MEDICAL PHYSICS
The International Journal of Medical Physics Research and Practice

Artificial Intelligence in Radiation Oncology, Ed. Seong K Mun and Sonja Dieterich. Hackensack, NJ: World Scientific, 2023. ISBN: 978-981-12-6353-8

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DESCRIPTION

This is the first edition of a 372-page edited book on artificial intelligence (AI) in radiation oncology. It is written by 30 well-established experts mostly from radiation oncology.

PURPOSE

The book was written to bridge the gap between the basics of AI and the exponentially increasing body of peer-reviewed literature on AI applications in radiation oncology. Radiation therapy is technologically driven, with multifaceted applications and with widespread use of imaging. Hence, the use of AI in radiation oncology is an excellent demonstration of its progression and utility - so a book like this was long overdue. This is one of the first books on AI written specifically to address applications in radiation oncology. With 30 knowledgeable authors, the editors met their objectives of synthesizing current knowledge into one book.

AUDIENCE

The authors did not specify the target audience. However, it is written by 30 experts (physicists and informatics scientists) with specialized knowledge in different aspects of AI, and most of the chapter authors are radiation oncology physicists. Both diagnostic and therapeutic physicists will find the book useful, and it is an instructive resource for radiation oncologists, dosimetrists, and radiologists. Although focused on radiation therapy, basic scientists and researchers in AI in medicine will also benefit from this book and its treatment of the substantial growth of AI in the field.

CONTENT / FEATURES

Artificial intelligence, specifically deep learning and machine learning have the demonstrated potential to further revolutionize the way we manage cancer patients, particularly in the area of radiation therapy. AI has the potential of making radiation oncology more precise and personalized with improved outcomes. As the literature is inundated with data on this topic, it is essential to synthesize it into a book. So, this book is timely and necessary. The authors present sixteen chapters organized into five sections: and these sections include: Define the Future, Strategy, AI Tools, AI Applications, and Assessment and Outcomes.

The book sets the stage by taking a more futuristic/ visionary approach and discussing what the value of AI will be in 2030 and 2040. The section on “Strategy” takes a deep dive into lessons learned from successes and failures in AI applications in radiology. AI is all about managing a large volume of data and the issue of open access data was extensively addressed in Chapter 4. One of the nice features of the text is that each chapter has a summary abstract. It is well known that the success of radiation therapy is heavily dependent on delineating the target volume. Hence imaging plays a pivotal role in cancer management. It is not surprising that Chapter 5 discusses radiomics – Radiomics is highly dependent on AI and the expectation is that radiographic features can be used for diagnostic and prognosis projections. In theory, radiomics was demonstrated to have the potential for individualized treatment plans for cancer patients.

One important area that had an early application of AI in radiation oncology is image segmentation. There are many commercially available software packages that can be used to delineate the organs at risk for radiation treatment planning. Chapter 6 evaluates the use of deep learning in image segmentation for radiation therapy treatment planning. Of significant importance to clinical physicists is the section that discusses the challenges in adopting AI segmentation in clinical practice. The lesser discussed field of Knowledge Representation (KR) and its connection to natural language processing (NLP) are presented in Chapters 7 and 8. NLP is one of the most promising technical applications for KR but many nuances must be addressed before it is ready for widespread application. Treatment planning is another time-consuming aspect of

radiation therapy and automating the process with various machine learning approaches is presented comprehensively in Chapters 9, 10 and 11. Another important aspect of radiation therapy is the management of radiation toxicity, and the use of AI in predicting treatment toxicity is presented in Chapter 12, while Chapter 13 addresses the use of radiomics to predict treatment response. There is the possibility of using AI to understand and mitigate error propagation in radiation oncology. This is elegantly presented in Chapter 14. Lastly, the fifth section highlights two important issues pertaining to the clinical adoption of AI: ethical issues and the evaluation of AI as a transformative technology.

In summary, each chapter was treated as an independent section with it own abstract, introduction, conclusion, and references. There was no cross referencing between chapters. Given that each chapter includes all of its own references, it is likely some references are duplicated in other chapters. Nevertheless, having comprehensive, stand alone chapters was clearly a priority for the editors. For clinical physicists, this reviewer would have found it useful to have a chapter that evaluates the commercially available solutions for image segmentation, and providing more insight into the technique use for its machine learning, etc. However, it is acknowledged that this snapshot of current AI solutions is a very dynamic space with new product features and companies constantly evolving. Currently, commercially available AI imaging products and services are more like a black box- and a book like this one could open the box up for readers to better understand and evaluate the AI systems in practice.

ASSESSMENT / COMPARISON

The use of AI in every aspect of our lives is inevitable and radiation oncology is no exception. This book provides the first attempt to provide a one-stop resource for physicists and clinicians for the use of AI in radiation oncology. The book is written by experienced physicists/scientists, with dedicated and instructive references included with each chapter.

Book Reviewer Biography:

Dr Christopher Njeh, is an Associate Professor of Radiation Oncology in the School of Medicine at Indiana University, Indianapolis. He also holds an administrative role as Director of Physics and Director of Medical Physics Residency Program. Dr Njeh is board certified in therapeutic radiologic physics and is a Fellow of American Association of Physicists in Medicine. He is also an Associate Editor of the *British Journal of Radiology*.