e-LEMENT online asynchronous course

ESMPE European School for Medical Physics Experts

Artificial Intelligence in Medical Physics

online from December 2022

This course is the first part of the ESMPE in AI in medical physics (**AI course part 1**), which started on line in 2022, and took place on site in Prague in October 2023. The school is focused on the medical physics aspects of artificial intelligence and is aimed at presenting the background, practical methodology, state-of-the-art and future developments of AI. The school was organized in collaboration with COCIR.

Given the interest shown and the relevance of the topic, EFOMP has decided to continue offering this first part of the course also in the new e-learning platform, as an asynchronous self-training course.

No CPDs will be provided. Certificates of attendance will be issued on request.

Content

- The strategic role, competence and education of medical physicist in the era of AI
- Medical Imaging analysis
- Basics of machine learning (ML) and deep learning (DL) in imaging
- Introduction on how to develop AI applications
- Role of the MP: how to deal with AI-based commercial solutions
- Big Data and Enterprise Imaging
- Radiomics
- Quality, Regulatory and Ethical issue

Organisers (2022)

Federica Zanca (Chair of the School), Alberto Torresin (Chair of the School),
Brendan McClean (Chair of the ESMPE)
Efi Koutsouveli (EFOMP Secretary General) and Christos Alexakos (ESMPE online platform)

Faculty

Name
Mika Kortesniemi Osvaldo Rampado Francesca Botta Berend Stoel, Nicola Maffei Oleksandra V. Ivashchenko Michele Avanzo Ana Barragan Matteo Maspero Andrea Barucci Tiziana Rancati Ana Jiménez Pastor Oliver Diaz Harmon, Stephanie Brouwer Charlotte Hilde Bosmans Kathleen Curran Lidia Stringari Floris van Velden Emmanuele Neri Alberto Traverso Fanny Orlhac Filippo Pesapane Caterina Brusasco Patrick Reichmann Zuzanna Kwade Kicky van Leeuwen Gabriele Guidi Matilde Ratti

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	Topic	Sub-Topic	Lecturer
1	The strategic role, competence and education of medical physicist in the era of AI	The philosophy of AI	Mika Kortesniemi
2	Medical Imaging analysis and background for AI	Image reconstruction in CT, MRI : from traditional to AI methods	Osvaldo Rampado
		Image reconstruction in PET and SPECT: from traditional to AI methods	Francesca Botta
		Segmentation, feature Extraction, Classificaiton, Registration and Visualiztion of Radiological Images	Berend Stoel
		Image quantification metrics. Which images can I use for a correct quantification of the information content represented by the digital matrices	Nicola Maffei
3	Practical	Image processing tools relevant for AI: Freeware tools applied to automatic 2D/3D segmentation, ROI/VOI extraction and features	Michele Avanzo
4		ML classes: clustering algorithms, support vector machines (SVM), decision trees / random forest learnings, reinforcement learning, and others.	Ana Barragan
		Differences between ML, DL and traditional CAD (computer-aided diagnosis)	Ana Barragan
		Representative power of neural network. Examples in medical imaging.	Matteo Maspero
		Introduction to Deep Learning focusing on Concolution Neural Networks	Andrea Barucci
		An overview of basic NN structure and various architectures with focus on convolutional neural networks (CNN)	Andrea Barucci
		Exploring some prominent CNNS	Andrea Barucci
		Training a network and the standard terminology: loss function, regularization, underfitting/overfitting, stochastic gradient descent (SGD), batch, epoch, backpropagation, inference/prediction/forward pass, hyperparameter optimization, activation maps, data augmentation, adversarial training	Andrea Barucci
		Terminology and common approaches (validation, train and test set division, class imbalance, cross-validation, conformance to TRIPOD statement	Tiziana Rancati
		Basic statistics: sensitivity, specificity, accuracy (etc.), F1 score, Receiver Operating Characteristic (ROC), Area Under the ROC curve, confidence intervals (CI), statistical significance	Tiziana Rancati

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5	Overview of AI development and deployment	Clinical problem definition and selection of the AI technology, data colleciton, data annotation, training, testing, validation, federated approach	Ana Jiménez Pastor
		Accessing, curating and preparing imaging data	Oliver Diaz
		Implementaiton of AI applciaiton	Oliver Diaz
		GPU, workstations, external scientific computing services, cloud computing, hybrid computing solutions	Harmon, Stephanie
6	Role of the MP: how to deal with AI-based commercial solutions	How to buy AI ?	Kicky Van Leeuwen
		Acceptance and commissioning of AI tools in clinical workflow	Brouwer Charlotte
		QA of AI tools	Hilde Bosmans
7	Big data and Enterprise Imaging	Basic principles of Enterprise Imaging Existing standards and platforms How to define key performance indicators for leveraging big data information EI in the context of AI	Kathleen Curran
8	Leveraging Big Data and Enterprise Imaging Radiomics	Basics of imaging biomarkers and radiomics	Lidia Stringari
		Overview of tools on the market for imaging biomarkers	Lidia Stringari
		Standardization initiatives (e.g. IBSI) in imaging biomarkers	Floris van Velden
		Imaging biobanks	Emmanuele Neri
		Radiomics workflow	Alberto Traverso
		Challenges for multi-centers radiomics studies: features robustness analysis and AI support methods to harmonize data	Fanny Orlhac

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9	Quality, Regulatory and Ethical Issues	International Law and data exchange iCloud (case example) General data protection regulation (GDPR), and HIPPA when dealing with data from countries outside EU, i.e. USA. AI process, decision making and ISO 9004 certification standard - Disaster Recovery solution	Filippo Pesapane
10	Quality Assurance and Regulatory Affairs (QARA)	European MD software approval process and regulation (leading to CE mark)	Caterina Brusasco
		Differences between European and US (FDA) software approval roads and regulation.	Caterina Brusasco
		Current regulation for developing AI software as a medical device (MDR), both for commercial and in-house use	Patrick Reichmann
		Further testing of such FDA/CE marked tools in a real clinical context	Zuzanna Kwade
		The (economic) value of AI: a cost item or a cost saver?	Kicky van Leeuwen
		Cybersecurity challenges and TRUSTWORTHY AI in Healthcare - review and state of art	Gabriele Guidi
11	Quality Assurance and Regulatory Affairs (QARA)	AI tools	Matilde Ratti
		AI and data protection	Matilde Ratti
		AI risks	Matilde Ratti
		AI in medical physics and reserach: some conclusions	Matilde Ratti

Course language	English
Level	Medical Physics Expert (MPE)
Registration fee	Open to Individual Associate Members of EFOMP with addition fee of **70 € included VAT (21%)**
Reduced registration fee subsidized by EFOMP	**35 € included VAT (21%)** - for the attendees coming from the following European countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Greece, Hungary, Latvia, Lithuania, Moldova, North Macedonia, Poland, Portugal, Romania, Serbia, Slovak Republic, Spain, Ukraine.
Maximum number of participants	Unlimited
CPDs	No CPDs are provided
Duration	40 lessons on line
Study load	16h online
Venue	e – LEMENT, the EFOMP e-learning platform
Website:	https://e-lement.efomp.org/
Information, programme at	https://e-lement.efomp.org/
Registration	Electronic registration via this link
Duration of the course:	Always accessible, (for the moment).
Registration period	No limit, for the moment.

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