

5th Summer School in Medical Physics: Data Science and Machine Learning in Radiotherapy

PROGRAM (version as of Sep. 12th 2023)

Target group

- BSc, MSc, PhD & MD students or young scientists and clinical trainees with degrees and a background in Physics, Medical Physics, Medical Engineering, Radiation Therapy or Radiology. BSc students should be at the end of their studies.
- Further requirements/knowledges: participants should have access to a computer (Windows, Mac or Linux) with admin rights to install required software. Guidelines for installations will be provided during the online phase.

Certificate and ECTS Points

Once successfully completed, participants will get a certificate of attendance including supplement with 4 ECTS points, issued by the German Cancer Research Center and our partners.

Online Phase: 28.08. – 17.09.2023

1. Recordings (1 Rec. = 45 min.)

Recording	Main Topic	Talk	Speaker
Rec. 1	Introduction	Overview on medical physics research in HD (the promise of data science) – contributing institutes	Oliver Jäkel
Rec. 2	Radiotherapy	Radiotherapy is not Radiotherapy (IMRT / IMPT / IGRT / MRgRT / ART / IGaRT): Technical developments & Concepts	Oliver Jäkel
Rec. 4	ML/AI Basics	Causality and Machine Learning	Gilmer Valdes
Rec. 5	Clinical Perspective	Which RT questions can be answered with Data Science? (Clinical perspective)	Eva Meixner
Rec. 6	Segmentation	Overview on Automated Medical Image Segmentation (Organs, Targets)	Constantin Ulrich
Rec. 7	Motion	Overview on AI-based Motion Extraction, Modeling & Prediction	Hannah Eichhorn & Veronika Spieker
Rec. 8	Treatment Planning	AI in planning and dose calculation	Steve Jiang
Rec. 9	Outcome Modeling	Radiomics/Dosiomics for (N)TCP outcome modeling	Steffen Löck

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2. Online Sessions on Zoom during Online Phase (28.08. – 17.09.2023)

Date	Time (CEST)	Main Topic	Talk	Speaker
04.09.2023	15.30 – 16.00		Mandatory Online-ID-Check	Anna & Marcel
	16.00 – 16.30	Networking & Expectations	Online: Welcome, Introduction and expectations	Kristina Giske, Niklas Wahl & coordinating team
	16.30 – 18.00		Breakout Groups: Radiotherapy in 50 years with AI? What do I need to trust an health AI algorithm? Who should provide their treatment data for AI application / research?	Kristina Giske, Niklas Wahl & coordinating team
07.09.2023	16.00 – 16.45	tech & methods	Computational Tools for Data Science in Medical Physics – Hands-On Part I: From MNIST to Medical Image Segmentation	Paul Jäger
	16.45 – 17.00		Break (exact time will be chosen based on hands-on progress)	
	17.00 – 17.45		Computational Tools for Data Science in Medical Physics – Hands-On Part II: Medical Image Segmentation with the nnUnet	Carsten Lüth
	17.45 – 18.00		Wrap-Up & Questions	
11.09.2023	16.00 – 16.45	Automation	How does data science change & automate the radiotherapy workflow?	Daniela Thorwarth
	16.45 – 17.00		Break	
	17.00 – 17.45		Generating medical image scans	Joao Pedro Dias Rodrigues
	17.45 – 18.00		Wrap-Up & Questions	
15.09.2023	16.00 – 16.45	Ethics	The Implementation Problem: A Tale of Morals and Methodology	Thomas Grote
	16.45 – 17.00		Break	
	17.00 – 17.45		General questions	Kristina Giske & Niklas Wahl
	17.45 – 18.00		Summary and final questions	

Duration of 1st mandatory Online Test (Multiple Choice) about all topics taught during the Online Phase: 08. – 17.09.2023

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Attendance Phase/Live Online Phase

Place: Marsilius-Kolleg, Building INF 130.1 or online on Zoom

Mon. 18.09.23	Time (CEST)	Main Topic	Talk: clinical view on data science?	Speaker
	13.00 – 13:30	Networking	Optional: Welcome Coffee & Get Together	
	13.30 – 14.00	Welcome	Welcome by Course Leaders and Team	Kristina Giske, Niklas Wahl & coordinating team
	14.00 – 14.30		Welcome by Heidelberg University & Studying in Heidelberg	International Office, Heidelberg University: Sabine Schenk
	14.30 – 15.00		Coffee Break	
	15.00 – 15.45		A medical physicist's perspective on AI-driven radiotherapy	Andrea Schwahofer
	15.45 – 16.30		A physician's perspective on AI-driven radiotherapy	Fabian Weykamp
	16.30 – 16.45		Coffee Break	
	16.45 – 17.30		Mind the Gap: Bridging the Divide between AI Research and Industry Reality	Mark Bangert & Christoph Bergen (HMS Analytical Software)
	17.30 – 18.00		Welcome and Presentation of the Health Life Science Alliance	Member of the Health + Life Science Alliance
	18.15	Tours	OPTIONAL: Guided Tour to EHTOS at DKFZ	Fabian Weykamp

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Tue. 19.09.23	Time (CEST)	Main Topic	Talk: imaging + static? pat model?	Speaker
	9.00 – 9.30	Networking	OPTIONAL: Welcome Coffee	
	9.30 – 10.15		Modern approaches for tomographic image reconstruction	Marc Kachelrieß
	10.15 – 11.00		Learning transfer functions between imaging modalities: Pseudo-CT for RT	Francesca Spadea
	11.00 – 11.30		Coffee Break	
	11.30 – 12.15		Semantic (Instance) Image Segmentation for RT Detecting OARs and CTVs for RT	Alexandra Walter
	12.15 – 12.30		Discussion and Wrap-up	
	12.30 – 13.30		Lunch Break	
	13.30 – 14.15		Challenging common practice in AI validation	Lena Maier-Hein
	14.15 – 15.00		Motion compensation (MoCo) in CBCT and how to use them in other modalities	Marc Kachelrieß
	15.00 – 15.30		Coffee Break	
	15.30 – 16.15		Poster Session + Shuffle - what ML applications would be possible in your project?	Kristina Giske & Niklas Wahl
	16.15 – 16.30		Discussion and Wrap-up	
	17.00	Tours	OPTIONAL: Guided Tour to MR-Linac	Carolin Rippke

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Place: Marsilius-Kolleg, Building INF 130.1 or online on Zoom

Wed. 20.09.23	Time (CEST)	Main Topic	Talk: imaging + post processing motion model	Speaker
	9.00 – 9.30	Networking	OPTIONAL: Welcome Coffee	
	9.30 – 10.15		Data Science Slam	Kristina Giske & Niklas Wahl
	10.15 – 10.30		Data Science Slam Award	Kristina Giske & Niklas Wahl
	10.30 – 11.00		Coffee Break	
	11.00 – 11.45		Motion as challenge in image space: Deep Learning hopes & demands for Segmentation, artifacts, etc. across modalities in the clinic?	Philipp Hoegen
	11.45 – 12.30		Measuring motion: medical image registration with machine learning	Kristina Giske
	12.30 – 13.30		Lunch Break	
	13.30 – 14.15		3D Statistical shape models	Tobias Norajitra
	14.15 – 15.00		Dealing with motion effects on dose with Machine Learning methods	Guillaume Landry
	15.00 – 15.30		Coffee Break	
	15.30 – 16.15		Vision: treating without motion? breath hold? ultra-fast FLASH? Role of AI?	Oliver Jäkel
	16.15 – 16.30		Discussion & Wrap-up	
	17.00	Tours	OPTIONAL: Guided Tour to HIT	Semi Harrabi

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Place: Marsilius-Kolleg, Building INF 130.1 and online on Zoom

Thu. 21.09.23	Time (CEST)	Main Topic	Topic: dose + planning + outcome I	Speaker
	9.00 – 9.30	Networking	OPTIONAL: Welcome Coffee	
	9.30 – 10.15		Ethics of AI in Medicine	Jessica Morley
	10.15 – 11.00		Learning dose calculation	Niklas Wahl
	11.00 – 11.30		Coffee Break	
	11.30 – 12.15		Modern data-driven and optimization-based approaches for radiation treatment planning	Jürgen Hesser
	12.15 – 12.30		Discussion & Wrap-up	
	12.30 – 13.30		Lunch Break	
	13.30 – 14.15		How to setup a multiomics project – tools, pitfalls etc. (Hands On Part I)	Patrick Salome
	14.15 – 15.00		How to setup a multiomics project – tools, pitfalls etc. (Hands On Part II)	Patrick Salome
	15.00 – 15.30		Coffee Break	
	15.30 – 16.15		Pro-Contra-Debates: AI methods v. explicit rule-based modelling	Fred Hamprecht (pro rule-based) vs. Martin Frank (pro AI)
	16.15 – 16.30		Discussion & Wrap-up	
	19.00	Networking	OPTIONAL: Dinner at restaurant “Zum Achter“ in Heidelberg (free of charge)	

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Fri. 22.09.23	Time (CEST)	Main Topic	Talk: outcome II	Speaker
	9.00 – 9.30	Networking	Welcome Coffee	
	9.30 – 10.15		NTCP Prediction for optimal patient allocation to available proton and photon therapy slots	Jan Unkelbach
	10.15 – 11.00		Outcome-based treatment planning: From classical models to Machine Learning models	Emanuel Bahn (POLO model and Julia Bauer (shared talk)
	11.00 – 11.30		Coffee Break	
	11.30 – 12.45		Summarizing Discussions with experts:	Kristina Giske, Niklas Wahl, Oliver Jäkel, Julia Bauer, Emanuel Bahn, Jan Unkelbach
	12.45 – 13.00		Wrap-up & Conclusion of the summer school	

Duration of 2nd mandatory Online Test (Multiple Choice) about topics taught during attendance phase/live online phase: 22.09. – 09.10.2023

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