Newsletter

Winter 2022

ProCAncer-I

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In this issue

Editorial

Prof Tsiknakis (FORTH)

The ProCAncer-I project has completed the first year of its lifecycle at the end of October 2021. With this brief note key results and achievements of the first year are summarized in the sequel.

A main focus of our work has been devoted on crystallizing the various clinical end points on which the project focuses, the so-called clinical Use Cases (UCs). The UCs within the ProCAncer-I project represent the drivers to answer Prostate Cancer (PCa) relevant clinical questions, ranging from PCa diagnosis and characterization to prediction of treatment response and occurrence of side effects after treatment.

Nine such UCs have been defined that cover the whole prostate cancer care continuum. I will provide a more detailed description of a couple of our UCs, so that our readers understand the clinical rational and importance of the work performed in ProCAncer-I.

- *UC2 focuses on the characterization of cancer according to its biological aggressiveness into clinically significant and non-significant disease*. UC2 aims to stratify men with suspicious findings on MRI into high-risk cases, which need radical treatments to ensure that cancer will not grow and spread to remote parts of the body becoming a deadly disease, from low-risk cases which could be safely followed-up with active surveillance, avoiding comorbidities of treatment and ensuring the highest possible quality of life for the patients;

- *UC5 focuses on the prediction of the risk of disease recurrence after radical prostatectomy, based on imaging data and AI techniques.* In UC5 post-surgery findings, as positive surgical margins and extracapsular extension, will be considered in a nomogram comprising also radiomics and clinical variables to predict disease recurrence. UC5 will help clinicians to “modulate” radical prostatectomy (in terms of different nerve sparing approaches, according to the site of extracapsular extension and/or seminal vesicle invasion), tailoring treatment to the predicted risk of disease recurrence;

In the context of this stream of activity a very detailed definition of related clinical and histopathological data that needs to accompany the imaging data has been defined and technical decisions regarding the standards to be used for its representation supporting interoperability with other similar repositories and infrastructures.

A second main area of work has focused on establishing the legal framework of the project. All collected data during the lifetime of the ProCAncer-I project will be anonymized on the premises of the clinical partners (Data Controllers). All data elements, either imaging data, or/and clinical data and metadata, will be anonymized prior to their upload and storage on the ProCAncer-I cloud platform. Significant efforts, both analytical and development have taken place in developing the ProCAncer-I Upload Tool, which is the communication gateway with the envisaged web platform, to execute the defined data anonymization process. In parallel, a detailed analysis of the risks of Re-identification within the ProCAncer-I Health Data Sets has taken place. Study protocols have been developed for both the retrospective as well as the prospective data collection. Most clinical partners have completed the process to obtain approvals from their corresponding Ethical Committees. This was a very important milestone, successfully achieved.

The third main area of work has been the definition and implementation of the cloud-based platform of the project and its integrated tools. User access to the ProCAncer-I platform will be granted via an Authentication and Authorization Infrastructure (AAI) implementation and the de-identified data will be accessed in a community-driven fashion. A fault-tolerant, elastic, and high-performance computing infrastructure provides the services and tools for the implementation of AI algorithms, execution of advanced processing steps, and visualization of results. Tools have been developed and will be provided to various user groups, i.e. clinicians/radiologists and other clinical staff, in order to support the efficient upload, curation, and annotation of imaging and related clinical data. In specific, the image curation tool developed guides users through a set of steps for the data curation, i.e. motion-correction, co-registration, and quality check, final approval and storage of the derived images. Also, for the annotation of the collected DICOM studies uploaded in the ProCancer-I platform, a web-based annotation tool has been developed and integrated with the rest of the ProCAncer-I platform components. All relevant metadata are stored in the Metadata catalogue of the project using an OMOP-based common data model that appropriately documents and catalogues data and model curation steps enabling traceability and trustworthiness.

Finally, along with the brief summary of activities and achievements, key work was also been performed, jointly with all other AI4MI projects (EUCanImage, Chaimeleon, INCISIVE and PRIMAGE), through a number of working groups that have already produced important and internationally visible results.

Having successfully completed the first, very important, phase of the project's lifecycle, the second, equally important, phase starts that focuses on uploading initially the retrospective data from the ProCAncer-I clinical partners and subsequently the relevant prospective data. In parallel, AI-base model development will begin targeting the initially described UCs.

UC1: Detection of prostate cancer with high accuracy in both the peripheral and transitional zone

Prof Fuetterer (Radboud)

Within the ProCancer-I project, a total of nine clinical needs will be addressed utilizing artificial intelligence (AI) models trained on ProstateNET – a unified repository of 1.5 million images of prostate MRI acquired across the consortium. In the current landscape of prostate MRI applications utilizing AI, two main computer-aided applications have been described.

1. Patient-level diagnosis or lesion-level classification (CADx)

2. Lesion-level detection (CADe)

CADx describes algorithms for classification of lesion candidates on MRI. They are primarily used to classify manually-annotated lesion candidates in two or multiple classes. Lesion-level CADx algorithms are semi-automated, i.e. readers are still required to manually annotate lesions candidates for further characterization, which does not reduce the current workload for prostate MRI assessment.

A different approach is that of lesion detection algorithms or CADe. Its pipeline is shown in Fig. 1. In comparison to CADx, CADe algorithms do not require manual input of lesion candidates or a region-of-interest, as images are classified on an object or voxel-level basis. For this reason, PCa detection algorithms could aid in prostate MRI assessment, by automatically highlighting suspicious regions with cancer likelihood maps and/or segmentations to the reader, which in turn, could decrease the current workload of radiologists.

Recent literature has described multiple algorithms for this task with varying results. Additionally, in the current landscape of AI developments for PCa, much of the AI work is limited to single-center, single AI-architecture analyses, and critically, on small data sets.

The scope of UC 1: "*Detection of prostate cancer with high accuracy in both the peripheral and transitional zone*" is to improve the accuracy of PCa detection on mpMRI, powered by AI models trained on a large collection of

multicenter mpMRI exams. It serves as a first step in the addressment of the current unmet clinical needs in PCa regarding precision diagnosis and personalized disease management while it provides lesion candidates open for further characterization. Within this UC, AI-models will be developed, classifying lesions candidates as cancerous or non-cancerous. Models will be trained on mpMRI images combined with clinical data such as PSA, PSAD and or follow-up. In total 13.000 cases will be dedicated to this clinical question.

Figures and text are excerpts from the recent ProCancer-I funded narrative review: Twilt JJ, van Leeuwen KG, Huisman HJ, Fütterer JJ, de Rooij M. Artificial Intelligence Based Algorithms for Prostate Cancer Classification and Detection on Magnetic Resonance Imaging: A Narrative Review. Diagnostics. 2021; 11(6):959. https://-doi.org/10.3390/diagnostics11060959

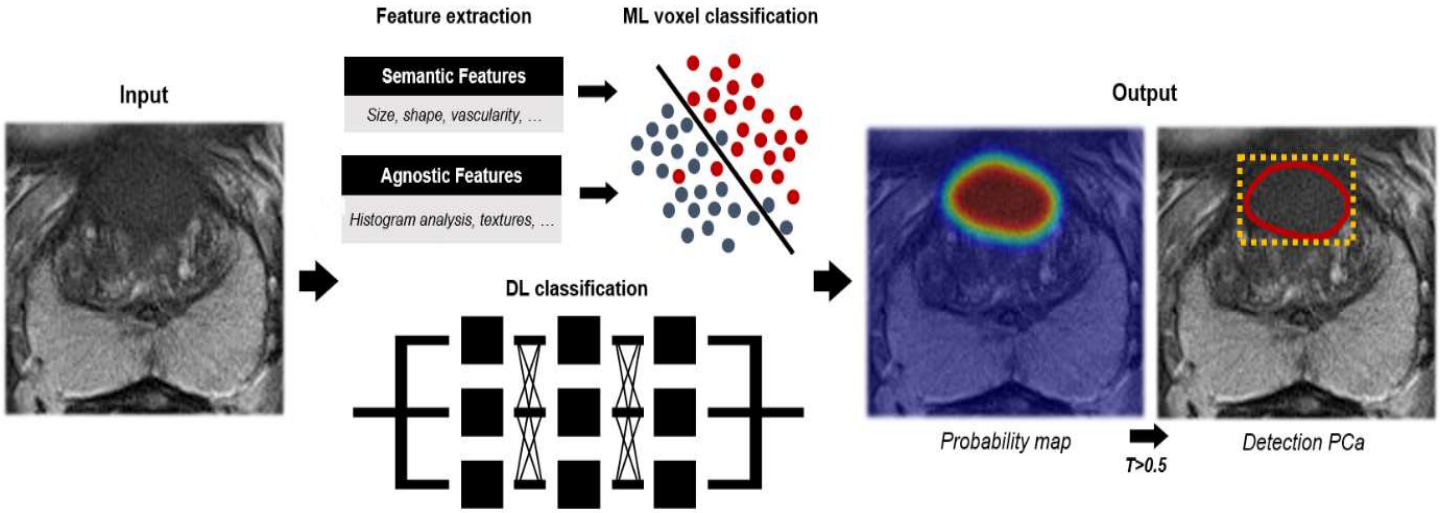


Figure 1 - Deep learning (DL) and radiomics-based machine learning (ML) workflow of algorithms for lesion detection (CADe) for prostate cancer (PCa) using an axial T2-weighted sequence. As input, multiparametric or single MR sequences are utilized. Algorithms provide a detection map for prostate cancer likelihood. Based on a threshold within the probability map (e.g., probability > 0.5), segmentation of PCa lesion candidates may be extracted.

(Meta)Data Infrastructure for Trustworthy AI

Valia Kalokyri & Haridimos Kondylakis (FORTH-ICS)

ProCAncer-I aspires to create the largest interoperable, high-quality multi-parametric Magnetic Resonance Imaging (mpMRI) dataset worldwide/globally comprising more than 11.000 retrospective and more than 6.000 prospective mpMRI examinations, including clinical data, for the study of prostate cancer (PCa). Based on these datasets the project will develop advanced, trustworthy, artificial intelligence models to address unmet clinical needs: diagnosis, metastases detection and prediction of response to treatment.

However, trustworthy AI requires traceability and transparency in every phase of the model development process. In essence, traceability refers to the mandate to document the whole development process and to track the functioning of an AI model or an AI-based system used to support analysis and interpretation. To this direction within the ProCAncer-I project, a metadata catalogue is established to enable both data and model transparency. As the outcomes of AI/ML systems depend directly on the data training process, transparency in data collection, utilisation and storage, is an area of significant concern. On the other hand, due to the rising complexity in modeling, end-to-end tracking of provenance information in the machine learning lifecycle, and on evaluating models for performance and trust are crucial. Towards this end, the metadata catalogue is used to store appropriate metadata for both the available data, the curation process followed for transforming and cleaning the data, and also for the development of the AI models and tools and their evaluation metrics.

Further, essential to building those models is a common data model that will be used for data storage and retrieval. ProCAncer-I adopts the OMOP-CDM, which is one of the most widely used common data models for supporting analysis of observational health data, to support the generation of reliable scientific evidence about disease history, effects of medical interventions and health care interventions and outcomes. Besides the standard CDM, OMOP-CDM extensions are used, such as the Oncology CDM extension for representing cancer data at the levels of granularity and abstraction required to support cancer research. For radiology exams, although those can be currently registered using the OMOP-CDM, the model does not enable the storage of the subsequent curation process. As such, the ProCancer-I aspires to introduce a radiology extension and is currently working on it in collaboration with the OHDSI Medical Imaging Working Group, focusing on including annotation, segmentation and curation data as radiomics features that need to be stored as well.

The clinical vision and impact of the project

Interview with prof. Daniele Regge (Clinical Coordinator of the ProCancer-I project)

Q: In the case of prostate cancer there are several tests which can help clinician in the decision process, for example prediction algorithms based on PSA blood test and biopsy. Why are they not good enough? What is the role of MRI in this context?

A: First, we know that there is a proportion of men with elevated PSA values that do not have cancer, and on the contrary, another group of patients with cancer but with PSA within normal range. Second, biopsy alone is not sufficient to predict the presence of cancer. Indeed, biopsy could miss cancer or it could sample only a small unrepresentative area of the tumour, failing to provide important information to guide clinical decision. For the above reasons urologists now request MRI before biopsy. MRI scans the whole prostate accurately detecting suspicious lesions, guiding biopsy towards them. Major limitations of MRI are the long reporting times and the need for experienced readers, the latter not readily available. Humans cannot easily perceive and process the huge amount of information embedded in each MRI examination. Artificial intelligence comes into play by supporting the radiologist in detecting cancer.

Q: The ProCAncer-I European project aims to develop several artificial intelligence solutions related to the most relevant clinical needs in prostate cancer. Which are at the moment the most important issues when managing prostate cancer patients?

A: Other than detection, one important task of AI could be to distinguish prostate cancers that are born to be bad, from those that are born to be good. In the past this did not matter since prostate cancer patients were treated with a one-size-fits-all approach. Today the goal is precision care. One of the most important aims of ProCAncer-I is to identify patients with aggressive forms of cancer, that therefore need whole gland treatment (prostatectomy or radiotherapy) from those that harbour indolent cancer and that can safely undergo active surveillance, sparing the side effects of treatments. Recent research has shown that with AI algorithms it is possible to extract and process information derived from prostate MRI that can be related to tumour histology. The capability of MRI to grade cancer without the need of tissue analysis is defined virtual biopsy.

Q: Given the importance of artificial intelligence applications, which are the advantages that the ProCancer-I project could bring into the real world?

A: The ProCancer-I is a EU-funded project which brings together 20 different European centres of excellence (13 clinical centres, 6 technical partners and 1 legal team) that will contribute to the creation of ProstateNET, the biggest collection of data and imaging (more than 17,000 cases) related to prostate cancer. This is really important because most trial results are achieved from limited datasets, hampering generalization to other patient cohorts. Using the ProstateNET database, we will not only detect and characterise prostate cancer, as previously said, but we will also aim at predicting which patients will develop metastasis, which will likely relapse and which will suffer the side effects of treatment. These findings will help clinicians to focus on the cases that should be follow-up more closely or that should undergo additional treatments, i.e. administration of adjuvant therapies, lymphadenectomy, etc. This approach could really become a game changer in the fight against the most common cancer in men.

Q: What should we expect from ProCancer-I and AI in the next five years? Will radiologists still be necessary to the patients or will computers do all the work?

A: In the last few years there has been a lot of talking on AI and how it will affect our everyday life. We are increasingly relying on computer workforce and the same is happening in hospitals, where AI is gradually becoming our virtual assistant. In prostate cancer, for example, there are studies demonstrating how the combination of radiologists and computers can improve the reporting process, bringing the benefit of a timely and accurate diagnosis in patients with clinically significant disease. When the results of ProCAncer-I will be integrated in a seamless process, cases could be prioritized by placing at the top of the list those needing accurate reporting by the radiologists, so that greater attention could be addressed to those who actually need treatment. In this view computers will do a great job, cooperating with human workforce and this synergy will reduce the workload for trivial aspects, letting clinicians focus on what really matters, their patients.

A regulated pathway for Artificial Intelligence in Medical Imaging

A brief historical survey of European state-of-play, the open issues and the ProCAncer-I approach | Sara Colantino (CNR)

Over the last decade, Artificial Intelligence (AI) solutions to support the whole value-chain of medical imaging[1] has experienced a considerable acceleration. This progress notably relies on the increased availability of imaging datasets and the impressive performance of data driven methods, spearheaded by the deep learning methodologies as well as the radiomics and multiomics studies. ProCAncer-I itself is expected to sensibly contribute to the field, with its AI-powered, quality-controlled and GDPR[2] -compliant platform, integrating imaging data and AI models for precision care in prostate cancer.

Nevertheless, considering the high impact that AI-driven applications may have on clinical workflows and the still-open challenges and hindrances to their uptake in practice, all stakeholders agree on the need for robust and regulatory frameworks to steer a positive impact. Only this way, we can expect to eventually realise the full benefits of AI in medical imaging and in healthcare as a whole. The 2020's joint report by EIT Health and McKinsey & Company clearly highlighted the existence of legislative gaps and the need for new legislation[3].

It was to respond to this kind of demands and concerns that the European Commission (EC) has taken action on a more general societal basis. In 2018, with its first Communication "Artificial Intelligence for Europe"[4], the Commission put forward a strategy for AI, by promoting a European approach based on **excellence and trust**. Such an approach seeks to maximise the benefits of AI, while preventing and minimising any risks that may affect the public sector, markets and businesses as well as people's safety and fundamental rights. In April 2019, the Commission-appointed High-Level Expert Group (HLEG) on AI nurtured this strategy by publishing the "Ethics Guidelines for Trustworthy AI" [5]. These propose seven key principles or requirements to guarantee the **trustworthiness** of an AI model or system. They comprise:

• human agency and oversight, through human-in-the-loop and human-centred approaches

• technical robustness and safety, based on accuracy, reliability and reproducibility

• privacy and data governance, relying on the preservation of privacy, data quality and integrity as well as on a legitimised access, use and reuse of data

• transparency, in terms of the traceability of data provenance and model development as well as of the explainability of any AI-based decisions

• diversity, non-discrimination and fairness

• societal and environmental well-being

• accountability, in terms of responsibility and auditability of AI models and systems.

Moving a step forward in 2020, the EC issued a first "*White Paper on AI*", by incorporating these seven principles and promoting an extensive stakeholder consultation. This resulted in the **first ever legal framework on AI**, the so-called "*Proposal for a Regulation of The European Parliament and of the Council Laying down Harmonised Rules on Artificial Intelligence*" or "*The Artificial Intelligence Act" (AIA)* [6]. The AIA is the world's first concrete initiative to regulate AI development, and fall within the European strategy to regulate the digital sector. It makes the pair with the GDPR and the "Data Governance Act" [7].

The AIA aims to provide AI developers, deployers and users with clear requirements and obligations, in order to ensure that European citizens can trust AI-powered applications. **A risk-based methodology** has been laid down to limit significant threats to the health and safety or the fundamental rights of persons. The approach categorises AI systems considering four risk tiers: (i) unacceptable risk, (ii) high risk, (iii) limited risk, and (iv) minimal or no risk (see Figure 1). According to the risk level they raise, the AI systems will have to comply with a set of horizontal mandatory requirements for trustworthy AI and to follow conformity assessment procedures before entering the Union market. The foremost focus of the AIA is on the high-risk AI systems.

In fact, the class of AI systems that have an unacceptable risk level (e.g., social scoring or real-time remote biometric identification systems) is simply totally banned. The use of applications with minimal or no risk (e.g., AI-enabled video games or spam filters) is free of obligations. The AI systems that may have limited risks are subject only to specific transparency obligations (e.g., when interacting with a Chabot, this should be clear and notified to the user). Whilst high-risk AI systems will be subject to strict technical, monitoring and compliance obligations before they can enter the market. The key obligations comprise:

[1] Pesapane, F., Codari, M. & Sardanelli, F. Artificial intelligence in medical imaging: threat or opportunity? Radiologists again at the forefront of innovation in medicine. Eur Radiol Exp 2, 35 (2018). https://doi.org/10.1186/s41747-018-0061-6

[2] European Commission, Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC

[3] EIT Health and McKinsey & Company joint report "Transforming healthcare with AI. The impact on the workforce and organisations", 2020 - https://tinyurl.com/rvwfw3cw

[4] EC's Communication "Artificial Intelligence for Europe", COM(2018)237 - https://tinyurl.com/39mvfy6d

[5] HLEG on AI, "Ethics Guidelines for Trustworthy AI" - https://tinyurl.com/4tej3t38

[6] EC "Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act)" COM/2021/206 final - https://tinyurl.com/4aa9d6e7

[7] European Commission, "Regulation of the European Parliament and of the Council on European data governance <-(Data Governance Act)", 2020 - https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0767

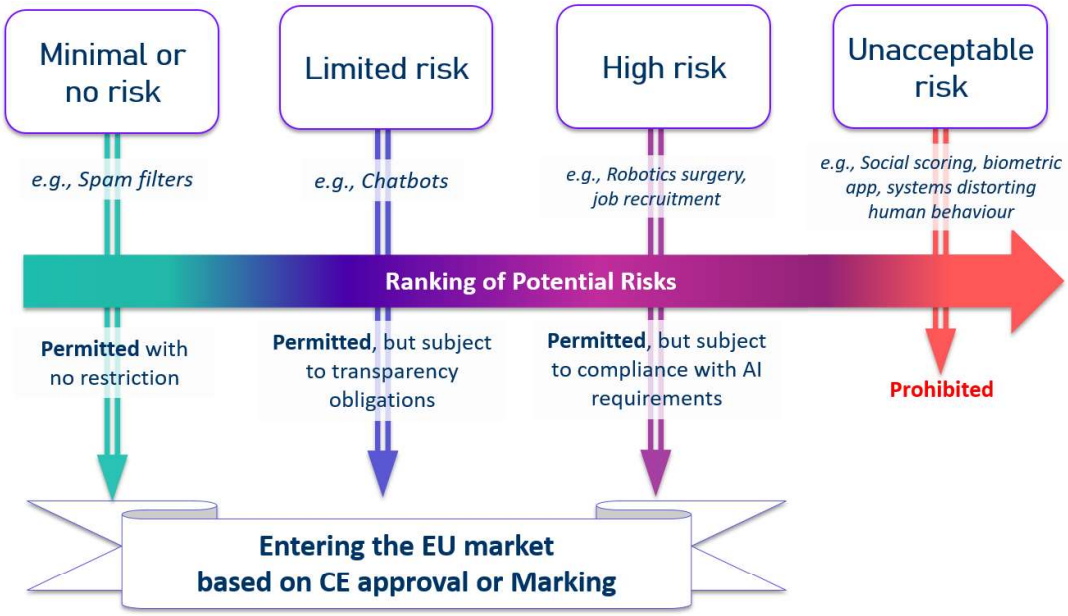


Figure 1. An illustration of the risk-based methodology proposed by EU Artificial Intelligence Act

- adequate risk assessment and mitigation systems
- high quality of the datasets feeding the system to minimise risks and discriminatory outcomes
- logging of activity to ensure traceability of results
- detailed documentation providing all information necessary on the system and its purpose for authorities to assess its compliance
- clear and adequate information to the user
- appropriate human oversight measures to minimise risk
- high level of robustness, security and accuracy.

As high-risk AI systems are considered the products that are already subject to other EU safety regulations (e.g., medical devices[8]) and those specifically enlisted in the AIA, such as the systems for the management and operation of critical infrastructures, for educational and vocational training, and for post remote biometric identification.

The Commission has clearly declared its intent to establish a balanced, cross-sector regulation, avoiding the duplication of frameworks and any undue limitations or market-hindrance to the technological advances. Nevertheless, a consultation has been launched to receive feedback on the AIA. The preliminary responses coming from the med-tech scientific, clinical and industrial communities are stressing the need for a coordinated and definite regulations taking into account the specificities of the healthcare field[9], and the concerns on potential misalignment or duplication of regulations[10].

Although preceding the AIA, ProCAncer-I's conception has taken duly into account the EU guidelines and recommendations on AI available at that time, as well as the provisions of other regulations[8] set by health-authorities on medical devices and software as a medical device. In this respect, significant effort has been planned to establish the **ProCAncer-I regulatory framework,** which provides **guidance** towards the delivery, validation, and qualification of **ethical-aware, legal and GDPR-compliant** as well as **trustworthy, safe, robust and traceable AI models.** Work Package (WP) 2 is entirely devoted to elaborate on the ethical and legal aspects to establish the legal framework for accessing and processing clinical data. WP4 is taking care to ensure the **provenance transparency** and **quality-curation** of the imaging and non-imaging datasets. WP4 is also providing the solutions for the **assessment and monitoring of risks** as well as for the **continuous performance monitoring of algorithms.** This monitoring is linked with an **audit trail layer**, which will guarantee **traceability of all the processes** involved in the execution of the AI models. Finally, WP6 encompasses concerted efforts to esnure the **trustworthiness** of the AI-powered solutions, by working on: (i) fairness and privacy preservation, (ii) safety and robustness, (iii) explainability and interpretability, and (iv) reproducibility and verifiability. All activities are taking advantage of a strict cooperation between developers (e.g. computer scientists and engineers) and domain experts/end-users (e.g. clinicians). This cooperation enables a clear definition of performance metrics to assess the value/efficiency of the AI framework in terms of trustworthiness.

Further to the work planned in the Description of the Action, ProCAncer-I is cooperating with the other projects funded under the H2020 call SC1-FA-DTS-2019-1 to define common strategies to develop, regulate, and validate AI models in medical imaging. The first result of this collaboration has been the drafting of six principles that should guide future AI developments in medical imaging[11]. The final goal is to ensure increased trust, safety and adoption.

[8] EC, "Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices", 2017 - https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R0745

[9] ESR's feedback to AI Act - https://tinyurl.com/envzbud2

[10] MedTech Europe response to the open public consultation on the Proposal for an Artificial Intelligence Act (COM/2021/206) - https://tinyurl.com/3ck4tpx9

[11] Lekadir, K. et al. "FUTURE-AI: Guiding Principles and Consensus Recommendations for Trustworthy Artificial Intelligence in Medical Imaging", arXiv, 2021 - https://arxiv.org/pdf/2109.09658.pdf

Presentation of partners

Fundacao D. Anna Sommer Champalimaud e Dr. Carloss Montez Champalimaud (CF)

Champalimaud Foundation (CF) is a private non-profit Portuguese institution, inaugurated in 2010 with the aim of advancing basic and translational world-leading research in neurosciences, physiology, and cancer, in close collaboration with tailored clinical care. Within the ProCAncer-I project, CF will act as both clinical and technical partner. In total, it is expected that CF will contribute with about 1200 multi-parametric Magnetic Resonance Imaging (mpMRI) exams. From a clinical provider's perspective, there will be an involvement from the Imaging, Urology and Histopathology CF Departments in the data collection, image annotation and validation of AI models. These departments have shown extensive experience in diagnosing, treating, and monitoring PCa patients throughout the disease continuum. On a complementary fashion, the Computational Clinical Imaging Group (CCIG) at CF, led by Dr. Nickolas Papanikolaou, the Scientific Coordinator of ProCAncer-I, will focus on relevant technical aspects of the project. One of the main responsibilities of CF as a ProCAncer-I partner is the coordination of WP5 on the development of the master models, based on the retrospective heterogeneous data from multiple vendors and institutions. This comprises the supervision of tasks such as the retrospective data upload and annotation, development of pre-processing pipelines – that address distortions (bias field) correction, motion-related artifacts, noise reduction, and data harmonization –, and the development and evaluation of AI master models. Another task with CF involvement is the creation of vendor-neutral models trough federated-learning strategies. Additionally, the clinical use case four on the biological validation of AI models through a radiologic-histopathologic correlation for side-by-side comparison of both image formats, will be performed at CF using whole-mount 3D-printed prostate molds from a subpopulation of radical prostatectomy patients. Finally, all models are to be compared from a radiomics and deep learning modeling perspective. During the last 5 years, the CCIG group has been involved in EU-funded projects and developed an international radiomics network with more than 15 partners coming from Europe, US, and Brazil. The purpose of the CCIG investigations is to apply AI and radiomics algorithms to solve problems in prostate, pancreas, rectal, lung and breast cancer, gliomas, and multiple myeloma, among others. In conclusion, with the previously described set of expertise, in combination with a lot of work and motivation, it is intended to deliver robust, fair, and interpretable AI models, for addressing prostate cancer open questions, and to deploy them into clinical practice.

Fundacion Para La Investigacion Del Hospital Universitario La Fe De La Comunidad Valenciana (HULAFE)

The FUNDACION PARA LA INVESTIGACION DEL HOSPITAL UNIVERSITARIO LA FE DE LA COMUNIDAD VALENCIANA (HULAFE) is a Spanish non-profit organization that carries out the patient-oriented scientific research of the La Fe's Hospital Health Department.

In particular, the work done for the Procancer-I project is being developed at the Biomedical Imaging Research Group (GIBI230), which is part of the Medical Imaging department led by Dr. Luis Martí Bonmatí. The research group belongs to the Network of Biomedical Research in Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN) and has been recently recognized as a node of the RedIB (Distributed Biomedical Imaging Network) within the National Scientific and Technical Singular Infrastructures (ICTS) of the Spanish government. Along with the research group members, the Urology and Pathology departments at HULAFE are equally involved in the project, bringing vast expertise in multiparametric MR of the prostate, PIRADS scoring, biomarkers implementation for lesion grading and clinical-pathological documentation of cases.

HULAFE's main role in the project involves the provision of cases and the development of AI models. At a final stage of the project and as WP7 leader, HULAFE will lead the Clinical Evaluation of these models.

Massachusetts General Hospital (The General Hospital Corp) (QTIM)

MASSACHUSETTS GENERAL HOSPITAL

Our lab, the Quantitative Translational Imaging in Medicine (QTIM) lab, at the Athinoula A. Martinos Center for Biomedical Imaging of the Massachusetts General Hospital (MGH), focuses on developing quantitative imaging biomarkers for cancer and other diseases using advanced imaging techniques and machine learning methods, with a particular focus on applying deep learning methods to a variety of diseases. Our goal is to unite the cutting edges of machine learning, medical oncology, and image analysis into practical clinical applications, and to that end, we span the gamut in terms of specialists – computer science researchers, medical physicists, neuro-oncologists, and MRI technicians, among others. Postdocs and graduate students in our lab come from a wide variety of backgrounds and departments, including Harvard/MIT Health Sciences and Technology, MIT Electrical Engineering and Computer Science, and Harvard Biophysics, in addition to MD-PhD students and high-school students/undergraduates from around the world!

Some of our recent works have demonstrated that the use of saliency maps in medical imaging is unreliable and do not meet specific defined criteria of trustworthiness, and that detection or segmentation models trained directly for localization tasks give higher utility than saliency maps. Additionally, we have shown that a distributed deep learning approach can outperform models trained on a single institution, in terms of testing accuracy, thereby highlighting the benefits of collaboration among multiple institutions in the context of deep learning without the need to share data in a common repository, relevant to ProCAncer-I's work. We are also currently involved in two multicenter clinical trials, which incorporate advance MR imaging to answer clinically and biologically relevant questions pertaining to brain metastases.

When we are not seeing patients in clinic or scripting away in lab, we are also an incredibly sociable (and active!) bunch. As a lab, we have participated in activities including but not limited to picnics, sightseeing, rock climbing, kayaking, apple picking, and the ever-popular Spikeball®, a lab-favorite!

We look forward to being a part of the ProCAncer-I collaboration!

news

Introducing FUTURE-AI: Best practices for trustworthy AI in medical imaging

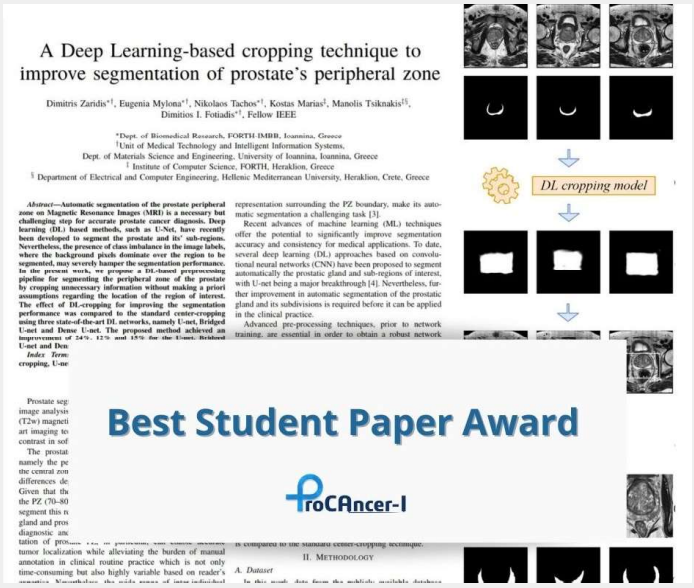
ProCAncer-I Project is part of the five H2020 projects that share the same vision, principles, and challenges. These projects are funded under the same Action Line: **AI for Health Imaging** (Call: H2020-SC1-FA-DTS-2019-1): CHAIMELEON (chaimeleon.eu), EuCanImage (eucanimage.eu), INCISIVE (incisive-project.eu), and PRIMAGE (primageproject.eu).

What is FUTURE-AI? It is an international, multi-stakeholder initiative for defining and maintaining concrete guidelines that will facilitate the design, development, validation and deployment of trustworthy **AI solutions in medical imaging** based on six guiding principles: Fairness, Universality, Traceability, Usability, Robustness and Explainability.

news (cont.)

Best Student Paper Award in Bioengineering

Our researchers received the **Best Student Paper Award in Bioengineering** category in the 21st IEEE International Conference on BioInformatics and BioEngineering that was held on October 25-27, 2021, at Kragujevac (Serbia). The award-winning paper is entitled: "**A Deep Learning-based Cropping Technique to Improve Segmentation of Prostate's Peripheral Zone**" and was co-authored by Eugenia Mylona, Dimitris Zaridis, Nikolaos Tachos, Dimitrios Fotiadis, Kostas Marias, and Manolis Tsiknakis



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publications

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