetics, toxicity, etc) in order to improve predictive ability.
- Challenging for end-users to interpret multiparametric radiomic models
- Acceptance and implementation of DNN-based AI systems in radiomics and other medical applications are difficult to predict.

The INFORM project aims to develop paths away from unexplainable black box algorithms towards explainable grey/white box models for radiomics.

Potential Impact

- Optimize patient management and clinical treatment strategies by developing novel methods to facilitate decision-aid systems.
- Play a major role in facilitating the acceptability of DNN decision-aid models in medical imaging and oncology.
- The successful implementation of this project will have a large and prolonged impact both in the medical and the computing field

Potential Impact

Multilevel impact is expected in different sections
science, economy, society

- i. Novel computational tools potentially translated to clinical practice.
- ii. Knowledge transfer to the team members and to the broader society.
- iii. Innovative results in the fields of Medical Physics, Bioinformatics, AI.
- iv. Attractive working environment for young Researchers.
- v. Preliminary market analysis by the involved SME to investigate potentiality of a software tool for support in clinical practice.

Current status (results / dissemination)

- Administration: Still waiting for National official approvals
CA in process.

- 1 common review publication
- Logo & social media
(preparation of dissemination
material, including website, poster)



Physica Medica 83 (2021) 108–121

Contents lists available at ScienceDirect

Physica Medica

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

Original paper

Artificial intelligence: Deep learning in oncological radiomics and challenges of interpretability and data harmonization

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Acknowledgements

This study was co-financed by:
a) the CHIST-ERA grant [CHIST-ERA-19-XAI-007] with project acronym INFORM, by General Secretariat for Research and Innovation (GSRI) of Greece, National Science Centre (NCN) of Poland [2020/02/Y/ST6/00071] and Agence Nationale de la Recherche (ANR) of France.

ARTICLE INFO

Keywords:
Deep learning
Machine learning
Convolutional neural network
Radiomics
Data curation
Explainability
Interpretability

Development of “hidden” biomarkers... Networks (DNN) have achieved... Lately, DNNs have been considered for... sification and prediction in clinical practice. However, generalized applicability. In this study we review the basics of radiomics analysis, and major interpretability methods that help enable explainable AI. Future requirement of multicenter recruitment of large datasets, increasing the biomarkers variability, the potential clinical value of radiomics and the development of robust explainable AI models.

Sustainability / Exploitation

- Peer reviewed journal publications
- Participation in public national/international events
- Organisation of a multistakeholder workshop to bridge AI researchers and stakeholders.
- 1 hands-on training school
- Exploitation strategy plan (6months)
- All knowledge generated on DL Interpretability on Radiomics will be open access.
- Aim at new collaborations / research proposals



Consortium members



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GSRI (National Funding Organisation)

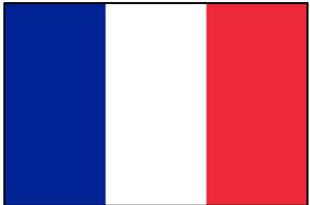
- Coordination
- MC simulations / Synthetic data
- Medical Image Processing / Evaluation of DNN models
- Dissemination / Exploitation / Training



Consortium members



Laboratoire de Traitement
de l'Information Médicale
Laboratory of Medical
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Mathieu Hatt (PhD, Medical Informatics)
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ANR (National Funding Organisation)

- Medical Image Processing & Analysis
- Medical Data Collection
- Expert in Radiomics / Multimodal Imaging
- Image Synthesis – GAN and ML techniques



Consortium members



Neo Christopher Chung (Assistant Professor in Computer Science)

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NCN (National Funding Organisation)

- AI expert (DL / ML)
- Expertise in High-dimensional Statistical Models
- Development of DNN classifiers and Saliency Maps
- Biomedical Engineering & Computational Biology background





Thank you!